WIFO WORKING PAPERS
683/2024

Industry Concentration, Firm-level Markups and Business Dynamics from Austrian Micro-data

Michael Peneder
Fabian Unterlass

Industry Concentration, Firm-level Markups and Business Dynamics from Austrian Micro-data

Michael Peneder, Fabian Unterlass

Research assistance: Nicole Schmidt-Padickakudy, Tim Slickers, Moritz Uhl

WIFO Working Papers 683/2024
July 2024

Abstract

This paper provides a first empirical assessment of selected key indicators of the degree of competition in Austria in terms of industry concentration, firm-level markups and business dynamics. The analysis is based on firm-level data from 2008 to 2020 in collaboration with OECD Multiprod 2.0 and the Austrian Micro Data Center (AMDC). The results show that concentration has remained rather stable, while firm dynamics have promoted the reallocation of production and employment to more productive firms. However, average markups have increased in various sectors, especially in non-tradable services, indicating a self-reinforcing dynamic where the "winners-take-more".

E-Mail: michael.peneder@wifo.ac.at, fabian.unterlass@wifo.ac.at

2024/1/W/0

Media owner (publisher), producer: Austrian Institute of Economic Research
1030 Vienna, Arsenal, Objekt 20 | Tel. (43 1) 798 26 01 0 | https://www.wifo.ac.at
Place of publishing and production: Vienna

WIFO Working Papers are not peer reviewed and are not necessarily based on a coordinated position of WIFO. The authors were informed about the Guidelines for Good Scientific Practice of the Austrian Agency for Research Integrity (ÖAWI), in particular with regard to the documentation of all elements necessary for the replicability of the results.

Free download: https://www.wifo.ac.at/publication/pid/53238660

Industry concentration, firm-level markups and business dynamics from Austrian micro-data

Michael Peneder, Fabian Unterlass*

July 2024

Abstract

This paper provides a first empirical assessment of selected key indicators of the degree of competition in Austria in terms of industry concentration, firm-level markups and business dynamics. The analysis is based on firm-level data from 2008 to 2020 in collaboration with OECD Multiprod 2.0 and the Austrian Micro Data Center (AMDC). The results show that concentration has remained rather stable, while firm dynamics have promoted the reallocation of production and employment to more productive firms. However, average markups have increased in various sectors, especially in non-tradable services, indicating a self-reinforcing dynamic where the 'winners-take-more'.

JEL Codes: L11, L16, L22, L25, L40

Key Words: Competition monitoring, industry concentration, markups, business dynamics

* Both authors: Austrian Institute of Economic Research, Arsenal Obj. 20, A-1030 Vienna, Austria. Corresponding author: Michael.Peneder@wifo.ac.at, Tel.: + 43- 1-798 26 01 480

1 Introduction

The widespread concern about a general trend towards decreasing competition and declining business dynamics has triggered a wave of international research and lively debates. However, a systematic empirical analysis of the intensity of competition and its changes across a broad range of sectors is still lacking in Austria. In their comprehensive review and discussion, Reiner and Bellak note that, "[i]nstead, the intensity of competition is conjectured and formulations are often kept in the subjunctive."[1] Consistent with early demands,[2] an amendment to the Federal Competition Act in 2013, and preparatory work by the Austrian Federal Competition Authority (AFCA),[3] Harsdorf-Borsch and Felbermayr (2023) recently called for the establishment of a regular Austrian *competition monitoring*.

After many years of engaged discourse, this paper aims to 'break the ice' and provide a first empirical assessment of selected key indicators on the degree of competition in the Austrian economy from 2008 to 2020. In short, the microdata show that industry concentration in Austria was relatively stable from 2008 to 2020, if not trending slightly upwards. The observed business dynamics also confirm that competition generally promotes the reallocation of production and employment in favour of the more productive companies. Of concern, however, is the evidence on average firm-level markups, which have increased in a number of mostly non-tradable service sectors and often exhibit a self-reinforcing *winners-take-more* dynamic, where markups have increased most in the top percentiles of the initial distribution.

The analysis was conducted in collaboration with the OECD project *Multiprod 2.0* and has been one of the first to test and trial the new *Austrian Micro Data Center* (AMDC), which was newly implemented by Statistics Austria in 2023. A further aim of this paper is therefore to demonstrate the importance and benefits of such access to microdata from statistical offices for empirical research and evidence-based policies. We are very grateful to both organizations for their cooperation!

Following this introduction, Section 2 discusses the meaning of effective competition, while Section 3 summarizes related findings from the empirical literature. Section 4 explains the data and key indicators used for the empirical analysis presented in Section 5. The focus there is on three selected dimensions: (i) industry concentration, (ii) firm-level markups and (iii) business dynamics (reallocation). Section 6 summarizes and concludes.

[1] Reiner and Bellak (2023A, p. 50); translation by the authors.
[2] Böheim (2008, 2013).
[3] Erharter (2015).

2 Effective competition

The idea of *competition* is so fundamental and pervasive throughout the economy that it is usually taken for granted and obvious. This may explain why there have been surprisingly few attempts to properly define it. Initially, it entered economics from general observation and discourse (Stigler, 1957), where its pivotal importance in explaining the price system turned it into a fundamental *principle*. With the classical synthesis of Adam Smith, it "became quite literally the *sine qua non* of economic reasoning."[4] In a decentralized market economy, it epitomizes the general tendency to eliminate excess profits and unsatisfied demand in the long run (Demsetz, 1982).

When economists sought a rigorous theoretical formulation[5] the focus increasingly turned away from competition as a behavioural process towards equilibrium outcomes "in which that process had run its limits" (McNulty, 1967, p. 398). The notion of **perfect competition** thus characterizes a market in which companies face a perfectly elastic (horizontal) demand curve and prices do not vary with residual quantities of supply. This makes it a convenient analytical benchmark for comparison with alternative market structures, where firms to varying degrees may enjoy market power to set prices with a markup over marginal costs.

Rigorous theory, however, also made transparent the restrictive assumptions (homogeneous goods, perfect information, free entry and unrestricted mobility of resources, etc.) that are required to substantiate the expected effects of competition on prices, allocation and welfare. Whether perfect competition is also a useful benchmark for the analysis of actual competitive behaviour has therefore remained the subject of much controversy. For example, Schumpeter (1911) criticised the static nature of models assuming fixed technology and preferences as well as the focus on short-term efficiency. Conceiving competition as a discovery process, Hayek (1945, 1946) took particular issue with the assumption of complete information and knowledge by all actors involved. Both considered the contestability of markets in the long run to be more important than short-term price effects. In this vein, the dynamic capabilities view of the firm emphasizes corporate resources and management to discipline markets through the threat of disruptive technological change (Teece, 2023).

[4] McNulty (1967, p. 396). Schumpeter (1954) refers to Becher (1635-82), Boisguillebert (1646-1714), Cantillon (ca. 1680-1734) and Turgot (1727-81), among others, as important precursors of Adam Smith.

[5] Stigler (1957) and McNulty (1968) highlight the contributions of Cournot (1801-77), Jevons (1835-82), Edgeworth (1845-1926), Knight (1885-1972), or Chamberlin (1899-1967).

What do these considerations mean for a useful definition of competition in the context of a comprehensive monitoring across different industries? Consistent with Robbins' definition of economics[6], competition arises whenever scarcity meets (individual) choice and rivalry. In other words, "whenever two or more parties strive for something that all cannot obtain."[7] Leaving aside the case of rivalry between buyers, John M. Clark offered a definition of what he called 'workable' competition[8] and which in modern terminology is better known as **effective competition**.[9] In the remainder of this paper, we will broadly think of it as *the pursuit of income and profit opportunities by satisfying customer demand better than others.*

An agenda to find out, what factors in particular make competition 'workable', or effective, and by which standards they should be assessed, initiated the very beginning of *Industrial Organization* (IO) as a proper discipline. Edward H. Chamberlin (1933) pointed out the heterogeneous nature of an economy made up of numerous structurally different industries. And Edward S. Mason (1939, 1949) argued that in order to understand the firms' pricing policy one must particularize critical elements of their internal organization together with that of market structure. Finally, Joe S. Bain (1950, 1951), who had earned his PhD under the supervision of Schumpeter, Chamberlin and Mason, advanced the classic **Structure-Conduct-Performance** (SCP) paradigm, which came to dominate the field up to the 1970s. According to it, market *structure* (entry barriers, concentration, product differentiation, etc.) is a major determinant of *conduct*, in particular the firms' pricing behaviour (e.g. limit pricing, collusive markups) and investment decisions (e.g. sunk costs), which in turn affect *performance* (e.g. profits, labour share, innovation).

Bain and other proponents were also explicit about the many limitations and shortcomings of the SCP-approach.[10] One of them is the heterogeneous nature of competition across different markets. Causal effects are hard to identify, since different factors often correlate with similar outcomes. On top of the general paucity of available data, economic markets cannot be observed directly and are only inadequately reflected by the classification of industries in official statistics. The spatial and product-related differentiation of firms violates the assumption of their rivalry

[6]That is, "the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses" (Robbins, 1932, p. 15).

[7]Stigler (2017, p. 1).

[8]"Competition is rivalry in selling goods, in which each selling unit normally seeks maximum net revenue, under conditions such that the price or prices each seller can charge are effectively limited by the free option of the buyer to buy from a rival seller or sellers of what we think of as 'the same' product" (Clark, 1940, p. 243).

[9]Bender et al. (2011), Littlechild (2011).

[10]Bresnahan (1989), Schmalensee (1989), Berry et al. (2019).

within an industry. Relatedly, most measures do not correct for the impact of exports and imports via international trade. This can lead to an overestimation of concentration, particularly in the case of manufacturing. Finally, enterprises are assigned to a business sector on the basis of their main activity, which further impedes the accurate measurement of effective competition. The upshot is, that there can be no simple mapping of industrial structure into firm behaviour and performance.

Within the discipline of IO, the SCP-program therefore has largely lost its academic appeal, and attention shifted from cross-sectoral comparative analysis to the detailed study of firm behaviour and the particular conditions of demand and supply in very specific markets.[11] However, in keeping with the original intentions of its founders, structural analysis remains relevant when it comes to monitoring potential risks to the effective functioning of competition between the sectors of an economy at large. Bearing in mind the many caveats, that is also the aim of the present research.

Like most economists, we will thereby favour more effective competition for at least four reasons: First, effective competition enhances *allocative efficiency* by aligning suppliers' choices with consumers' preferences, benefits and welfare. Second, it fosters *productive efficiency* by detecting and punishing incompetence, negligence or corruption more swiftly (Leibenstein, 1966). Third, it enables a discovery process, by which buyers and sellers *co-ordinate* their decentralized knowledge about supply and demand in the market (Hayek, 1945). Relatedly, competition facilitates the *learning* about one's own relative competitive strengths and weaknesses, which helps to shape efficient patterns of specialization and structural change.[12] Individually and collectively, these arguments provide ample reasons for a comprehensive monitoring of competition in the Austrian economy.

3 Recent empirical literature

Modern research in empirical IO focuses on very narrowly defined markets. Recent *international* examples include Backus (2020), who examined local industries for ready-mixed concrete in the US, or Rubens (2023), who studied the buying power of manufacturers in local Chinese markets for tobacco leaf. A wealth of sophisticated academic studies on competition in individual markets has also developed in *Austria*. The markets addressed range from gasoline[13] to food retailing, from camping sites

[11] Tirole (1990), Belleflamme and Peitz (2015).

[12] Peneder (2017).

[13] Pennerstorfer and Weiss (2013), Firgo et al. (2015, 2016), Pennerstorfer et al. (2020), or Loy et al. (2022).

to ski lift tickets,[14] or from construction procurement contracts to treasury auctions and patients' choice of physicians.[15] As the availability of the required data often depends on the specifics of markets and the institutional environment, the selection of industries tends to be biased (Miller, 2024). Consequently, none of these studies aims to make general statements about the intensity of competition and the corresponding structural changes in the economy at large.

Triggered by the increasing availability of large micro-level datasets covering comprehensive firm populations, there has been a new wave of research and lively debate in recent years about the threats of a general macroeconomic trend towards declining competition and business dynamics in developed economies. Though far better equipped in terms of data and methods, these studies nevertheless mark a surprising return to the broader agenda of the traditional SCP-paradigm (Eeckhout, 2021). This new wave was triggered by studies for the USA, pointing at a pervasive decline of business dynamism in terms of corporate entry and exits since the beginning of the 1980s (Decker et al. 2014, 2016).

A different strand of the literature addresses industry concentration and firm-level markups. Kwon et al. (2024) document a century-long and persistent increase in the concentration of production in the USA, which was more pronounced in manufacturing and mining before the 1970s and then in the service sectors. Before that, Gutiérrez and Phillippon (2017) and Grullon et al. (2019) observed a long-term increase in industrial concentration and offered some related evidence on the profitability of US firms. In an influential study, De Loecker et al. (2020) estimated markups from Compustat data of US publicly traded firms since the 1950s. They find that average markups remained rather stable until 1980, but then experienced a steady rise from 21% above cost to 61% in 2016. Moreover, the distribution of markups significantly changed as this increase occured mainly in the higher percentiles, while the median remained rather flat. Updating these estimates, Konczal and Lusiani (2022) confirmed a further steep and sudden rise of average markups of US publicly traded firms to 72% above cost in the year 2021. In contrast, Traina (2018) challenged these findings, arguing that markups and their increase over time are systematically overestimated because of increasing cost in certain categories (e.g., for marketing and management) and a selection bias from using samples restricted to public traded companies in commercial databases.[16] Calibrating the data to adjust

[14] Böheim et al. (2016); Pennerstorfer (2017); Firgo and Kügler (2018).

[15] Gugler et al. (2015); Elsinger et al. (2019); Irlacher et al. (2023).

[16] Decker and Williams (2023) make a similar argument with regard to measures of industry concentration.

for such biases, his own estimates show a modest increase of average markups, which he argues to be within the range of long-run variations.

The same problem affects many studies on concentration and markups in European economies based on Bureau van Dijk's ORBIS database. For example, Cavalleri et al. (2019) report that recent trends of concentration and markups have remained rather flat in countries such as Germany, France, Italy and Spain. Investigating 17 EU countries from 2007 to 2015, Weche and Wambach (2018) show that markups had dropped sharply in the course of the financial crisis and increased afterwards, but did not reach the pre-crisis level by 2015. In contrast, Bajgar et al. (2019, 2021) report increasing industry concentration in most countries and sectors in Europe and the USA from 2002 to 2014. Considering only countries with sufficient coverage in ORBIS, neither study includes Austrian firms in their main analysis.[17] Koltay et al. (2022) show that from 1998 to 2019 concentration increased in more than two thirds of the 159 ISIC industries in France, Germany, Italy, Spain and the UK (mostly so in France and the UK and before the financial crisis of 2009). Finally, covering 18 to 23 European countries from 2000 to 2019,[18] Calligaris et al. (2024) provide the latest evidence of a trend of increasing industry concentration by around 5% on average, as well as an average increase in markups of around 7 %. Consistent with earlier international findings, the latter is mainly due to the performance of the top decile of the markup distribution.

Among studies that address individual countries, Ganglmair et al. (2020) report a slight increase of average markups in their sample of German firms from 2007 to 2016. Similarly, the German Monopolkommission (2022) reports a slight increase of average markups in manufacturing and decreases in services industries, whereas concentration rates have remained flat. Finally, Davies (2021) or Carr and Davies (2022) find an increasing producer concentration in the UK, especially in the first decade of this century, but less so when they take into account the impact of international trade.

Different from the burgeoning international literature, and partly due to the very limited representation of Austrian companies in ORBIS, there exists no comparable empirical evidence on industry concentration and firm markups of Austrian firms.[19]

[17] One exception is Kouvavas et al. (2021), whose sample of Austrian firms changes considerable over the years, rising from 301 in 2008 up to 4401 in 2018. In contrast, Bajgar et al. (2019, 2021) cover Austria in auxiliary tables that are drawn from official business registers.

[18] Most data do not include Austria and the results for individual countries are not shown separately.

[19] One notable exception is Badinger and Breuss (2005), who examined structural breaks in the Lerner Index for a cross-section of 46 Austrian industries from 1978 to 2001 and found only moderate pro-competitive effects in a few industries. Of related interest, Aiginger et al. (1995) examined sectoral time series for Austria from 1963 to 1990. Concentrating on the glass and

The situation is somewhat better for measures of industry dynamics, where aggregate data from Eurostat's business demography database have been used in various reports.[20] Also Peneder and Prettner (2021) examined the contribution of firm entry, exit and reallocation to average productivity growth in broad sectors based on firm-level census data (see Sections 4.4 and 5.3). Overall, however, there is a lack of comprehensive evidence on the intensity of competition in the Austrian economy. This paper therefore attempts to take a first step towards reducing this gap relative to the international literature.

4 Data and indicators

4.1 Multiprod 2.0

The research reported in this paper originates in a cooperation between WIFO and the OECD's **Multiprod 2.0** project. For the first time we could thereby source key indicators on industry concentration, firm-level markups or corporate dynamics directly from Statistics Austria's newly established **Austrian Micro Data Center** (AMDC). The OECD provides internationally harmonized programs for computing the indicators and receives the national empirical results in return (Berlingieri et al., 2017). In order to maintain confidentiality, these indicators are based exclusively on micro-aggregated data, i.e. they are never analyzed for individual companies. This involves assigning the companies to different cells along the selected dimensions (e.g. sector, size classes by turnover or employment, age classes or quintiles of the productivity distribution) and then calculating aggregated annual data for each cell. No numbers are displayed if there are fewer than four observations within a cell. This ensures that no inferences can be made about individual companies. Depending on the data and methods required for the computations, the indicators cover different years from 2008 to 2020 and refer to different levels of aggregation by sectors.

The main data sources are the Business Register and the **Structural Business Statistics** (SBS). The base population comprises "enterprises (legal units) or statistical enterprises that carry out a main activity in accordance with ÖNACE Sections B to N and Division S95 and are active in the reporting year with sales revenue of more than 10 thousand € and/or are employers (approx. 359,600 enterprises as legal units and 337,400 statistical enterprises)."[21] The SBS survey is mandatory for companies

electrical machinery sectors, they report a pronounced decline in market power, which they explain with the increasing competition from trade integration.

[20] Peneder et al. (2023).

[21] Statistik Austria (2022, p. 6); translation by the authors using DeepL.

that exceed certain industry-specific turnover and size thresholds, which range from 550 thousand € to 3.25 million € or from 10 to 20 employees. All companies that exceed these thresholds are included in the SBS. This amounts to around 35 thousand companies (legal entities) per reporting year.[22] Companies are not consolidated according to group ownership.

All monetary variables are converted in real terms at 2005 prices and purchasing power standards (PPS).[23] In order to improve the international comparability of the results, Multiprod additionally uses the OECD's STAN database for selected key figures at country, sector and annual level (e.g. deflators, depreciation rates, capital intensities as well as levels and growth rates of labour productivity). An important limitation for the estimation of the production functions is that the Austrian data do not contain any book values for the determination of the capital stock. The capital variable is calculated using the perpetual inventory method (PIM), whereby in this case the initial values are determined by linking the sectoral capital intensities in the OECD STAN database for Austria in the given year with the respective employment of the individual companies. Due to the relatively short observation period and the often small sample size, this approach can lead to distortions in the estimation of capital services. Therefore, caution is generally required in the interpretation, but especially so for all sectors outside manufacturing and non-financial market services. Within the latter group, this also applies, for example, to transport and storage (NACE H), real estate activities (L), advertising, market research, etc. (MC) or administrative and support service activities (N).

4.2 Industry concentration

If we associate competition with the notion of 'rivalry' in selling goods and services, the actual number of firms competing in a market can be a first indication of its inherent potential. Adam Smith already embraced the idea that competition increases with the number of suppliers.[24] Similarly, the common distinction between monopoly, duopoly, oligopoly or polypoly rests on the number of sellers as the defin-

[22] According to the SBS for 2020, the number of companies in Austria amounted to just under 360 thousand. Of these, 88.1% had fewer than 10 employees and 6.4% employed 10 to 19 people. Together, these companies accounted for 34.6% of total employment and 27.0% of total gross value added.

[23] This does not apply to manufacturing. As the majority of production is traded internationally, the series are adjusted using the nominal exchange rate (as an average for 2005).

[24] "If this capital [sufficient to trade in a town] is divided between two different grocers, their competition will tend to make both of them sell cheaper, than if it were in the hands of one only; and if it were divided among twenty, their competition would be just so much the greater, and the

ing structural characteristic of a market. What matters, however, is not the mere number of firms, but also their size distribution, which leads to the measurement of firm concentration.

Subject to important caveates discussed in Section 2, measures of industry concentration have remained a standard tool for monitoring potential risks for effective competition across sectors. In the following analysis, we apply two key indicators of industry concentration that are frequently used. If for any given year t we think of N firms i producing output Q in industry j, then the **Herfindahl-Hirschman index** (HHI) is defined as the sum of the squared output shares $s_{ij} \equiv \frac{Q_i}{Q_j}$ of all firms N_j in the industry:

$$HHI_{jt} = \sum_{i=1}^{N_{jt}} s_{ijt}^2 \tag{1}$$

The HHI must fall within the range from $1/N$ in the case of maximum competition to 1 in the case of a monopoly. Covering the entire distribution of a firm population, the HHI is proportionate to the average market share of firms weighted by market shares. In contrast, the **concentration ratio** CRX_j measures the sum of shares of the X largest firms in an industry's total output:

$$CRX_{jt} = \sum_{i=1}^{X} s_{ijt} \tag{2}$$

The concentration ratio directly addresses the concern for a potential oligopolistic market structure and is more robust in case of firm samples, where the coverage of the firm population varies by size and across industries. However, the choice of X is rather arbitrary and the measure would not detect any changes in the size distribution of all other firms. In section 5.1 we will summarise the findings on the shares of the four ($CR4$), eight ($CR8$) and twenty ($CR20$) largest firms per industry.

4.3 Markups

Measures of industry concentration can only provide for a first and very crude indication of the *potential* market power of individual firms. In contrast, firm-level *markups* μ of output prices p over marginal cost c aim to detect market power from the firms' actual price setting behaviour:

chance of their combining together, in order to raise the price, just so much the less" (Smith, 1776, p. 342).

$$\mu_i \equiv \frac{p_i}{c_i} \tag{3}$$

In the following empirical sections, we will denote the markups in %, i.e. as $(\mu - 1) * 100$.

Unlike the concentration measures mentioned above, these markups do not depend on the precise definition of the boundaries of the individual markets and suitably reflect the heterogeneity of multi-product firms. This makes them particularly attractive for comparisons across sectors and industries as well as for observing general trends and structural shifts within an overall economy. However, it is important to be aware that for multi-product companies they measure the combined effect of their market power in the different markets and that these can vary considerably.

In recent years, the approach of Hall (1988) and De Loecker and Warzynski (2012) has become increasingly popular. In short, the latter estimate the firm-level markups μ_i by relating the output elasticity of variable inputs θ_i^V to their share of expenditures in the firms' total revenues. Merely positing an optimal choice of inputs according to the *Lagrange* conditions for cost-minimization, their approach does not have to impose any further restrictions on consumer demand or the firms competitive behaviour. However, to determine the output elasticites, one must estimate a production function, for which Multiprod 2.0 uses the approach by Ackerberg et al. (ACF, 2015).[25] In short, the ACF-function relates output $Q_{i,t}$ to productivity $A_{i,t}$, capital stock $K_{i,t}$, labour $L_{i,t}$ and variable intermediate inputs $V_{i,t}$:

$$Q_{i,t} = Q_{i,t}(A_{i,t}, K_{i,t}, L_{i,t}, V_{i,t}, \psi_{it}, \epsilon_{it}) \tag{4}$$

In addition to the observable choice of inputs, two types of exogenous shocks that are not observable to the econometrician may also affect production: shocks ψ_{it} can (potentially) be observed or predicted by companies; shocks ϵ_{it} cannot. Within a period t, the choice of intermediate inputs V can adapt to ϵ_{it} without friction, while capital K cannot. The (inverted) demand for V is conditional on the choice of K and L.[26] Under the conditions of cost minimization, the Lagrange multiplier λ is a direct measure of the marginal cost c, which provides the following expression for the output elasticity of the variable inputs V:

$$\theta_{i,t}^V \equiv \frac{\delta Q(.)}{\delta V_{it}} \frac{V_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{p_{it}^V V_{it}}{Q_{it}} \tag{5}$$

[25] See Peneder and Unterlass (2024) for a brief discussion.

[26] The ACF-production function thereby allows for the possibility of unobserved (i) heterogeneity in labour input prices, (ii) dynamic effects of L (i.e., firm-specific adjustment costs), and/or that firms (iii) sequentially choose V after L. See Ackerberg et al. (2015, p. 2441).

The markup then corresponds to the output elasticity of the variable input divided by its share in total expenditures:

$$\mu_{it} = \theta_{i,t}^{V} \frac{p_{it} Q_{it}}{p_{it}^{V} V_{it}} \tag{6}$$

Markups reflect the ability of companies to raise prices above marginal costs, i.e. their market power. For the purpose of competition monitoring, they provide a more accurate indication than various measures of profitability. Although the latter are more readily available from balance sheet data and are also more comprehensive in the sense that they account for the expenditure on gross fixed capital formation, markups are generally preferred as they have a more direct link to the firms' pricing behaviour. To illustrate the difference, consider the example of (large) companies with significant market power that report low total profits even over a long period of time, when the high markups achieved are reinvested to grow fast and thus possibly further strengthen a dominant market position.

4.4 Business dynamics

Finally, we focus on business dynamics as an indication of the effectiveness of competition in terms of the **reallocation** of economic activities through firm entry, exit and differential growth. Applying the *Dynamic Olley-Pakes Decomposition* (DOPD) by Melitz and Polanec (2015), we aim to determine the direct contribution of the reallocation between firms to the aggregate productivity growth of an industry. In short, Olley and Pakes (1996) had split the weighted average productivity A_{jt} into the unweighted mean $\bar{a}_{jt}$ and the covariance of the firms' productivity a_{ijt} and their shares s_{ijt} in total production of the respective industry:

$$A_{jt} = \bar{a}_{jt} + \sum_{i=1}^{N_{jt}} (s_{ijt} - \bar{s}_{jt})(a_{ijt} - \bar{a}_{jt}) = \bar{a}_{jt} + \mathrm{cov}(s_{ijt}, a_{ijt}) \tag{7}$$

Melitz and Polanec (2015) further distinguished between three types of firms: Group E comprises all companies that have newly entered the market, group X comprises the companies that left the market in the previous time interval, and group R comprises the companies that have remained in the market in both periods. For two consecutive time intervals, in the first period t=1, the population of firms consists of the groups R and X, so that $s_{R1} + s_{X1} = 1$. In the second period t=2, the group X has left the firm population, but the new entrants E join the group of remaining firms R, i.e. $s_{R2} + s_{E2} = 1$. For the overall productivity of industry j, this implies that:

$$A_{j1} = s_{Rj1}A_{Rj1} + s_{Xj1}A_{Xj1} = A_{Rj1} + s_{Xj1}(A_{Xj1} - A_{Rj1}) \tag{8}$$

and

$$A_{j2} = s_{Rj2}A_{Rj2} + s_{Ej2}A_{Ej2} = A_{Rj2} + s_{Ej2}(A_{Ej2} - A_{Rj2}) \tag{9}$$

The change in overall productivity of the industry ΔA_j is therefore made up of the following components:

$$\Delta A_j = (A_{Rj2} - A_{Rj1}) + s_{Ej2}(A_{Ej2} - A_{Rj2}) + s_{Xj1}(A_{Rj1} - A_{Xj1}) \tag{10}$$

Ultimately, the DOPD method breaks down the total productivity growth of industry j into the following four effects:

$$\overbrace{\Delta A_j}^{\text{Total}} = \overbrace{\Delta \bar{a}_{Rj}}^{\text{Within}} + \overbrace{\Delta cov(s_{Rj}, a_{Rj})}^{\text{Reallocation}} + \overbrace{s_{Ej2}(A_{Ej2} - A_{Rj2})}^{\text{Entry}} + \overbrace{s_{Xj1}(A_{Rj1} - A_{Xj1})}^{\text{Exit}} \tag{11}$$

The total productivity growth of an industry on the left hand side is thus attributed to four different components: The first term on the right-hand side shows the unweighted average productivity change of all firms remaining in the market. It represents the general *within* growth of productivity without any reallocation of activities. The second term depicts the impact of *reallocation* among the remaining companies. It accounts for their different growth rates and the corresponding shifts in production shares between companies operating at different productivity levels. Third, the decomposition determines the productivity effect of *entry* as the weighted productivity differential between new entrants and the remaining companies. Conversely, *exit* affects overall productivity through the weighted difference in productivity between the companies that remain in the market and those that have left it.

Finally, we want to examine the relationship between firm-level productivity differences and the **reallocation of labour**. This is of interest, since the extent of job reallocation from firms in the lower percentiles of the productivity distribution to firms with higher productivity provides an indirect indication of whether competition is effective in a market. To this end, the average change in the number of employees per firm is calculated for different deciles of the original productivity distribution of all firms in a sector after one year, three years and five years. To determine the original productivity distribution, the Multiprod 2.0 program code alternatively uses labour productivity or multifactor productivity (MFP) according to the method of Wooldridge (2009).

5 Empirical findings

5.1 Industry concentration

Even though industry concentration cannot be a genuine measure of market competition, it remains a popular tool for identifying structural changes in the size distribution of firms across industries. Our sample comprises 207 3-digit NACE industries, of which the data are missing in 13 industries, because the cells contain less than 4 firm. For the given boundaries of the NACE nomenclature, these are obviously the sectors with the highest degree of concentration. Most of them concern tradable goods for which we are not aware of major import restrictions that would trigger an alert for lack of competition. Some of them relate to mining[27], others to manufacturing.[28] The data were also deleted in three services sectors with considerable economies of scale and/or network effects.[29]

Taking the unweighted mean of the remaining 194 industries results in an average HHI of 0.161 in 2020. The average output share of the four, eight and twenty largest companies was 52.9%, 65.3% and 79.0%, respectively. Compared to 2010, the average concentration has increased only slightly. The HHI remained virtually unchanged, while the three concentration measures rose moderately by an average of 0.76 percentage points (PP; for $CR4$), 0.64 PP ($CR8$) and 0.68 PP ($CR20$) over the ten-year period.

Figure 1 shows a chain of pairwise correlations between the different measures of concentration. Overall, they confirm a close relationship that is almost linear when we compare the different measures of CRX. The correlation of the HHI with $CR4$ (and similarly with $CR8$ and $CR20$, not shown) is also tight, but convex, as the HHI increases exponentially with higher values of CRX. The strong association between the various concentration measures also becomes evident when we plot the (unweighted) mean values of the 3-digit industry concentration measures aggregated by major NACE groups over time in Figure 2 and Figure A.2 (in the Annex). All of them essentially show a flat sideways movement from 2008 to 2020.

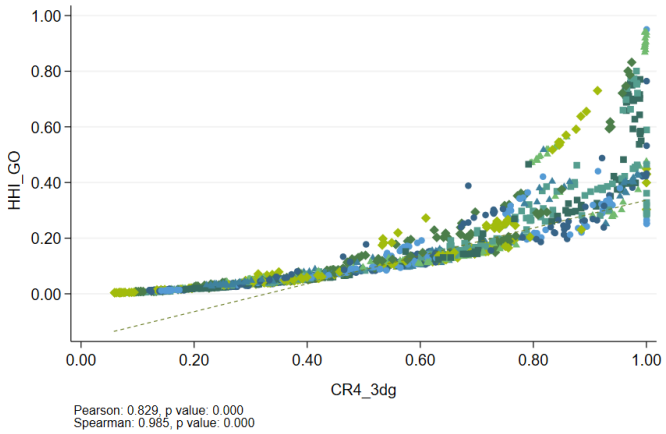
[27] Crude petroleum (NACE 061), Iron ores (NACE 071), Auxiliary mining activities (NACE 099).

[28] Processing of fish (NACE 102), Recorded media (NACE 182), Refined petroleum products (NACE 192), Agrochemical products (NACE 202), Steam generators (NACE 253), Ships, boats (NACE 301), Military vehicles (NACE 304).

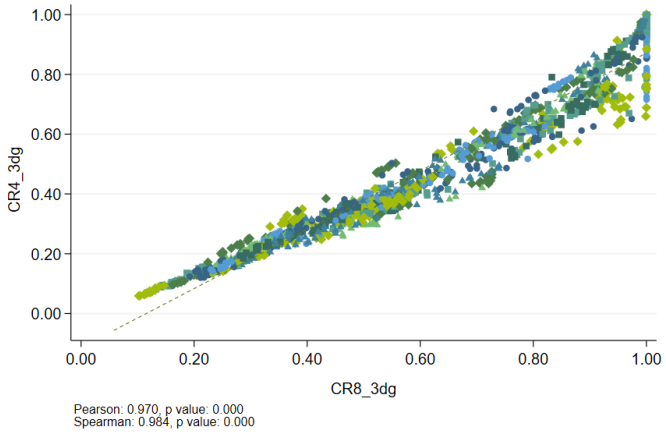
[29] Transport via pipeline (NACE 495), Inland freight water transport (NACE 504), or Postal services under universal obligations (NACE 531).

Figure 1: Pairwise correlation of different concentration measures, 3-digit industries, 2010-2020

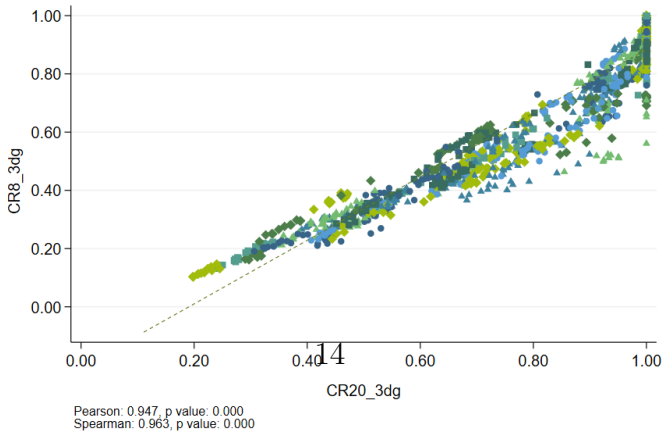
(a) HHI and CR4



(b) CR4 and CR8



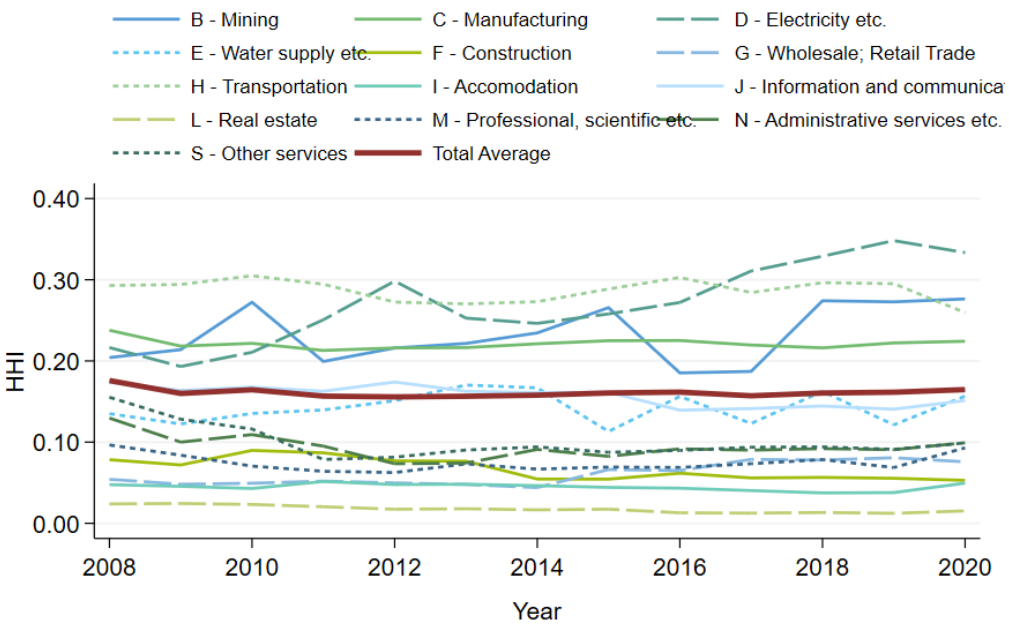
(c) CR8 and CR20



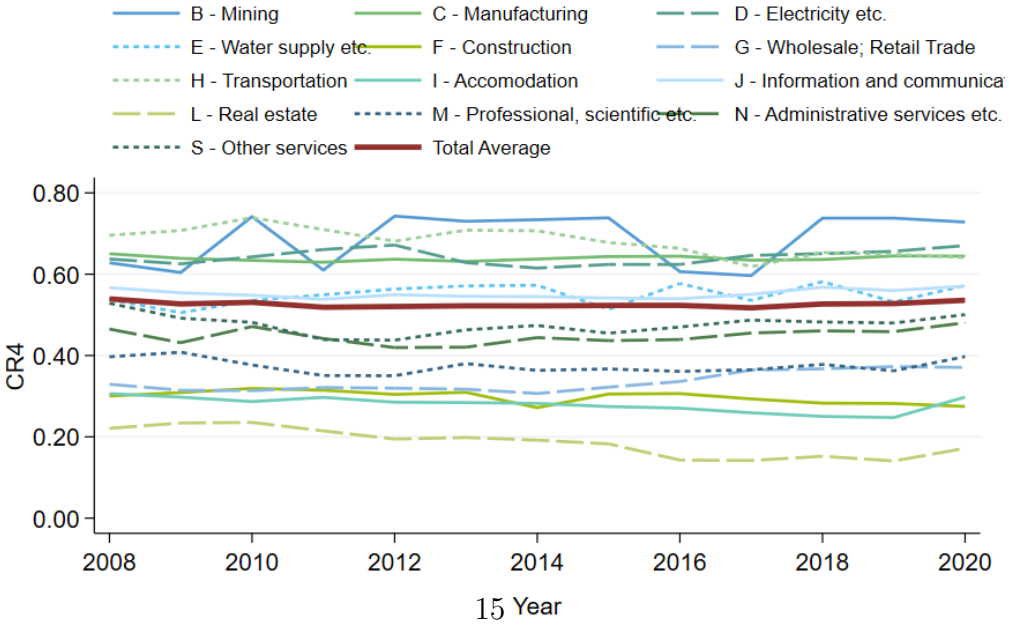
Source: OECD, STAT, WIFO calculations.

Figure 2: The development of concentration from 2008 to 2020, unweighted mean of 3-digit industries for HHI and CR4

(a) HHI



(b) CR4



Source: OECD, STAT, WIFO calculations.

For a more detailed analysis, table A.1 in the Annex contains the data for all available 3-digit NACE sectors. Among the industries with the highest concentration, the HHI was above a value of 0.5 in nine of them: *Manufacture of jewellery* (0.93), *Interurban passenger rail transport* (0.91), *Basic pharmaceuticals* (0.83), *Gas, distribution of gaseous fuels* (0,79), *Knitted and crocheted apparel* (0.78), *Weapons and ammunition* (0.72), *Refractory products* (0.69), *Man-made fibres* (0.68) and *Consumer electronics* (0.54). *Spinning and textile fibres* (0.48) completes a list of the top 10 industries.

When computing the **change** in concentration between 2010 and 2020 for 191 3-digit NACE industries, the HHI increased in 98 of them, while it decreased in the other 93. Similarly, the $CR4$ increased in 96, the $CR8$ in 90 and the $CR20$ in 79 industries, while it decreased or remained the same in all other industries. The Austrian microdata therefore do not indicate a general trend towards increasing industry concentration, at least at the NACE 3-digit level. Among the top 10 industries with the highest increase of the HHI we find *Gas and distribution of gaseous fuels through mains* (+0.42), *Beverages* (+0.31), *Weapons and ammunition* (+0.31), *Sale, maintenance and repair of motorcycles etc.* (+0.29) and *Weaving of textiles* (+0.29), *Motion picture, video and television program* (+0.22), *Photographic activities* (+0.19), *Textile fibres* (+0.18), *Management consultancy* (+0.17) and *Inland passenger water transport* (+0.15).

However, such comparisons between industries should be made with utmost caution. Traditional industries such as mining and manufacturing are often more narrowly defined than many services. In addition, most manufactured goods are tradable and therefore compete with suppliers in larger geographical areas, so their concentration based on national data is most likely overestimated. Conversely, the provision of many (personal) services is tied to location. Correcting for trade flows and moving to ever finer classifications of industries could make concentration measures more accurate, but would generally not eliminate the fundamental problems mentioned in section 4.2.

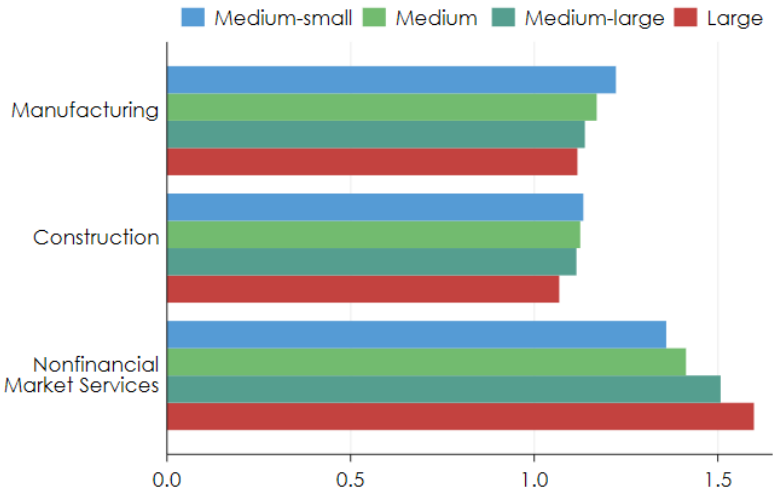
Finally plotting the level of industry concentration in percent against the change from 2008 to 2020 in percentage points, Figure A.1 in the Annex shows a small but statistically significant positive correlation with a coefficient of 0.19 for $CR4$ (and a similar coefficient of 0.19 for HHI, not displayed). It is significantly positive but smaller for $CR8$ (0.15), and not significant for $CR20$ (0.11). Overall, these observations suggest that an increase in concentration was more likely to be observed in industries with higher initial concentration and is mainly due to the higher average growth of the very largest companies.

5.2 Markups

Markups reflect the firms' ability to sell goods and services above their marginal costs. They are therefore a measure of market power, which can depend on numerous factors, such as industry concentration, barriers to entry and exit, network effects or the degree of product differentiation. Neither of them necessarily relates to anti-competitive behaviour *per se*. For example, larger capital investments require higher markups to break even and cover average costs. Also, when comparing companies within an industry, higher markups indicate their relative competitive strengths, usually based on advanced capabilities in terms of technology and human resources, management or business models.

In Austria, the **average firm-level markup** across 26 broad STAN sectors amounted to 33.05% in 2020. From 2008 to 2020 they had increased by 1.47 percentage points (PP) on average. During that period, the average markup was highest in the non-financial market services (39.6%), followed by manufacturing (18.7%) and construction (13.0%). In all the three sector aggregates, average markups clearly associate with firm size (Figure 3). The association, however, heads into opposite directions for non-financial market services, where firms in the largest size group achieve the highest markups, and manufacturing or construction, where the average markups tend to decrease with firm size.

Figure 3: Average markups by sector and size class: 2008-2020



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

To monitor the **development over time**, Figure 4 shows the index of average markups by (i) broad sector aggregates, (ii) firm size and (iii) percentile of the markup distribution from 2008 to 2020:

- Average markups were relatively stable until 2013 in both manufacturing and construction, while in non-financial services they initially dropped, but recovered shortly after, and then increased up to 2020. From 2008 until 2020 average markups increased in non-financial services and construction, whereas manufacturing experienced a moderate decline.

- Large and medium-large firms experienced a pronounced increase up to 2018, in the former size group markups dropped sharply up to 2020, while they remained robust in the latter. The average markups of the largest size group declined strongly in construction and non-financial services, but not in manufacturing (Figure A.3 in the Annex).

- There is neither a sign of convergence in average markups, nor a simple horizontal movement, but a pronounced trend of divergence. That is to say, firms in the top percentiles of the initial distribution generally managed to increase their markups the most and the differences in the inter-firm distribution of markups within sectors tend to be self-reinforcing.

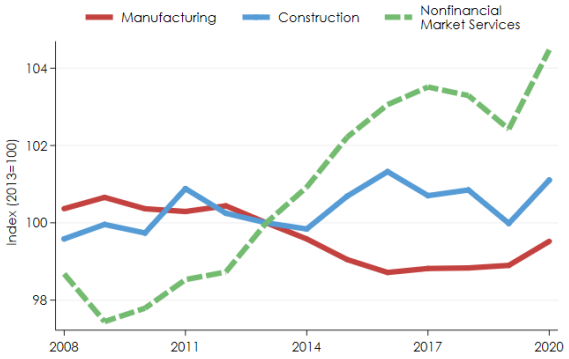
A general **winners-take-more** dynamic [30] is also apparent in Table 1, which provides the detailed numbers for 26 broad sectors in the OECD's STAN classification.[31] Since the Multiprod code replaces negative markups by the value 1, changes in the lowest percentiles of $p5$ and $p10$ are either zero or distorted by the truncation in some of the firms. We therefore do not include them in the charts and table. For the remaining percentiles, the unweighted mean of the changes of average firm-level markups across 26 sectors from 2008 to 2020 clearly rises with the initial percentile of the initial markup distribution. Markups decreased in $p25$ (-0.99 PP) and $p50$ (-0.06 PP), whereas firms above the median of the initial markup distribution managed to further increase it (+1.63 PP in $p75$, +7.40 PP in $p90$ and +12.90 PP in $p95$).

[30] Just a humorous side note: To learn whether that expression already existed or is new, we received this charming explanation by Copilot (09.03.2024): "The term 'winners-take-more' is actually an interesting variant and differs from the more common 'winner-takes-all' principle. While 'winner-takes-all' focuses on absolute victory, 'winners-take-more' emphasizes incremental success and the accumulation of advantages. By using the term 'winners-take-more', you bring a subtle nuance to the discussion". Further questions did not produce any source, which had used this expression before.

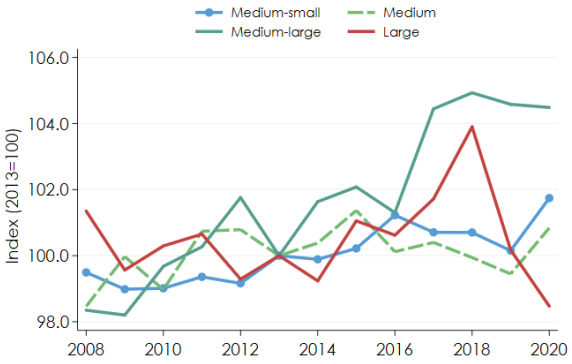
[31] In four additional sectors no markups were computed (n.a.), because the number of observations was considered not to be sufficient for a valid estimation of the ACF-production function.

Figure 4: Development of average markups, index 2013 = 100

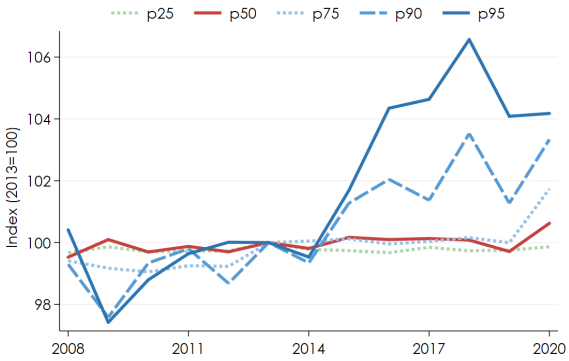
(a) Broad sector groups



(b) Firm size



(c) Percentile of markup distribution



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations. Since Multiprod sets negative markups to 1, the lowest percentiles (p5, p10) may not be included.

Table 1 shows the development of average firm-level markups in the different sectors. The main findings are as follows:

- Markups showed a marked **decline** in *Wood and paper products, incl. printing* (-4.6 PP), *Basic metals and fabricated metal products* (-5.5 PP), *Electricity, gas, steam, etc.* (-6.2 PP), *Water supply, sewerage and waste management* (-13.0 PP) as well as *Other services* (-21.9 PP).

- Markups remained relatively **flat** in *Food products, beverages and tobacco* (-0.6 PP), *Textiles, wearing apparel, etc.* (-0.9 PP), *Computer, electronic and optical products* (-0.8 PP), *Wholesale and retail trade, incl. repair of motor vehicles* (+0.9 PP) *Publishing, audiovisual and broadcasting* (+1.0 PP).

- A **modest** increase ($>$ 1.0 PP and $<$ 6.0 PP) was found in *Machinery and equipment n.e.c.* (+1.3 PP), *Transport equipment* (+2.4 PP), *Furniture and other manufacturing* (+3.1 PP), *Construction* (+1.7 PP), *Transportation and storage* (+4.1 PP), *IT and related services* (+5.9 PP) or *Research and development* (+4.4 PP).

- Finally, markups **increased** by more than 6.0 PP in *Real estate* (+19.8 PP), *Legal and accounting services* (+6.1 PP), *Advertising and market research, incl. veterinary services* (+23.8 PP), *Administrative and support activities* (+14.8 PP).

In addition, the following sectors were characterized by the aforementioned *winner-takes-more* dynamic, with companies in the higher percentiles of the distribution increasing their markups significantly more than those in the lower percentiles:

- *Chemicals and chemical products*, *Basic pharmaceuticals and products*,[32] *Wholesale and retail trade*,[33] *Real estate*, *Legal, accounting activities, etc.*, *Advertising and market research* as well as *Administrative and support services*.

[32]Here it is only $p90$ and $p95$ that forged ahead, whereas markups declined in all other percentiles.
[33]Except for the almost identical rates at the percentiles $p90$ and $p95$.

Table 1: Average firm level-markups by broad sectors and percentile of the markup distribution

STAN	**Sector**	**Markup**	**Change 2008/20** (*percentage points*)				
		2020 (%)	**All**	**25th**	**50th**	**75th**	**90th**	**95th**
B	Mining and quarrying	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CA	Food products, beverages, tobacco	17.29	-0.64	-0.11	-0.99	-1.28	-4.31	-1.62
CB	Textiles, wearing apparel, etc.	15.16	-0.90	-0.78	0.53	1.77	0.03	-17.49
CC	Wood & paper products, printing	15.76	-4.56	-3.32	-6.82	-7.60	-5.39	-5.80
CD	Coke, refined petroleum products	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CE	Chemicals and chemical products	14.43	6.01	0.00	5.12	9.30	21.35	14.79
CF	Basic pharmaceuticals and products	30.94	-5.46	-8.08	-8.64	-13.78	17.67	16.88
CG	Rubber and plastics products	18.45	-1.76	1.06	-2.85	-1.80	-6.12	-8.83
CH	Basic metals and products	21.22	-3.27	-1.85	-1.78	-7.72	-7.05	-1.70
CI	Computer, electronic, optical products	25.52	-0.76	-3.27	2.12	-3.00	-1.64	-2.91
CJ	Electrical equipment	8.25	-1.84	-2.61	-4.11	-3.15	0.99	1.89
CK	Machinery and equipment n.e.c.	17.82	1.29	0.00	2.01	3.49	3.35	-0.35
CL	Transport equipment	10.36	2.37	1.73	-0.67	5.16	9.75	5.52
CM	Furniture; other manufacturing	23.23	3.09	3.39	1.53	1.43	4.86	12.62
D	Electricity, gas, steam, etc.	34.03	-6.16	-5.13	-6.80	-12.52	-3.80	-11.94
E	Water supply; sewerage, waste	27.39	-13.02	-3.88	-12.93	-24.66	-41.57	-42.31
F	Construction	13.79	1.71	0.32	0.62	1.75	6.48	2.99
G	Wholesale, retail, repair motor vehicles	8.26	0.95	0.00	0.13	1.70	4.50	4.06
H	Transportation and storage	23.26	4.09	1.72	3.49	9.30	7.57	-2.65
I	Accommodation and food services	28.58	3.31	2.12	3.99	5.24	5.32	3.84
JA	Publishing, audiovisual, broadcasting	17.71	1.02	-1.31	2.95	1.75	21.16	21.19
JB	Telecommunications	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
JC	IT and other information services	43.64	5.89	5.29	7.92	9.63	7.08	-3.69
L	Real estate activities	95.56	19.76	-1.43	7.29	32.07	47.50	125.44
MA	Legal, accounting activities, etc.	61.46	6.05	0.66	1.22	4.08	22.26	29.37
MB	Scientific research and development	40.56	4.40	-6.50	-1.36	22.18	-1.52	36.02
MC	Advertising & market research; veterinary	73.76	23.83	16.48	30.66	31.90	44.93	64.74
N	Administrative and support services	159.88	14.78	-0.93	-3.56	10.01	72.81	129.86
QB	Residential care and social work	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
S	Other service activities	13.01	-21.89	-19.33	-20.64	-32.83	-33.85	-34.62
Total (*unweighted mean*)		**33.05**	**1.47**	**-0.99**	**-0.06**	**1.63**	**7.40**	**12.90**

Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

The different dynamics by percentiles are also illustrated in the Figures 5 to 7 as well as Figures A.4 to A.9 in the Annex. To pick out a few examples: *Wood and paper, incl. printing* and *Base metals and fabricated metal products* are two manufacturing sectors that saw a decline in firm-level average markups that began around 2012 and intensified in 2020. Markups declined most sharply for companies in the higher percentiles of the distribution. Since both sectors produce highly tradable goods, it is more likely that the decline in markups is either related to a particular cyclical impact on the primary industries during these years or to problems with their overall competitiveness, rather than to a general increase in competition.

With average firm-level markups of 13.8% in 2020, *Construction* has seen a modest but steady overall increase of 1.8 PP since 2008. This increase was mainly due to the higher percentiles of the markup distribution, especially $p90$. The increase in markups contrasts with the negative productivity growth in the sector reported in Peneder and Unterlass (2024). However, both observations are consistent with public concerns about anti-competitive behaviour, which have led to an extensive investigation of a possible construction cartel by the AFCA.[34]

In *Wholesale and retail trade* the average markup in 2020 was 8.3% and thus only +0.9 PP above that of 2008. As Figure 6 shows, this increase was considerably higher in the upper perecentiles. One segment that drew particular attention from the AFCA is the food sector, where the four largest retailers hold a combined market share of 91%.[35]. While the AFCF expressed its concern about their bargaining power and many reports of unfair practices in relation to their suppliers, it did not identify a causal impact on the recent period of high inflation.

In 2020 the average firm-level markup of *Accomodation and food services* was 28.6%, 3.3 PP higher than in 2008. This increase is apparently due to the special market conditions in this sector during the COVID-19 pandemic and the lockdowns. While the variable costs for intermediate inputs fell sharply, generous public subsidies attempted to compensate for the overall loss of revenue. [36] As the markups had either remained constant or even fallen in the years before the pandemic, they do not indicate a general lack of competition in the sector.[37]

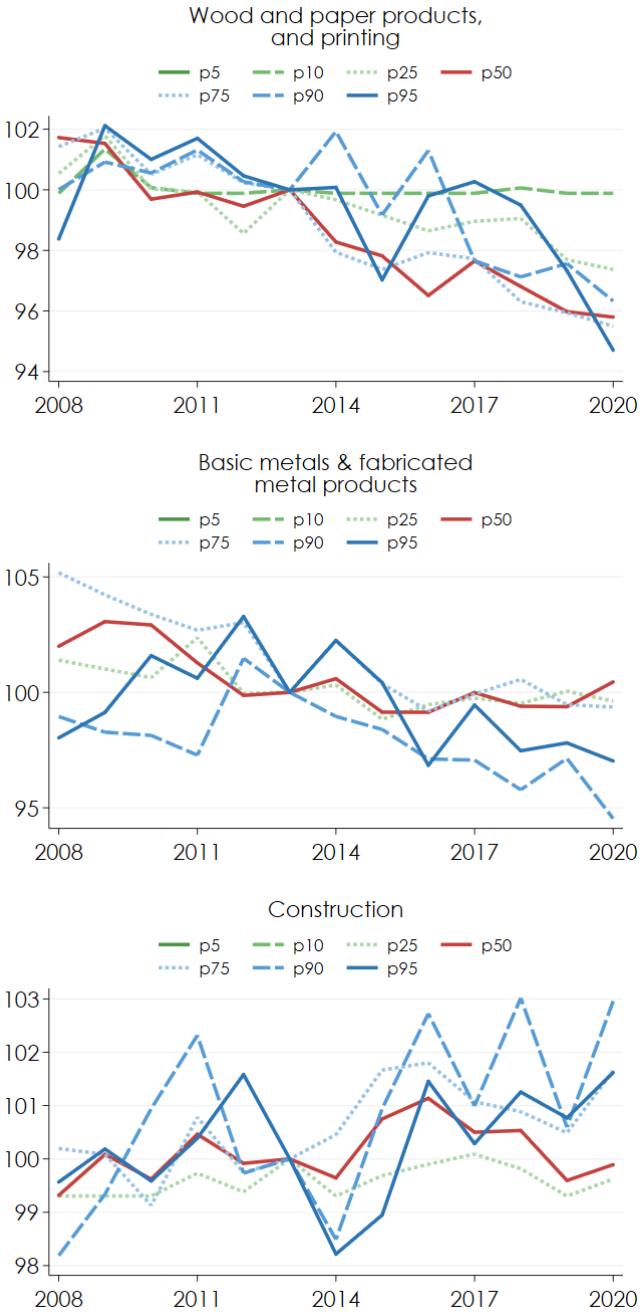
[34]Bundeswettbewerbsbehörde (2023B).

[35]Bundeswettbewerbsbehörde (2023A).

[36]Fritz et al. (2022).

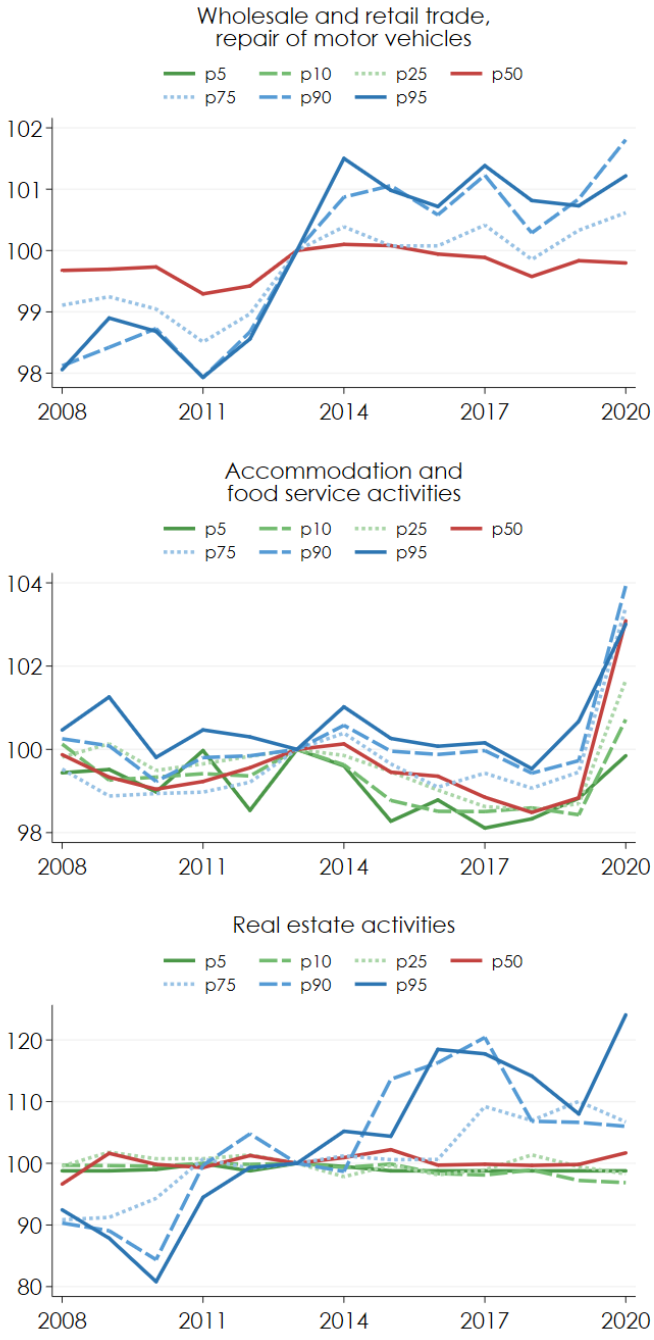
[37]Horizontal segmentation can nevertheless pose problems of anti-competitive behaviour in more specific markets. See, e.g, Firgo and Kügler (2018) on the pricing of ski-lift tickets.

Figure 5: Development of average markups in selected sectors, index 2013 = 100



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure 6: Development of average markups in selected sectors, index 2013 = 100



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Real estate is another sector that has come under public scrutiny due to rising prices and the spectacular collapse of the SIGNA Group in December 2023. After an increase of 19.8 PP since 2008, average firm-level markups amounted to 95.6% in 2020. The growth of markups was extremely uneven, but consistently higher for firms in the higher percentiles of the distribution. The changes thus spanned a range from -1.4 PP in $p25$ to 125.4 PP in $p95$.

The following examples offer specialized, often knowledge-intensive business services (Figure 7), where effective competition is also an important driver of competitiveness for other companies in downstream sectors:[38]

- In *Legal and accounting activities, etc.* the average markups in 2020 amounted to 61.4%. Since 2008, they had increased by an average of 6.1 PP. This increase was again very uneven and to the advantage of firms in the top percentiles.

- In *Advertising and market research*, the increase in markups was somewhat spread more evenly and thereby also higher on average. With an increase of +23.8 PP since 2008, it amounted to 73.8% in 2020.

- In *Administrative and support activities*[39] the average markup was 159.9% in 2020, 14.8 PP above the 2008 level. Here too, markups grew fastest for companies in the highest percentiles of the distribution. Conversely, they fell on average in the lower percentiles.

In summary, the microdata for the above-mentioned business services show a significant increase in average firm-level markups and a self-reinforcing *winners-take-more* dynamic between 2008 and 2020. Although these sectors are very heterogeneous and one must be cautious with generalizations, the results confirm the concerns expressed in various OECD reports about overly restrictive business regulations in Austria, affecting both personal and professional services.[40] Among them, occupational entry regulations (OER) are particularly relevant for competition monitoring, as they have a direct impact on entry barriers and thus on the contestability of the mostly local markets. This includes, for example, the control by the professional chambers of the licensing requirements and the scope of the exclusive tasks that can be performed.[41]

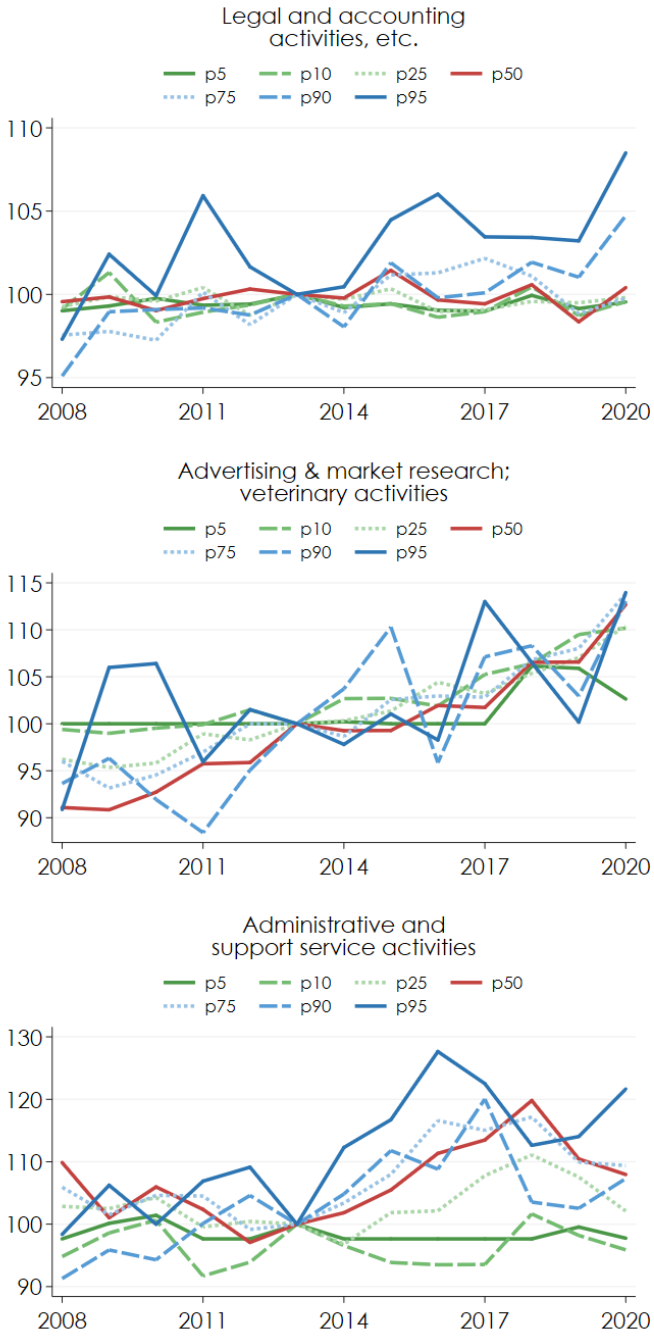
[38] Peneder et al. (2003).

[39] This group includes various business services, e.g. in the areas of cleaning, security and human resources.

[40] Von Rueder and Bambalaite (2020, p. 18 and p.56); Bambalaite et al. (2020).

[41] Other aspects monitored by the OECD relate to administrative burdens or mobility restrictions, as well as restrictions on cross-border services, such as the requirement of a commercial presence for engineering services (OECD 2024).

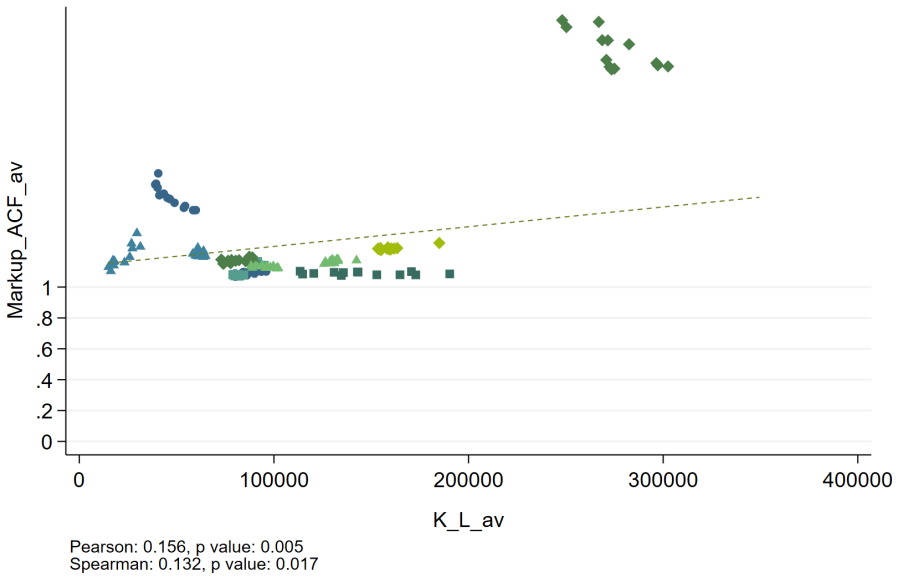
Figure 7: Development of average markups in selected sectors, index 2013 = 100



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

As mentioned before, rising markups, especially if consistently found among the firms in the higher percentile of the distribution, do not necessarily result from anti-competitive behaviour. Instead, they may, for instance, reflect higher sunk investments to reduce marginal costs. Brief inspection shows that the pairwise correlation of average firm-level markups with the capital-labour ratio from 2008 to 2020 is positive but modest in size, with a significant coefficient of 0.362 when applied to all 26 sectors. If we remove *Real Estate* as an obvious outlier with a particularly high capital-labour ratio, the correlation remains significant, but the coefficient drops to 0.156 (Figure 8). Overall, the observed correlation is mainly due to cross-sectional variation.[42]

Figure 8: Average markups and capital-labour ratio (K/L)



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations. NB: *Real estate* dropped.

[42]If we restrict the sample to the cross-section of 26 sectors in 2020, the correlation coefficient is significant at the 5 percent level and even somewhat higher than before. If we drop *Real estate*, the coefficient for the cross-section correlation becomes very small (0.1065) and is no longer significant. Conversely, if we look at the pairwise correlations within each sector over time, exactly half of the 26 coefficients are positive and the other negative. Overall 15 coefficients are significant, of which 8 have a positive sign.

5.3 Business dynamics

Finally, we consider two aspects of firm dynamics that give us an indirect indication of whether competition effectively enables the reallocation of production and employment in favour of the more productive firms. Depending on reliable weights and estimates of productivity at the firm level and due to a break in the series of the Austrian business register, we limit the analyses to the period from 2013 to 2020.[43] While this is long enough to examine whether competition is effective overall in terms of the expected reallocation effects, the time series is too short to examine *changes* in these dynamics over time. To this end, we refer to indicative aggregate statistics that report, for example, a worrying decline in the share of young firms.[44]

5.3.1 Productivity and the reallocation of production

To begin with, the DOPD splits the aggregate productivity growth of an industry into the direct contributions of the entry of new firms, the average growth of incumbent firms, the reallocation of economic activity between them and firm exits (Section 4.4). Given the more reliable estimates of the ACF production function and of MFP, we only consider the broad sector of non-financial market services. We also omit the year 2020 because of the strong distortions caused by the COVID-19 pandemic. Calculating MFP in logarithms means that the reported changes are expressed as log differences (percent). The dimensionless nature of MFP, however, implies that the individual figures are intuitively difficult to grasp. The discussion will therefore focus on the relative magnitudes of the various components. The choice of the interval t, i.e. the time between two observations, has a considerable influence. Figure 9 compares the changes after one year (t=1), after 3 years (t=3) and after 5 years (t=5) from 2014 to 2019.

The contribution of new *entrants* can be positive or negative, depending on whether they are on average more productive than incumbents or not. Assuming that new firms have a steeper learning curve than established firms, one might expect that their contribution tends to increase with the length of the time interval. In our analysis, the new entrants made a positive contribution to the annual change in MFP. However, this decreases when longer time intervals of three or five years are considered. Perhaps this is because some firms fail to climb the learning curve and firmly establish themselves on the market in the first few years of the trial-and-error phase. As a result, the average contribution of new entrants could be lower.

[43] See also Peneder and Unterlass (2024).

[44] According to Peneder et al. (2023, p. 46), the share of companies in Austria with an age of less than 5 years fell from 5.4% in 2013 to 3.8% in 2020.

Table 2: Dynamic Olley-Pakes decomposition (DOPD) of MFP (ACF) in log differences: Non-financial market services 2014 to 2019

After	**1 year** (2014-19)	**3 years** (2016-19)	**5 years** (2018-19)
Entry	2.46	2.07	1.19
Within	16.38	39.82	57.61
Reallocation	13.77	51.16	102.20
Exit	-3.01	-18.12	-11.44

Source: Multiprod 2.0 - OECD, STAT, WIFO.

In contrast, the average change in MFP of *incumbents* increases with the duration of the time interval (from around 16.4 percent for one-year intervals to 39.8 and 57.6 percent for three- and five-year intervals, respectively). But the increase over time is even more pronounced in the reallocation of production between them, indicating a certain consistency of this process and in the distribution of competitive advantages between firms.

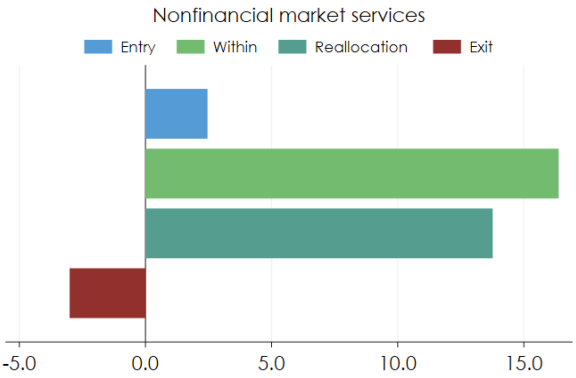
Finally, one would generally expect a positive productivity effect of market selection, as the least competitive firms are forced to *exit*. However, the data does not support this conjecture. On the contrary, from 2013 to 2019, company exits had a negative impact on overall productivity growth in the non-financial market services. This finding is surprising, but not uncommon.[45] In fact, companies can exit a market for many reasons, such as negative changes in preferences and demand for their own product portfolio, lack of complementary services, network effects in favour of competitors, etc., which are not necessarily related to the firm's productivity. Before an acute failure, many firms seem likely to go through a prolonged struggle for survival in which they desperately exploit opportunities to increase the efficiency of their operations.

In conclusion, from 2013 to 2019, the contribution of new entrants to productivity growth in the broad sector of non-financial market services has been rather small, while competition has been effective primarily through the channel of differential growth in favour of more competitive over less competitive firms, rather than selective attrition through firm exits.

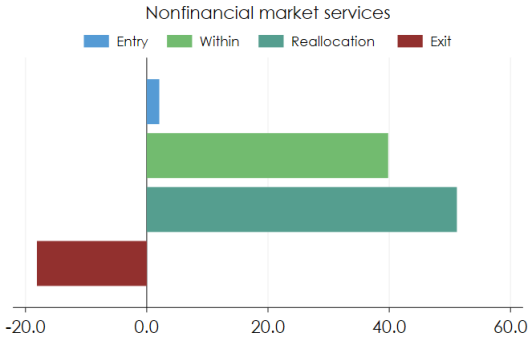
[45]For example, Backus (2020).

Figure 9: Dynamic Olly-Pakes decomposition (DOPD) of the average change in MFP, log differences 2014-2019

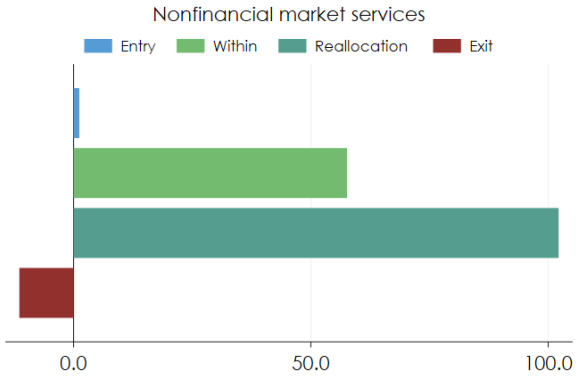
(a) After 1 year



(b) After 3 years



(c) After 5 years



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

5.3.2 Productivity and the reallocation of employment

As a final indication of effective competition, we examine the reallocation of jobs in relation to the firms' relative productivity performance. Effective competition implies that the more competitive a company is, the faster it can grow and thus create more jobs. Therefore, we expect to observe a substantial reallocation of labour from firms in the lower percentiles to those in the higher percentiles of the productivity distribution. Figure 10 illustrates the aggregate patterns in the form of the weighted mean of changes in the number of employees by decile of the productivity distribution across sectors after one, three and five years.

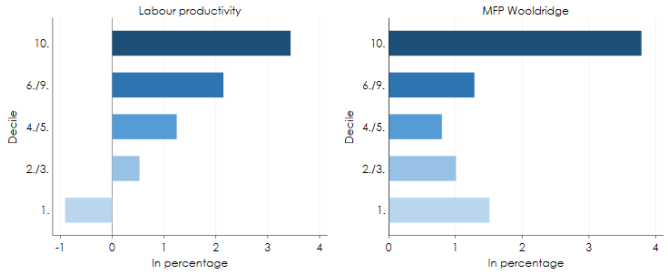
For the Austrian economy at large, the results clearly confirm the expected positive employment effect of a company's competitiveness. In terms of both labour productivity and MFP, firms in the top decile of the distribution achieved by far the highest employment growth of all firms, regardless of which time interval we choose. The expected reallocation is most evident in labour productivity, as employment growth tends to increase with each range of deciles. For example, companies in the first decile recorded an average decline in employment of 0.40% after one year. In contrast, companies in the second or third decile were able to increase employment by 1.05%, in the fourth or fifth decile by 1.85% and in the sixth to ninth decile by 2.58%. Companies in the tenth decile, however, created the most jobs with an average change in employment of +3.80%.

Regarding MFP, the microdata reveal a non-linear pattern, with the highest employment growth in the top decile, followed by the bottom decile, and the middle deciles of the productivity distribution coming last. Thus, average employment growth after one year was comparatively low at +1.36% in the second and third deciles, +1.19% in the fourth and fifth deciles and +1.77% in the sixth to ninth deciles. Conversely, the number of jobs in the bottom first decile increased on average by +2.34% and in the top tenth decile by +4.63%.

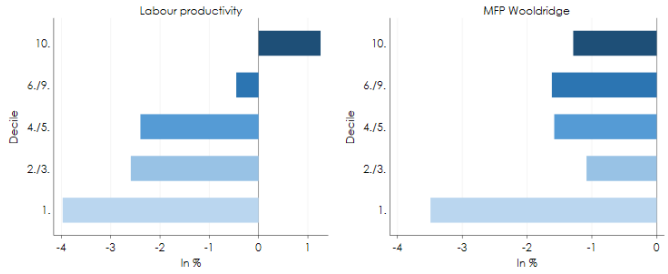
The expected reallocation of workers from companies at the lower end to companies at the upper end of the productivity distribution also applies to many individual sectors (table 3 and tables A.2 to A.3 in the Annex). There are only a few exceptions in manufacturing, most notably the production of *Chemicals and chemical products* or *Transport equipment*. Different from the earlier findings on rising profit margins in *Construction*, this observation suggests that competition is effective in substantially reallocating workers towards companies with high labour productivity. Apart from utilities, such as *Electricity, gas, steam, etc.* or *Water supply; sewerage, waste management*, with high capital investment and strong network effects, it is mainly the service sectors, such as *Professional and technical services*, that deviate from the expected reallocation of labour.

Figure 10: Average change in the number of employees by decile of the productivity distribution, 2013-2019

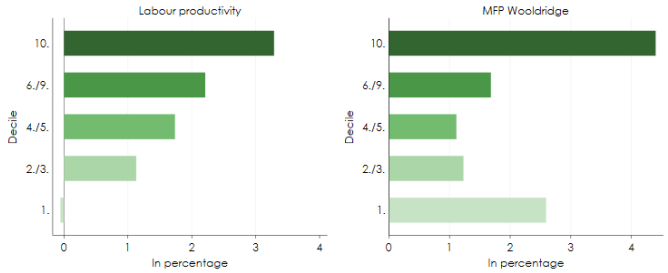
(a) After 1 year: 2013-19



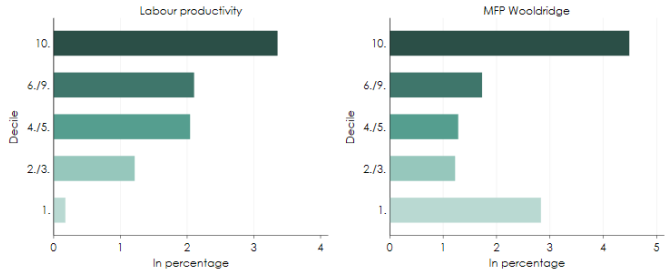
(b) After 1 year: 2019-20



(c) After 3 years: 2013-2019



(d) After 5 years: 2013-2019



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Table 3: Average change of employment after one year by percentile of the productivity distribution

Sector	**Labour productivity**					**Multifactor productivity**				
	1.	2./3.	4./5.	6./9.	10.	1.	2./3.	4./5.	6./9.	10.
Mining and quarrying	0.30	0.66	0.41	1.07	-4.29	n.a.	n.a.	n.a.	n.a.	n.a.
Food products, beverages, tobacco	-0.17	0.46	1.33	2.27	4.07	0.33	0.24	1.35	2.15	4.29
Textiles, wearing apparel, etc.	-4.19	-7.14	-2.84	-0.58	3.12	-21.53	-2.32	-0.33	-0.37	0.41
Wood & paper products, printing	-1.22	-0.76	0.80	1.55	1.19	-1.37	0.10	0.57	0.99	0.91
Coke, refined petroleum products	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Chemicals and chemical products	-0.46	3.25	2.24	6.52	-3.10	16.88	3.74	-3.23	2.23	1.78
Basic pharmaceutical products	n.a.	1.82	12.67	8.80	n.a.	n.a.	n.a.	5.74	8.18	n.a.
Plastics, non-metallic mineral products	-2.68	-0.35	1.06	2.31	2.71	-5.01	1.33	1.60	1.12	1.94
Basic metals and products	-1.70	0.60	1.36	2.22	8.48	7.79	1.96	0.99	0.64	0.44
Computer, electronic, optical products	0.93	0.82	4.59	7.53	9.00	33.60	3.79	2.50	1.55	1.83
Electrical equipment	-0.93	-0.08	7.64	-9.13	11.85	-19.74	1.32	2.26	1.76	5.92
Machinery and equipment n.e.c.	-2.24	0.23	2.93	5.54	10.36	-1.47	3.68	4.16	3.80	2.13
Transport equipment	0.89	20.97	-4.17	27.28	29.56	59.70	28.51	3.87	1.49	1.07
Other manuf., repair of machinery	-0.75	-0.22	0.78	1.39	2.23	-1.03	-0.02	0.70	0.96	3.20
Electricity, gas, steam, etc.	-0.58	-1.57	-1.74	1.16	2.11	-4.64	-3.01	3.65	0.55	0.91
Water supply; sewerage, waste	-1.59	-0.08	0.83	0.11	0.37	-5.92	1.05	0.31	0.38	1.24
Construction	-0.30	0.12	0.53	2.10	4.89	1.29	0.76	0.64	1.12	4.36
Sale and repair of motor vehicles	-2.07	0.82	1.54	2.15	2.43	-0.08	-0.07	0.24	0.86	9.65
Transportation and storage	0.21	2.35	1.09	1.43	3.37	8.16	1.33	0.77	0.99	0.82
Accommodation and food services	-1.14	-0.38	-0.17	-0.31	1.28	0.48	0.02	0.23	-0.50	-0.51
Publishing, audiovisual, broadcasting	-0.61	-0.22	-0.42	2.95	2.61	-0.22	-0.03	-1.54	3.28	2.02
Telecommunications	n.a.	0.18	3.60	n.a.	6.58	n.a.	7.27	-2.63	2.96	n.a.
IT and other information services	1.54	1.13	6.47	3.38	7.40	2.47	3.19	3.95	3.59	4.89
Real estate activities	-2.26	0.52	-5.08	-0.02	-0.40	-11.58	-0.44	0.02	0.55	0.28
Legal, accounting activities, etc.	-0.41	0.55	2.18	3.62	3.53	1.58	2.04	1.53	2.34	2.28
Scientific research & development	3.35	1.53	2.58	2.40	8.82	6.18	1.64	-0.37	3.59	3.03
Professional and technical services	0.44	1.58	0.86	0.86	1.23	-0.33	0.57	1.66	2.20	0.23
Administrative and support services	-0.30	0.31	2.73	3.68	1.79	2.05	1.84	-0.02	2.96	2.95
Other service activities	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Residential care and social work	n.a.	-2.42	0.25	-0.79	n.a.	n.a.	-4.51	1.00	-0.60	n.a.
Total	-0.40	1.05	1.85	2.58	3.80	2.34	1.36	1.19	1.77	4.63

Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

6 Summary and discussion

6.1 Context

In this paper we understand *effective competition* as the pursuit of income and profit opportunities by satisfying customer demand better than others and consider the *monitoring* of competition to be a tool for structural analysis within the general systematic study of an economy ("Wirtschaftsanalyse"). It is of particular interest for competition policy, but neither can it establish the kind of detailed diagnosis needed for public interventions, nor should it intend to do so. On the contrary, concrete policy interventions must always call for the very specific inquiry of particular markets or industries.

In cooperation with the OECD (Multiprod 2.0) and exploiting the opportunities for micro-data analysis offered by the newly established *Austrian Micro Data Center* (AMDC), this paper focuses on three dimensions of effective competition in Austria: (i) industry concentration, (ii) firm-level markups, and (iii) business dynamics. Depending on the variables and methods required for the respective computations, the indicators cover different years from 2008 to 2020 and refer to different levels of aggregation by sector.

6.2 Key results

The main findings of our analysis are as follows:

- **Industry concentration**: There is no general trend towards increasing concentration, at least at the level of 191 3-digit NACE industries. In 2020, the average output shares of the four, eight and twenty largest enterprises were 52.9%, 65.3% and 79.0% with an average HHI of 0.16. The latter remained virtually unchanged, while the other metrics increased only slightly over a ten-year period. The HHI rose in 98 sectors, while it fell in the remaining 93 sectors. The $CR4$ rose in 96, the $CR8$ in 90 and the $CR20$ in 79 sectors.

- **Firm-level markups**: In 2020, the average markups across 26 broad STAN sectors amounted to 33.05%, an increase of 1.47 PP since 2008. They were highest in the non-financial market services (39.6%), followed by manufacturing (18.7%) and construction (13.0%). From 2008 to 2020, they increased in the non-financial services and construction sectors, while the manufacturing sector recorded a slight decline.

- **'Winners-take-more'**: The strongest increases of markups occurred in *Real estate* and the typical business services of *Legal and accounting*, *Advertising and market research*, *Administrative and support activities*. Here and in other sectors, the micro-data reveal a self-reinforcing dynamic, where companies in the higher percentiles of the initial distribution increase their markups significantly more than those in the lower percentiles.

- **Dynamic reallocation**: For the broad sector of non-financial market services, the analysis confirms that competition effectively contributes to the reallocation of production towards the more productive firms. Relatedly, the companies with higher productivity also create more jobs. From 2013 to 2020 employment growth was by far the highest in the top ten percent of all companies in terms of both labour productivity and MFP.

The empirical evidence is therefore mixed, but nonetheless **worrying overall**. To begin with, industry concentration does not show a general trend, but if anything it is tending slightly upwards. In order to further advance these preliminary results, a more fine-grained analysis at lower levels of aggregation is certainly warranted. However, the confidentiality rules will then also lead to more missing observations precisely in the cells with the highest concentration (i.e. in which fewer than four companies report their main activity). Second, the observed business dynamics confirm that competition is generally effective in stimulating the reallocation of economic activity and productivity growth. Longer time series are needed to assess also the change in business dynamics, for which other studies show, for instance, a decline in the number of young firms in Austria (Peneder et al., 2023). Finally, the clearest indication of a general weakening of competition is provided by the firm-level markups, which this study has analyzed comprehensively for Austria for the first time. In many of the non-tradable sectors in particular, these have moved upwards on average - not to the benefit of all companies, however, but unevenly in favour of firms that already enjoyed higher markups and thus greater market power.

6.3 Discussion

The breadth and scope of the observed empirical trends do not allow any simple conclusions to be drawn about the presumed anti-competitive behaviour of individual companies. Rather, the results point to more general structural factors that may shift the balance against effective competition in various sectors. So what factors might be involved?

- First of all, **anti-competitive behaviour** by individual companies are a possible explanation, and if this is suspected, they must be targeted through specific market investigations by the AFCA. However, the observation of increasing market power in a large number of sectors raises the question of why such cases might occur more frequently than in the past.

- Secondly, an alleged softening of **competition policy**, as has been discussed in the USA, seems an unlikely explanation in the case of Austria. In the past, experts often suspected a 'soft touch' due to the particular institutional setup in Austria. However, EU accession and reforms in recent years should have strengthened it.

- Third, specific **sector regulations**, such as the strict occupational entry requirements in many professional services, are repeatedly criticized by international organizations. Although we are not aware of any major reforms in this area, the lack of significant changes in the regulatory environment would in turn make this an implausible explanation for the recent rise in average markups. Existing entry barriers may nevertheless have established a regulatory environment that facilitates the observed uneven dynamics in the markup distribution.

None of the above arguments can or should invalidate the necessary call for regulatory reform and a vigorous competition policy. However, the empirical evidence suggests that larger secular trends may also be at play. The answer probably lies in a combination of (i) technological change, (ii) business strategy and (iii) firm organization:

- When **innovation** raises the competitive edge in terms of the required technologies and capabilities, firms need to achieve higher markups to cover the required fixed investments in tangible and intangible assets. In many cases, this also lowers marginal costs, as is often true with the introduction of new digital technologies and AI. In the wake of the recent wave of digitalization, which simultaneously affects many industries, the technology-driven channel of fixed investments is gaining additional weight and can explain a general trend towards increasing markups.

- If we add the dimension of **corporate strategy**, Sutton's (1991, 1998) theory of endogenous sunk costs has shown how firms can deliberately increase such investments, e.g. in RTD, brands or networks, to prevent entry and thus protect their market power. Considering both mechanisms, endogenous sunk costs

can explain why industry concentration remains stable, while increasing fixed investments and the expected reduction in marginal costs foster the growth of markups.

- **Business intelligence** is an increasingly important example of such strategically sunk investments, where technology and business strategy co-evolve in a likely self-reinforcing process. Through big data, highly skilled professionals and new analytical tools, companies tend to become smarter and increasingly capable to exploit new profit opportunities, e.g. from personalized marketing and pricing to algorithmic cooperation (Berry et al., 2019; Johnson et al., 2023; Assad et al., 2024; Kasberger et al., 2024; Rhodes and Zhou, 2024).

- Finally, **technology adoption** frequently calls for major complementary investments, e.g. in labour skills, firm organization, or business models, before companies can fully exploit the inherent economic potential (Bresnahan et al., 2002). In combination with the previous arguments about sunk investment and business intelligence, this may contribute to the presumed slowdown in technology diffusion (Andrews et al., 2016; Akcigit & Ates, 2023), which we also see as a likely cause of the asymmetric distribution of markups and their self-reinforcing dynamics in our data.

6.4 Conclusions

As the research briefly summarized represents only a first and preliminary attempt at a comprehensive competition monitoring in Austria, it would be premature to draw sweeping policy conclusions. Although the increase in average markups and the observed tendency towards a self-reinforcing unequal distribution are consistent with the latest findings from the international literature, no consensus has yet been reached there on the likely causes or possible policy implications. Clearly, this development poses major challenges for the traditional methods and tools of sector regulation and competition policy. What is still entirely unclear, however, is the specific channels through which public interventions could remedy its possible negative consequences.

Our discussion of potential causes suggests a comprehensive approach that also targets the dynamic capabilities of firms at the lower end of the markup distribution to become effective contenders to industry leaders. In some cases, this may involve removing barriers to entry, such as enabling data portability when switching between different service providers. In other situations, attempts can be made to limit the build-up of a dominant position, e.g. by narrowing the scope of intellectual property

rights. Finally, if the widespread adoption of innovations is a major obstacle to catching up with the industry leaders, it may be appropriate to use tools aimed at technology diffusion. In any case, the rise of average markups and the observed *winners-take-more* dynamic are an obvious reason for increased alertness and further highlight the urgency of a regular and systematic monitoring of competition based on micro data.

Acknowledgements

We would like to thank our colleagues from the OECD Multiprod Team and the Austrian Micro Data Centre (AMDC) for their excellent cooperation and support. The OECD team together with Philipp Schmidt-Dengler, Dieter Pennerstorfer and Michael Klien also provided valuable feedback and comments on earlier drafts of the paper. We greatly appreciate their suggestions and ideas for further analyses. Finally, we are greatly indebted to Nicole Schmidt-Padickakudy, Tim Slickers and Moritz Uhl for their invaluable technical support.

References

Ackerberg D.A., Caves K., Frazer G., 2015. Identification Properties of Recent Production Function Estimations, *Econometrica* 83(6), 2411-2451.

Aiginger K., Brandner P., Wüger M., 1995. Measuring Market Power for Some Industrial Sectors in Austria, *Applied Economics* 27, 369-376.

Akcigit U., Ates S.T., 2023. What Happened to US Business Dynamism? *Journal of Political Economy* 131 (8), 2059-2124

Andrews D., Criscuolo C., Gal P., 2016. The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy, Productivity Working Papers No. 5, OECD, Paris.

Assad S., Clark R., Ershov D., Xu L., 2024. Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market, *Journal of Political Economy* 132(3), 723-771.

Backus M., 2020. Why is Productivity Correlated with Competition? *Econometrica* 88 (6), 2415-2444.

Badinger H., Breuss F., 2005. Has Austria's Accession to the EU Triggered an Increase in Competition? A Sectoral Markup Study, *Empirica* 32, 145-180.

Bain, J. S. (1950). Workable Competition in Oligopoly: Theoretical Considerations and Some Empirical Evidence. *American Economic Review* 40(2), 35–47.

Bain J.S., 1951. Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936–1940, *Quarterly Journal of Economics*, 65(3), 293–324.

Bajgar M., Berlingieri G., Calligaris S., Criscuolo C., Timmis J., 2019. Industry Concentration in Europe and North America, Productivity Working Paper 18, OECD, Paris.

Bajgar M., Criscuolo C., Timmis J., 2021. Intangibles and Industry Concentration, Science,Technology and Industry Working Papers 12, OECD, Paris.

Bambalaite I., Nicoletti G., von Rueden C., 2020. Occupational entry regulations and their effects on productivity in services: Firm-level evidence, OECD Economics Department Working Papers, No. 1605, OECD, Paris.

Belleflamme P., Peitz M., 2015. Industrial Organization: Markets and Strategies, Cambridge: Cambridge University Press

Bender C.M., Götz G., Pakula B., 2011. Effective Competition: Its Importance and Reelvance for Network Industries, *Intereconomics* 2011(1), 4–10.

Berlingieri G., Blanchenay P., Calligaris S., Criscuolo C., 2017. The Multiprod Project: A Comprehensive Overview, OECD Science, Technology and Industry Working Papers 2017/04, OECD, Paris.

Berry S., Gaynor M., Morton F.S., 2019. Do Increasing Markups Matter? Lessons from Empirical Industrial Organization. *Journal of Economic Perspectives* 33 (3): 44–68.

Böheim M., 2008. Reformoptionen zur Wettbewerbspolitik in Österreich, *WIFO-Monatsberichte* 81(6), 449-45.

Böheim M., 2013. Wettbewerbsmonitoring im Spannungsfeld zwischen ökonomischen Gestaltungsmöglichkeiten und wettbewerbspolitischen Erwartungen, *WIFO-Monatsberichte* 86(3), 225-336.

Böheim M., Pennerstorfer D., Sinabell F., 2016. Strukturanpassung im österreichischen Lebensmittelhandel. Auswirkung auf die Versorgung und wettbewerbsökonomische Implikationen, WIFO-Monatsberichte 89 (3), 171-183.

Bresnahan T. F., 1989. Empirical Studies of Industries with Market Power, in: Schmalensee R., Willig R. (eds), Handbook of Industrial Organization, Vol. 2, Amsterdam: North Holland, 1011–57.

Bresnahan T.F., Brynjolfsson E., Hitt L.M., 2002. Information Technology, Workplace Organisation, and the Demand for Skilled Labor: Firm-level Evidence, *Quarterly Journal of Economics* 117 (1), 339-376.

Bundeswettbewerbsbehörde, 2023A. Branchenuntersuchung Lebensmittel: Executive Summary, BWB, Wien.

Bundeswettbewerbsbehörde, 2023B. FAQ Baukartell - Ermittlungen der Bundeswettbewerbsbehörde, Stand Dezember 2023, BWB, Wien.

Calligaris S., Chaves M., Criscuolo C., de Lyon J., Greppi A., Pallanch O., 2024. Exploring the Evolution and the State of Competition in the EU, https://competition-policy.ec.europa.eu/system/files/2024-06/Exploring_the_evolution_and_the_state_of_competition_in_the_EU_launch.pdf

Carr J., Davies S., 2022. Seller versus Producer Concentration: Incorporating the Impact of Foreign Trade, CCP Working Paper 22-05, University of East Anglia, Norwich.

Cavalleri M.C., Eliet A., McAdam P., Petroulakis F., Soares A., Vansteenkiste I., 2019. Concentration, Market Power and Dynamism in the Euro Area, Discussion Paper No. 2253/March 2019, European Central Bank, Frankfurt am Main.

Chamberlin E.D., 1933. The Theory of Monopolistic Competition, Cambridge University Press, Cambridge UK.

Clark J.M., 1940. Toward a Concept of Workable Competition, *American Economic Review* 30 (2), 241-256.

Davies S., 2021. Competition and Concentration: Charting the Faultlines, CCP Working Paper 21-11, University of East Anglia, Norwich.

De Loecker J., Eeckhout J., Unger G., 2020. The Rise of Market Power and the Macroeconomic Implications. *Quarterly Journal of Economics* 135(2), 561–644.

De Loecker J., Warzynski F., 2012. Markups and Firm-Level Export Status. *American Economic Review*, 102(6), 2437–2471.

Decker R., Haltiwanger J., Jarmin R.S., Miranda J., 2014. The Role of Entrepreneurship in US Job Creation and Economic Dynamism, *Journal of Economic Perspectives* 28 (3), 3-24.

Decker R., Haltiwanger J., Jarmin R.S., Miranda J., 2016. Where Has All the Skewness Gone? The Decline in High-growth (young) firms in the U.S, *European Economic Review* 86, 4-23.

Decker R., Williams J., 2023. A Note on Industry Concentration Measurement, FEDS Notes No. 2023-02-03, http://dx.doi.org/10.17016/2380-7172.3256

Demsetz H., 1982. Economic, Legal, and Political Dimensions of Competition, North-Holland, (125 Seiten).

Eeckhout J., 2021. Book Review: The Great Reversal by Thomas Philippon, Journal of Economic Literature 59 (4), 1340-1360.

Elsinger H., Schmidt-Dengler P., Zulehner C., 2019. Competition in Treasury Auctions *American Economic Journal: Microeconomics* 11(1), 1-29.

Erharter D., 2015. Arbeitspapier Wettbewerbsmonitoring, BWB, Wien.

Fink N., Schmidt-Dengler P., Stahl K., Zulehner C., 2017. Registered Cartels in Austria. An Overview, *European Journal of Law and Economics* 44 (3), 385-422.

Firgo M., Kügler A., 2018. Cooperative pricing in spatially differentiated markets, *Regional Science and Urban Economics* 73, 51-67.

Firgo M., Pennerstorfer D., Weiss C.R., 2015. Centrality and pricing in spatially differentiated markets: The case of gasoline, *International Journal of Industrial Organization* 40, 81-90.

Firgo M., Pennerstorfer D., Weiss C.R., 2016. Network Centrality and Market Prices: Empirical Evidence, *Economics Letters* 139, 79-83.

Fritz O., Burton A., Ehn-Fragner S., Laimer P., Orsolic I., Weiß J., 2022. Auswirkungen von COVID-19 auf die österreichische Tourismus- und Freizeitwirtschaft im Jahr 2021, WIFO, Vienna.

Ganglmair B., Hahn N., Hellwig M, Kann A., Peters B. Tsanko I. (2020). Price Markups, Innovation, and Productivity: Evidence from Germany, Bertelsmann Stiftung, Gütersloh.

Grullon G., Larkin Y., Michaely R., 2019. Are US Industries Becoming More Concentrated?, Review of Finance 23 (4): 697–743.

Gugler K., Heim S., Janssen M., Liebensteiner M., 2023. Incumbency Advantages: Price Dispersion, Price Discrimination, and Consumer Search at Online Platforms, *Journal of Political Economy Microeconomics* 1 (3), 517-556.

Gugler K., Weichselbaumer M., Zulehner C., 2015. Competition in the economic crisis: Analysis of procurement auctions, *European Economic Review* 73, 35-57.

Gutiérrez G., Philippon T., 2017. Declining Competition and Investment in the U.S., NBER Working Paper 23583.

Hall R. E. 1988. The Relation between Price and Marginal Cost in U.S. Industry. Journal of Political Economy 96 (5): 921–47.

Harsdorf-Borsch N., Felbermayr G., 2023. Auch Wettbewerb ist ein Mittel gegen die Inflation, *Der Standard* Kommentar der Anderen, 2.12.2023: https://www.derstandard.at/story/3000000197893/auch-wettbewerb-ist-ein-mittel-gegen-die-inflation

Hayek F.A., 1945. The Use of Knowledge in Society, *The American Economic Review* 35, 519 530

Hayek F.A., 1946. The Meaning of Competition, Stafford Little Lecture at Princeton University, May 20, 1946; reprinted in Hayek F.A. (1948), *Individualism and Economic Order*, University of Chicago Press, Chicago, pp. 92-106.

Irlacher M., Pennerstorfer D., Renner A., Unger F., 2023. Modeling Interregional Patient Mobility: Theory and Evidence from Spatially Explicit Data, *International Economic Review* 64(4), 1493-1532.

Janger J., Schmidt-Dengler P., 2010. The Relationship between Competition and Inflation, *Monetary Policy & the Economy* Q1, 53-65.

Johnson J.P., Rhodes A., Wildenbeest M. (2023). Platform Design When Sellers Use Pricing Algorithms, *Econometrica* 91(5), 1841–1879.

Kasberger B., Martin S., Normann H.T., Tobias W., 2024. Algorithmic Cooperation, CESifo Working Paper No. 11124.

Koltay G., Lorincz S., Valetti T., 2022. Concentration and competition: Evidence from Europe and implications for policy, Working Paper No. 9640, CESifo, Munich.

Konczal M., Lusiani N., 2022. Prices, Profits, and Power: An Analysis of 2021 Firm-Level Markups, Brief, The Roosevelt Institute, New York: https://rooseveltinstitute.org/publications/prices-profits-and-power

Kouvavas O., Osbat C, Reinelt T., Vansteenkiste I., 2021. Markups and inflation cyclicality in the Euro Area. Working Paper No. 2617, ECB, Frankfurt.

Kwon S.Y., Ma Y., Zimmermann K., 2024. 100 Years of Rising Corporate Concentration, *American Economic Review* 114 (7): 2111–40.

Leibenstein H., 1966. Allocative Efficiency vs. 'X-Efficiency', *American Economic Review* 56 (3), 392-415

Littlechild S., 2011. The Nature of Competition and the Regulatory Process, *Intereconomics* 2011(1), 10–17.

Loy J.-P., Pennerstorfer D., Rroshi D., Weiss C., Yontcheva B., 2022. Consumer Information and Price Transmission: Empirical Evidence, *Journal of Industrial Economics* 70, 631-683.

Mason E.S., 1939. Price and Production Policies of Large-Scale Enterprise. *American Economic Review* 29(1), 61–74. https://www.jstor.org/stable/1806955

Mason, E.S. (1949). The Current Status of the Monopoly Problem in the United States, The Harvard Law Review Association, *Harvard Law Review* 62, S. 1265–1285

McNulty P.J., 1967. A Note on the History of Perfect Competition, *Journal of Political Economy* 75 (4), 395-399.

McNulty P.J., 1968. Economic Theory and the Meaning of Competition, *Quarterly Journal of Economics* 82 (4), 639-656.

Melitz M.J., Polanec S., 2015. Dynamic Olley-Pakes Productivity Decomposition with Entry and Exit, *Rand Journal of Economics* 46 (2): 362–375.

Miller N.H., 2024. Industrial Organization and the Rise of Market Power, NBER Working Paper No. 32627, Available at SSRN: https://ssrn.com/abstract=4881206.

Monopolkommission. 2022. Wettbewerb 2022. XXIV. Hauptgutachten der Monopolkommission gemäß § 44 Abs. 1 Satz 1 GWB, Bonn.

OECD, 2024. OECD Services Trade Restrictiveness Index (STRI) - Austria: https://www.oecd.org/trade/topics/services-trade/documents/oecd-stri-country-note-aut.pdf

Olley G.S., Pakes A., 1996. The Dynamics of Productivity in the Telecommunications Equipment Industry, *Econometrica* 64(6), 1263-1297.

Peneder M., 2017. Competitiveness and Industrial Policy. From Rationalities of Failure Towards the Ability to Evolve, *Cambridge Journal of Economics* 41, 829-858.

Peneder M., Bittschi B., Köppl A., Mayerhofer P., Url T., Bärenthaler-Sieber S., Böheim M., 2023. Wettbewerbsfähigkeit und nachhaltige Entwicklung der österreichischen Wirtschaft, WIFO, Wien.

Peneder M., Kaniovski S., Dachs B., 2003. What Follows Tertiarisation? Structural Change and the Role of Knowledge Based Services, *The Service Industries Journal* 23 (2), 47-66.

Peneder M., Prettner C., 2021. Entwicklung der Produktivität österreichischer Unternehmen von 2008 bis 2018. Auswertung von Mikrodaten für Österreich im Rahmen von Multiprod 2.0, WIFO, Wien.

Peneder M., Unterlass F., 2024. Die Produktivitätsentwicklung österreichischer Unternehmen in den Jahren 2013 bis 2020. Eine Auswertung von Mikrodaten. WIFO-Monatsberichte 1/2024, 43-56.

Pennerstorfer D., 2017. Can Competition Keep the Restrooms Clean? Price, Quality and Spatial Competition, *Regional Science and Urban Economics* 64, 117-136.

Pennerstorfer D., Schmidt-Dengler P., Schutz N., Weiss C., Yontcheva B., 2020. Information and Price Dispersion: Theory and Evidence, *International Economic Review* 61, 871-899.

Pennerstorfer D., Weiss C., 2013. Spatial Clustering and Market Power: Evidence from the Retail Gasoline Market, *Regional Science and Urban Economics* 43, 661-675.

Reiner C., Bellak C., 2023A. Hat die Macht von Unternehmen in Österreich zugenommen? Teil 1, *Wirtschaft und Gesellschaft* 49 (1), 21-59.

Reiner C., Bellak C., 2023B. Hat die Macht von Unternehmen in Österreich zugenommen? Teil 2, *Wirtschaft und Gesellschaft* 49 (2), 17-76.

Rhodes A., Zhou J., 2024. Personalized Pricing and Competition, *American Economic Review* 114 (7), 2141–70.

Robbins L., 1932. An Essay on the Nature and Significance of Economic Science, Macmillan, London.

Rubens M., 2023. Market Structure, Oligopsony Power, and Productivity, *American Economic Review* 113 (9), 2382-2410.

Ruede C.v., Bambalaite I., 2020.Measuring Occupational Entry Regulations: A New OED Approach, OECD, Paris.

Schmalensee R., 1989. Inter-industry Studies of Structure and Performance, in: Schmalensee R., Willig R. (eds), Handbook of Industrial Organization, Vol. 2, Amsterdam: North Holland, 951–1009.

Schumpeter, J.A. 1911. *Theorie der wirtschaftlichen Entwicklung*, 4th edition. Duncker & Humblot, Berlin

Schumpeter J.A., [HEA] 1954. History of Economic Analysis, Oxford: Oxford University Press.

Smith A., 1776. An Inquiry into the Nature and Causes of the Wealth of Nations, London: Strahan and Caddel, vol. 1&2; quotation from reprint by Liberty Press, Indianapolis (1981).

Statistik Austria, 2022. Standard-Dokumentation Metainformationen (Definitionen, Erläuterungen, Methoden, Qualität) zur Leistungs- und Strukturstatistik, STAT, Vienna.

Stigler G.J., 1957. Perfect Competition, Historically Contemplated, *Journal of Political Economy* 65(1), 1-17.

Stigler G.J., 2017. Competition, *The New Palgrave Dictionary of Economics*, Palgrave Macmillan, London.

Sutton J., 1991. Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration. Cambridge, MA: MIT Press.

Sutton, John. 1998. Technology and Market Structure: Theory and History. Cambridge, MA: MIT Press.

Syverson C., 2019. Macroeconomics and Market Power: Context, Implications, and Open Questions, Journal of Economic Perspectives 33 (3): 23–43.

Teece D.J., 2023. The Dynamic Competition Paradigm: Insights and Implications, *Columbia Business Law Review* Vol 2023 (1), 373-461.

Tirole J., 1990. The Theory of Industrial Organization, MIT-Press, Cambrdidge MA.

Traina J., 2018. Is Aggregate Market Power Increasing? Production Trends Using Financial Statements, Working Paper No. 272, University of Chicago Booth Schoold of Business, Chicago.

Weche J.P., Wambach A., 2018. The Fall and Rise ofMarket Power in Europe, ZEW Discussion Paper No. 18-003.

Weiss C., 2000. Mark-ups, industry structure and the business cycle, *Applied Economics Letters* 7(3), 189-191.

Wooldridge J., 2009. On estimating firm-level production functions using proxy unobservables, *Economics Letters* 104 (3), 112-114.

Annex

A.1 Supplementary tables

Table A.1: Industry concentration (NACE 3-digit) in 2020

NACE	Industry	HHI	CR4	CR8	CR20
61	Extraction of crude petroleum	n.a.	n.a.	n.a.	n.a.
71	Mining of iron ores	n.a.	n.a.	n.a.	n.a.
81	Quarrying of stone. sand and clay	0.04	0.28	0.37	0.55
89	Mining and quarrying n.e.c.	0.34	0.90	0.98	1.00
91	Support activities for petroleum; natural gas extraction	0.45	1.00	1.00	1.00
99	Support activities for other mining and quarrying	n.a.	n.a.	n.a.	n.a.
101	Processing, preserving of meat; meat products	0.03	0.23	0.40	0.67
102	Processing. preserving of fish, crustaceans, molluscs	n.a.	n.a.	n.a.	n.a.
103	Processing and preserving of fruit and vegetables	0.18	0.69	0.87	1.00
104	Manufacture of vegetable and animal oils and fats	0.30	0.86	1.00	1.00
105	Manufacture of dairy products	0.14	0.59	0.78	0.97
106	Grain mill products, starches and starch products	0.32	0.75	0.85	0.98
107	Manufacture of bakery and farinaceous products	0.03	0.27	0.39	0.56
108	Manufacture of other food products	0.03	0.26	0.42	0.72
109	Manufacture of prepared animal feeds	0.11	0.55	0.75	0.98
110	Manufacture of beverages	0.42	0.82	0.89	0.96
131	Preparation and spinning of textile fibres	0.48	1.00	1.00	1.00
132	Weaving of textiles	0.46	0.88	0.95	1.00
133	Finishing of textiles	0.16	0.71	1.00	1.00
139	Manufacture of other textiles	0.05	0.37	0.53	0.77
141	Manufacture of wearing apparel, w/o fur apparel	0.07	0.44	0.65	0.88
143	Manufacture of knitted and crocheted apparel	0.78	1.00	1.00	1.00
151	Tanning, dressing of leather, fur; handbags, etc.	0.41	1.00	1.00	1.00
152	Manufacture of footwear	0.18	0.76	0.93	1.00
161	Sawmilling and planing of wood	0.03	0.28	0.42	0.66
162	Products of wood, cork, straw and plaiting materials	0.04	0.32	0.44	0.63

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	Industry	HHI	CR4	CR8	CR20
171	Manufacture of pulp, paper and paperboard	0.08	0.46	0.72	1.00
172	Manufacture of articles of paper and paperboard	0.05	0.34	0.55	0.81
181	Printing and service activities related to printing	0.03	0.24	0.36	0.58
182	Reproduction of recorded media	n.a.	n.a.	n.a.	n.a.
192	Manufacture of refined petroleum products	n.a.	n.a.	n.a.	n.a.
201	Basic chemicals, fertilisers, plastics, etc. in primary forms	0.47	0.80	0.88	0.98
202	Manufacture of pesticides and other agrochemical products	n.a.	n.a.	n.a.	n.a.
203	Paints, varnishes and similar coatings, printing ink, etc.	0.13	0.64	0.93	1.00
204	Soap, detergents, cleaning; perfumes, toilet preparations	0.13	0.61	0.80	0.99
205	Manufacture of other chemical products	0.15	0.66	0.80	1.00
206	Manufacture of man-made fibres	0.68	1.00	1.00	1.00
211	Manufacture of basic pharmaceutical products	0.83	0.99	1.00	1.00
212	Manufacture of pharmaceutical preparations	0.11	0.61	0.80	0.98
221	Manufacture of rubber products	0.44	0.93	0.99	1.00
222	Manufacture of plastic products	0.02	0.23	0.33	0.54
231	Manufacture of glass and glass products	0.15	0.64	0.78	0.96
232	Manufacture of refractory products	0.69	0.96	1.00	1.00
233	Manufacture of clay building materials	0.33	0.81	0.95	1.00
234	Manufacture of other porcelain, ceramic products	0.37	0.96	1.00	1.00
235	Manufacture of cement, lime and plaster	0.18	0.74	1.00	1.00
236	Manufacture of articles of concrete, cement, plaster	0.02	0.21	0.33	0.53
237	Cutting, shaping and finishing of stone	0.07	0.40	0.51	0.72
239	Abrasive and non-metallic mineral products n.e.c.	0.11	0.56	0.70	0.82
241	Basic iron and steel, ferro-alloys	0.27	0.76	0.92	1.00
242	Tubes, pipes, hollow profiles and related fittings, of steel	0.20	0.75	0.96	1.00
243	Other products of first processing of steel	0.19	0.79	0.99	1.00
244	Manufacture of basic precious, other non-ferrous metals	0.09	0.49	0.77	0.99

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	Industry	HHI	CR4	CR8	CR20
245	Casting of metals	0.07	0.40	0.64	0.94
251	Manufacture of structural metal products	0.01	0.15	0.24	0.40
252	Tanks, reservoirs and containers of metal	0.09	0.50	0.70	0.95
253	Steam generators, except central heating water boilers	n.a.	n.a.	n.a.	n.a.
254	Manufacture of weapons and ammunition	0.72	0.99	1.00	1.00
255	Metal processing; powder metallurgy	0.11	0.64	0.78	0.94
256	Treatment and coating of metals; machining	0.15	0.50	0.56	0.68
257	Manufacture of cutlery, tools and general hardware	0.19	0.60	0.73	0.86
259	Manufacture of other fabricated metal products	0.04	0.27	0.41	0.68
261	Manufacture of electronic components and boards	0.39	0.87	0.94	1.00
262	Manufacture of computers and peripheral equipment	0.30	0.99	1.00	1.00
263	Manufacture of communication equipment	0.19	0.77	1.00	1.00
264	Manufacture of consumer electronics	0.54	1.00	1.00	1.00
265	Manufacture of instruments: measuring, testing; watches	0.06	0.39	0.55	0.82
266	Manufacture of electromedical/-therapeutic equipment	0.39	0.95	0.99	1.00
267	Manufacture of optical instruments, photographic equipment	0.33	0.83	1.00	1.00
271	Electric motors, generators, transformers; appliances	0.09	0.54	0.73	0.90
272	Manufacture of batteries and accumulators	0.43	0.99	1.00	1.00
273	Manufacture of wiring and wiring devices	0.19	0.75	0.91	1.00
274	Manufacture of electric lighting equipment	0.27	0.84	0.94	1.00
275	Manufacture of domestic appliances	0.15	0.64	0.83	1.00
279	Manufacture of other electrical equipment	0.17	0.64	0.79	0.98
281	Manufacture of general-purpose machinery	0.06	0.39	0.54	0.80
282	Manufacture of other general-purpose machinery	0.03	0.27	0.46	0.66
283	Manufacture of agricultural and forestry machinery	0.16	0.70	0.80	0.93
284	Manufacture of metal forming machinery, machine tools	0.07	0.43	0.64	0.89
289	Manufacture of other special-purpose machinery	0.05	0.38	0.50	0.69

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	**Industry**	**HHI**	**CR4**	**CR8**	**CR20**
291	Manufacture of motor vehicles	0.29	0.88	1.00	1.00
292	Manufacture of motor vehicles: bodies and (semi-)trailers	0.10	0.52	0.68	0.93
293	Manufacture of motor vehicles: parts & accessories	0.09	0.49	0.64	0.89
301	Building of ships and boats	n.a.	n.a.	n.a.	n.a.
302	Manufacture of railway locomotives, rolling stock	0.35	0.98	1.00	1.00
303	Manufacture of air & spacecraft, related machinery	0.24	0.83	0.97	1.00
304	Manufacture of military fighting vehicles	n.a.	n.a.	n.a.	n.a.
309	Manufacture of transport equipment n.e.c.	0.39	0.96	1.00	1.00
310	Manufacture of furniture	0.01	0.16	0.28	0.45
321	Manufacture of jewellery, bijouterie, etc.	0.93	0.98	0.99	1.00
322	Manufacture of musical instruments	0.32	0.92	1.00	1.00
323	Manufacture of sports goods	0.18	0.73	0.85	0.97
324	Manufacture of games and toys	0.28	0.89	1.00	1.00
325	Manufacture of medical & dental instruments, supplies	0.09	0.55	0.69	0.83
329	Manufacturing n.e.c.	0.10	0.56	0.78	0.98
331	Repair of metal products, machinery, equipment	0.13	0.62	0.67	0.76
332	Installation of industrial machinery and equipment	0.04	0.29	0.45	0.70
351	Electric power generation, transmission, distribution	0.04	0.32	0.48	0.81
352	Gas manufacture and distribution through mains	0.79	0.95	0.98	1.00
353	Steam and air conditioning supply	0.17	0.74	0.81	0.89
360	Water collection, treatment and supply	0.29	0.73	0.80	0.92
370	Sewerage	0.13	0.49	0.54	0.65
381	Waste collection	0.05	0.35	0.52	0.67
382	Waste treatment and disposal	0.04	0.30	0.43	0.64
383	Materials recovery	0.18	0.56	0.68	0.86
390	Remediation and other waste management services	0.25	1.00	1.00	1.00
411	Development of building projects	0.01	0.15	0.24	0.42

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	**Industry**	**HHI**	**CR4**	**CR8**	**CR20**
412	Construction: (non-)residential buildings	0.01	0.11	0.18	0.29
421	Construction: roads and railways	0.16	0.72	0.80	0.90
422	Construction: utility projects	0.03	0.25	0.42	0.69
429	Construction: other civil engineering projects	0.22	0.75	0.88	1.00
431	Demolition and site preparation	0.03	0.24	0.33	0.50
432	Electrical, plumbing, etc. installation	0.00	0.09	0.14	0.25
433	Building completion and finishing	0.00	0.08	0.11	0.19
439	Other specialised construction activities	0.01	0.09	0.15	0.26
451	Sale of motor vehicles	0.03	0.30	0.38	0.50
452	Maintenance and repair of motor vehicles	0.01	0.13	0.20	0.32
453	Sale of motor vehicle parts and accessories	0.04	0.29	0.42	0.62
454	Sale, maintenance, repair of motorcycles & parts	0.34	0.83	0.89	0.94
461	Wholesale on a fee or contract basis	0.08	0.51	0.69	0.89
462	Wholesale agricultural materials, live animals	0.03	0.26	0.35	0.55
463	Wholesale food, beverages and tobacco	0.02	0.25	0.35	0.50
464	Wholesale of household goods	0.01	0.16	0.21	0.33
465	Wholesale information & communication equipment	0.10	0.47	0.58	0.73
466	Wholesale other machinery, equipment, supplies	0.01	0.09	0.15	0.24
467	Other specialised wholesale	0.02	0.23	0.33	0.48
469	Non-specialised wholesale trade	0.09	0.54	0.73	0.85
471	Retail sale in non-specialised stores	0.16	0.72	0.86	0.92
472	Retail of food, beverages, tobacco, specialised	0.04	0.28	0.39	0.57
473	Retail of automotive fuel, specialised	0.03	0.27	0.44	0.57
474	Retail of ICT equipment, specialised	0.02	0.14	0.24	0.43
475	Retail of other household equipment, specialised	0.07	0.44	0.60	0.70
476	Retail cultural & recreation goods, specialised	0.04	0.31	0.44	0.59
477	Retail sale of other goods in specialised stores	0.02	0.20	0.28	0.40

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	Industry	HHI	CR4	CR8	CR20
478	Retail sale via stalls and markets	0.38	1.00	1.00	1.00
479	Retail trade not in stores, stalls or markets	0.05	0.35	0.53	0.70
491	Passenger rail transport, interurban	0.91	1.00	1.00	1.00
492	Freight rail transport	0.35	0.89	0.95	1.00
493	Other passenger land transport	0.06	0.32	0.37	0.49
494	Road freight transport and removal services	0.06	0.33	0.39	0.47
495	Transport via pipeline	n.a.	n.a.	n.a.	n.a.
503	Inland passenger water transport	0.35	0.81	0.99	1.00
504	Inland freight water transport	n.a.	n.a.	n.a.	n.a.
511	Passenger air transport	0.21	0.82	0.90	0.96
512	Freight air transport and space transport	0.46	0.98	1.00	1.00
521	Warehousing and storage	0.08	0.49	0.75	0.92
522	Support activities for transportation	0.05	0.36	0.46	0.60
531	Postal services under universal service obligation	n.a.	n.a.	n.a.	n.a.
532	Other postal and courier activities	0.06	0.41	0.63	0.88
551	Hotels and similar accommodation	0.00	0.04	0.06	0.11
552	Holiday and other short-stay accommodation	0.04	0.31	0.45	0.74
553	Camping grounds, recreational vehicle & trailer parks	0.05	0.32	0.52	0.94
559	Other accommodation	0.14	0.61	0.83	1.00
561	Restaurants, mobile food services	0.00	0.05	0.08	0.14
562	Event catering, other food services	0.06	0.42	0.58	0.74
563	Beverage serving activities	0.05	0.34	0.46	0.74
581	Publishing of books, periodicals, etc.	0.06	0.34	0.45	0.62
582	Software publishing	0.06	0.38	0.59	0.84
591	Motion picture, video & television programming	0.26	0.61	0.69	0.82
592	Sound recording and music publishing	0.13	0.62	0.87	1.00
601	Radio broadcasting	0.13	0.59	0.83	1.00

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	**Industry**	**HHI**	**CR4**	**CR8**	**CR20**
602	Television programming and broadcasting	0.38	0.85	0.98	1.00
611	Wired telecommunications activities	0.15	0.69	0.89	0.98
612	Wireless telecommunications activities	0.35	0.95	0.99	1.00
619	Other telecommunications activities	0.09	0.56	0.72	0.92
620	Computer programming, consultancy, etc.	0.02	0.20	0.28	0.41
631	Data processing, hosting, etc.; web portals	0.04	0.34	0.50	0.70
639	Other information service activities	0.16	0.71	0.86	1.00
681	Buying and selling of own real estate	0.02	0.20	0.32	0.51
682	Rental and operating of own or leased real estate	0.02	0.18	0.24	0.37
683	Real estate activities on a fee or contract basis	0.01	0.14	0.22	0.38
691	Legal activities	0.01	0.13	0.21	0.32
692	Accounting, bookkeeping, auditing; tax consultancy	0.01	0.16	0.25	0.41
701	Activities of head offices	0.03	0.27	0.40	0.57
702	Management consultancy activities	0.18	0.50	0.55	0.64
711	Architectural, engineering and related services	0.03	0.24	0.29	0.39
712	Technical testing and analysis	0.05	0.32	0.44	0.65
721	Research & development: natural sciences, engineering	0.06	0.38	0.50	0.70
722	Research & development: social sciences, humanities	0.27	0.92	1.00	1.00
731	Advertising	0.01	0.17	0.27	0.45
732	Market research and public opinion polling	0.09	0.48	0.64	0.91
741	Specialised design activities	0.19	0.65	0.82	1.00
742	Photographic activities	0.29	0.71	0.86	1.00
743	Translation and interpretation activities	0.12	0.57	0.85	1.00
749	Other professional, scientific and technical activities n.e.c.	0.04	0.31	0.46	0.72
750	Veterinary activities	0.01	0.13	0.20	0.34
771	Rental and leasing of motor vehicles	0.09	0.52	0.69	0.91
772	Rental and leasing of personal and household goods	0.13	0.63	0.77	0.91

Table A.1: Industry concentration (NACE 3-digit) in 2020 ctd.

NACE	**Industry**	**HHI**	**CR4**	**CR8**	**CR20**
773	Rental, leasing of other machinery, equipment, tangible goods	0.03	0.28	0.44	0.68
774	Leasing of intellectual property, etc., except if copyrighted	0.32	0.92	0.99	1.00
781	Activities of employment placement agencies	0.15	0.60	0.72	0.90
782	Temporary employment agency activities	0.02	0.19	0.29	0.45
783	Other human resources provision	0.03	0.26	0.35	0.54
791	Travel agency and tour operator activities	0.04	0.34	0.47	0.69
799	Other reservation service and related activities	0.10	0.52	0.79	1.00
801	Private security activities	0.12	0.65	0.80	0.90
802	Security systems service activities	0.29	1.00	1.00	1.00
803	Investigation activities	0.19	0.84	1.00	1.00
811	Combined facilities support activities	0.04	0.31	0.50	0.78
812	Cleaning activities	0.02	0.22	0.34	0.52
813	Landscape service activities	0.01	0.13	0.20	0.36
821	Office administrative and support activities	0.09	0.51	0.72	0.99
822	Activities of call centres	0.08	0.49	0.64	0.86
823	Organisation of conventions and trade shows	0.05	0.34	0.52	0.85
829	Business support service activities n.e.c.	0.07	0.37	0.48	0.64
951	Repair of computers and communication equipment	0.15	0.70	0.91	1.00
952	Repair of personal and household goods	0.05	0.30	0.49	0.88
	Mean	0.161	0.529	0.653	0.790

Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Table A.2: Average change of employment after three years by percentile of the productivity distribution

Sector	**Labour productivity**					**Multifactor productivity**				
	1.	2./3.	4./5.	6./9.	10.	1.	2./3.	4./5.	6./9.	10.
Mining and quarrying	0.37	1.04	0.44	1.24	-5.27	n.a.	n.a.	n.a.	n.a.	n.a.
Food products, beverages, tobacco	0.14	1.05	0.85	2.65	4.02	0.79	0.76	1.38	2.60	3.52
Textiles, wearing apparel, etc.	-1.26	-6.80	-3.11	-0.27	3.18	-17.63	-1.88	-0.45	-0.38	0.94
Wood & paper products, printing	-0.52	-0.07	0.99	1.18	0.95	0.28	0.27	1.10	0.72	0.37
Coke, refined petroleum products	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Chemicals and chemical products	0.00	2.81	1.38	8.82	-7.61	16.35	4.07	-4.28	2.64	1.88
Basic pharmaceutical products	n.a.	4.50	8.07	27.37	n.a.	n.a.	n.a.	4.41	9.55	n.a.
Plastics, non-metallic mineral products	-1.39	0.62	0.75	2.42	2.70	-3.23	2.16	1.50	1.21	1.89
Basic metals and products	0.19	1.16	1.47	2.35	9.23	10.29	2.47	0.97	0.63	0.63
Computer, electronic, optical products	-0.28	1.89	9.60	6.80	12.63	38.93	5.24	3.50	1.68	2.06
Electrical equipment	-0.16	1.40	9.60	-13.73	10.49	-31.73	2.56	1.78	1.17	7.07
Machinery and equipment n.e.c.	-0.43	1.38	2.29	6.34	9.60	0.51	4.15	5.72	3.71	1.48
Transport equipment	2.66	10.66	1.58	11.90	34.12	92.16	18.16	3.35	1.87	1.30
Other manuf., repair of machinery	-0.11	-0.08	0.41	2.28	2.12	-0.12	0.45	0.88	0.95	3.57
Electricity, gas, steam, etc.	0.41	-1.81	0.85	-1.74	2.17	-11.04	-2.44	2.49	1.17	0.31
Water supply; sewerage, waste	-1.06	-0.30	0.94	0.38	0.46	-2.28	0.02	0.51	0.52	0.97
Construction	0.20	0.24	0.72	1.70	5.01	1.84	0.72	0.46	1.11	4.68
Sale and repair of motor vehicles	-0.91	1.63	1.85	2.32	2.04	0.32	0.23	0.30	1.19	11.29
Transportation and storage	0.84	3.55	1.38	1.64	3.06	9.69	1.67	1.31	1.16	0.90
Accommodation and food services	-0.91	0.34	0.48	0.11	1.62	0.29	0.41	0.53	0.28	0.30
Publishing, audiovisual, broadcasting	-0.82	-0.21	-0.38	2.65	2.35	-0.81	-0.20	-0.32	2.61	1.97
Telecommunications	n.a.	-0.65	2.21	n.a.	5.46	n.a.	14.20	-2.46	2.31	n.a.
IT and other information services	2.33	1.79	5.25	3.39	4.99	0.61	3.01	4.69	3.38	4.43
Real estate activities	-1.50	0.57	-5.14	-0.58	-0.03	-11.49	-0.42	-0.06	0.34	0.46
Legal, accounting activities, etc.	0.18	0.67	2.34	4.45	2.95	2.43	2.55	1.70	2.59	2.30
Scientific research & development	1.20	2.42	2.20	3.75	10.89	4.30	3.41	-0.98	3.71	1.14
Professional and technical services	10.41	-0.04	0.94	0.81	1.49	0.37	0.53	0.88	3.53	0.02
Administrative and support services	0.34	2.32	6.68	4.53	1.70	4.20	1.70	2.76	5.75	4.45
Other service activities	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Residential care and social work	n.a.	n.a.	1.17	-0.25	n.a.	n.a.	-2.44	1.17	-0.20	n.a.
Total	0.16	1.28	2.11	2.23	3.27	2.70	1.31	1.30	1.82	4.74

Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Table A.3: Average change of employment after five years by percentile of the productivity distribution

Sector	**Labour productivity**					**Multifactor productivity**				
	1.	2./3.	4./5.	6./9.	10.	1.	2./3.	4./5.	6./9.	10.
Mining and quarrying	0.40	0.89	0.32	1.52	-5.90	n.a.	n.a.	n.a.	n.a.	n.a.
Food products, beverages, tobacco	0.61	1.03	1.34	2.15	3.90	1.06	0.93	1.71	2.36	2.56
Textiles, wearing apparel, etc.	-1.10	-6.25	-4.05	-0.32	2.82	-17.52	-1.89	-0.69	-0.33	0.39
Wood & paper products, printing	0.40	0.05	1.11	1.07	1.00	0.77	0.46	1.43	0.66	-0.04
Coke and refined petroleum products	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Chemicals and chemical products	-0.07	2.91	2.02	8.64	-8.27	16.96	3.71	-3.66	3.03	2.08
Basic pharmaceutical products	n.a.	4.01	n.a.	n.a.	n.a.	n.a.	n.a.	8.13	6.03	n.a.
Plastics, non-metallic mineral products	-1.23	0.41	1.00	3.05	2.50	-2.96	1.95	1.90	1.56	1.81
Basic metals and products	0.04	1.07	1.56	2.64	10.07	10.61	2.43	1.29	0.49	0.68
Computer, electronic, optical products	0.85	2.21	9.90	8.22	14.14	48.90	5.50	2.74	2.06	1.87
Electrical equipment	3.39	1.74	11.25	-16.17	8.59	-37.30	3.54	2.42	1.00	3.97
Machinery and equipment n.e.c.	0.65	1.13	4.13	6.71	6.68	3.89	4.30	5.79	3.06	2.08
Transport equipment	6.20	2.91	20.65	9.12	33.00	67.87	18.20	4.89	1.84	1.28
Other manuf., repair of machinery	-0.49	0.22	0.34	2.39	3.02	0.29	0.41	0.97	1.47	3.40
Electricity, gas, steam, etc.	-1.27	-1.98	-1.35	-0.23	7.91	-9.73	-2.99	2.04	1.53	0.48
Water supply; sewerage, waste	-0.73	-0.66	1.09	0.25	0.67	-3.76	0.35	0.69	0.51	0.83
Construction	0.01	0.43	1.04	1.21	5.40	2.51	0.47	0.31	1.23	4.87
Sale and repair of motor vehicles	0.00	1.78	1.82	2.40	1.71	0.47	0.27	0.33	1.34	11.11
Transportation and storage	0.27	3.51	0.84	2.10	2.68	9.33	1.63	0.88	1.36	0.61
Accommodation and food services	-1.20	0.60	0.59	-0.08	1.79	0.16	0.27	0.61	0.43	0.39
Publishing, audiovisual, broadcasting	-0.91	-0.17	0.36	1.79	1.51	-1.04	-0.10	0.16	2.10	0.57
Telecommunications	n.a.	-0.57	0.70	n.a.	6.95	n.a.	15.73	-1.21	2.61	n.a.
IT and other information services	1.53	2.26	5.35	2.81	5.74	-0.10	2.87	5.06	3.26	4.98
Real estate activities	-1.82	0.36	-2.56	-0.73	0.08	-6.53	-0.43	0.06	0.00	0.56
Legal and accounting activities, etc.	-0.11	0.61	2.15	4.44	5.28	1.75	2.47	1.96	2.62	4.42
Scientific research and development	2.54	2.11	3.17	5.45	n.a.	5.23	3.28	0.65	2.00	0.19
Prof., scientific, technical services	11.98	-0.61	0.75	0.47	1.58	-0.40	0.57	0.37	3.70	-0.53
Administrative and support services	0.41	3.11	7.62	4.28	1.73	5.21	1.80	4.12	5.75	4.17
Other service activities	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Residential care and social work	n.a.	n.a.	n.a.	-1.02	n.a.	n.a.	n.a.	n.a.	-0.74	n.a.
Total	0.31	1.42	2.18	2.17	3.30	2.69	1.30	1.45	1.79	4.73

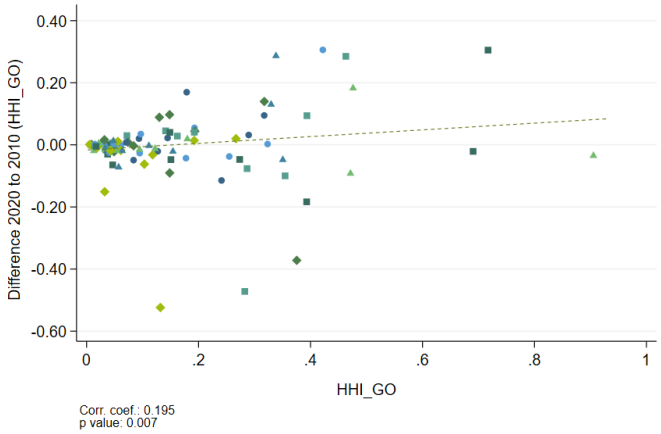
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

A.2 Supplementary figures

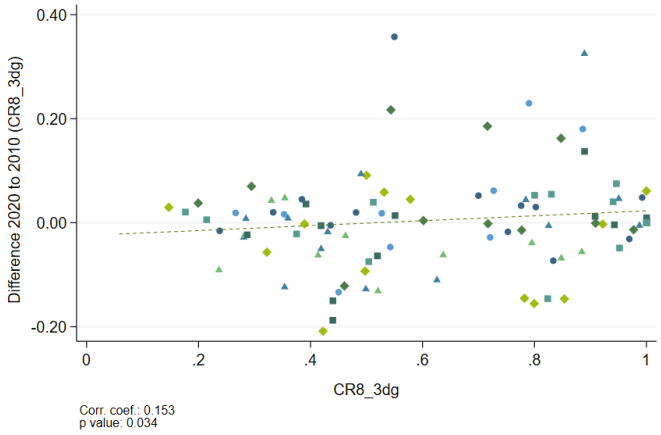
- Figure A.1: Industry concentration: level vs change (2008-2020)
- Figure A.2: The development of concentration from 2008 to 2020, unweighted mean of 3-digit industries for $CR-8$ and $CR-20$
- Figure A.3: Development of average markups by sector and size class, Index 2013 = 100
- Figure A.4 to Figure A.9: Development of average markups in selected sectors, index 2013 = 100
- Figure A.10: Average markups, fixed capital investments and intermediate inputs

Figure A.1: Industry concentration: level vs change (2008-2020)

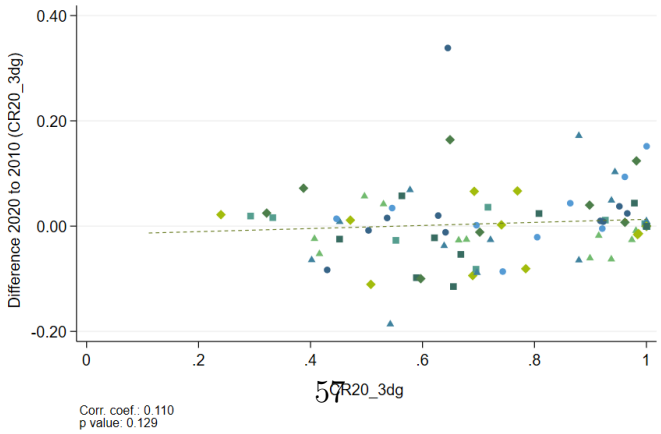
(a) HHI



(b) $CR8$



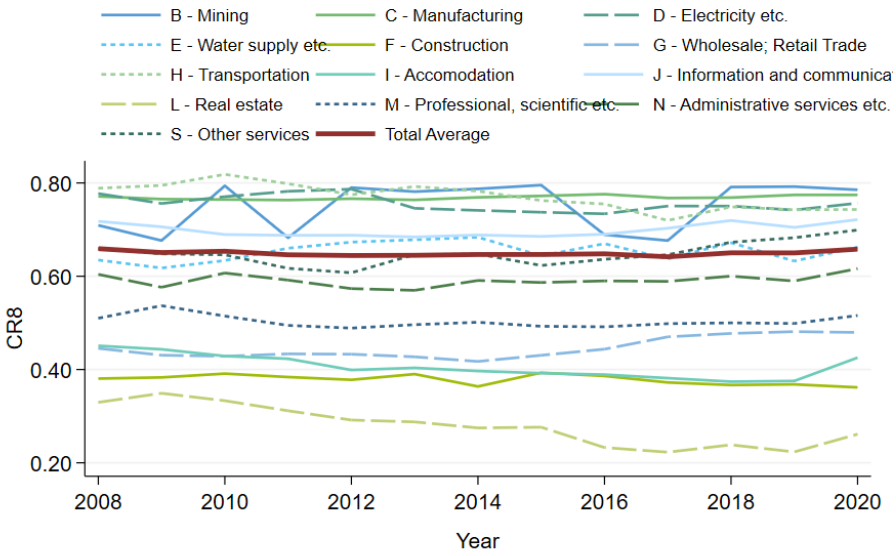
(c) $CR20$



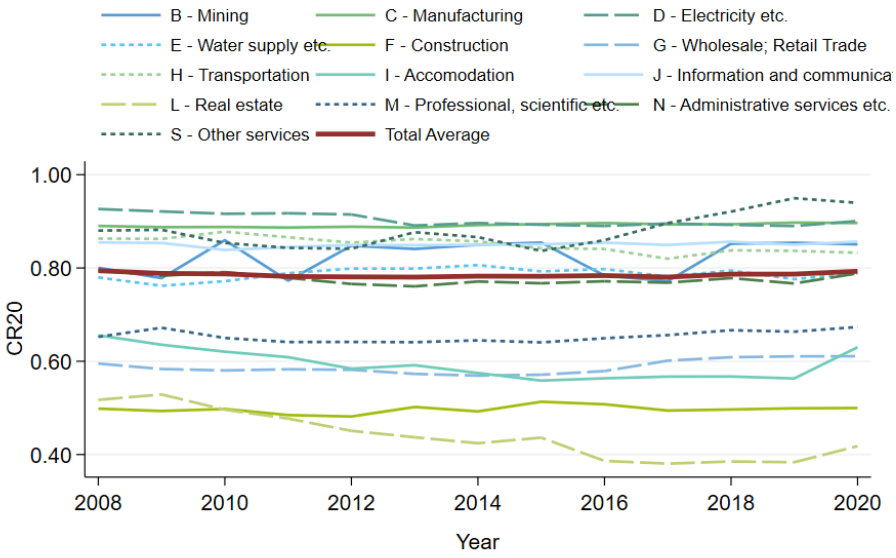
Source: OECD, STAT, WIFO calculations.

Figure A.2: The development of concentration from 2008 to 2020, unweighted mean of 3-digit industries for $CR-8$ and $CR-20$

(a) $CR-8$

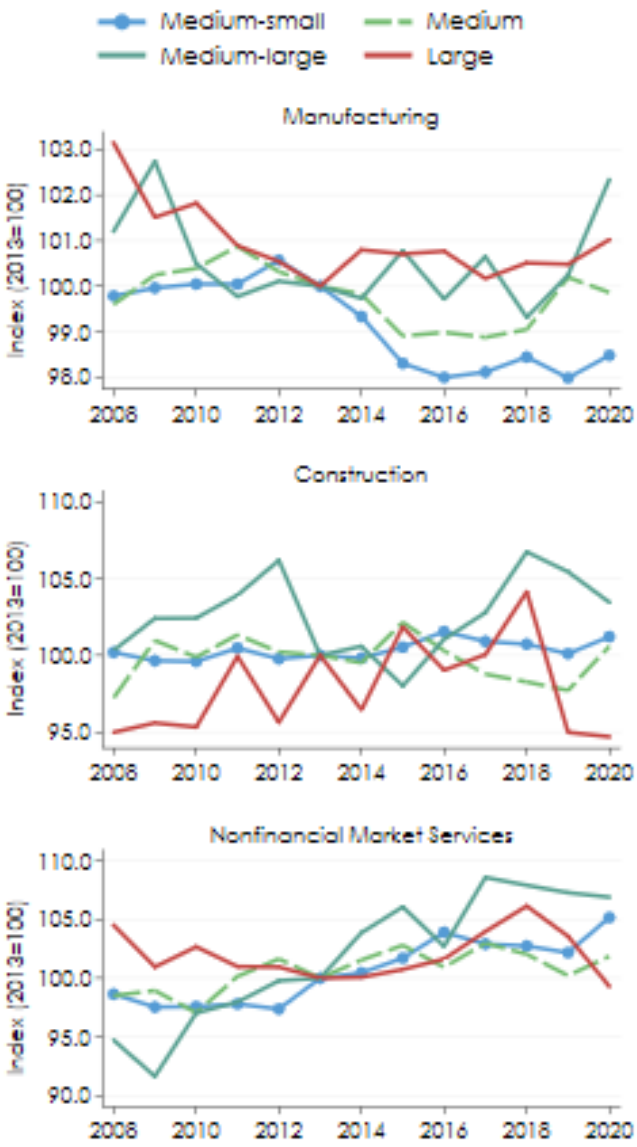


(b) $CR-20$



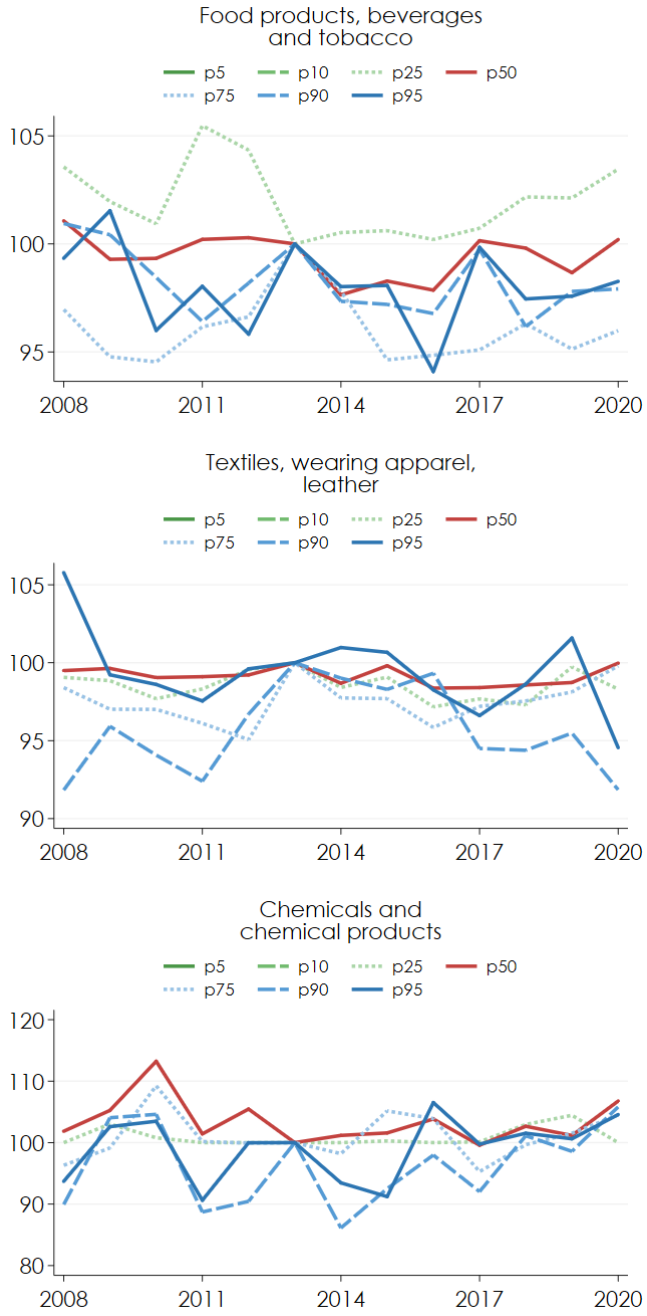
Source: OECD, STAT, WIFO calculations.

Figure A.3: Development of average markups by sector and size class, Index 2013 = 100



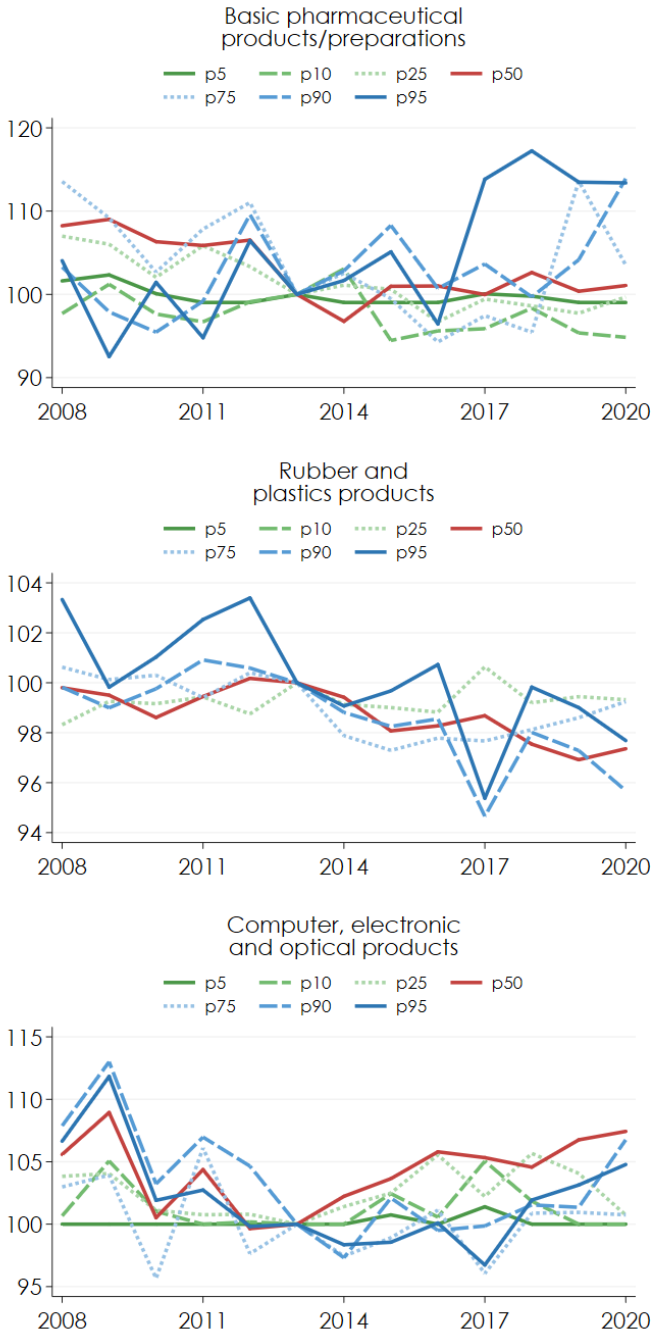
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.4: Development of average markups in selected sectors, index 2013 = 100



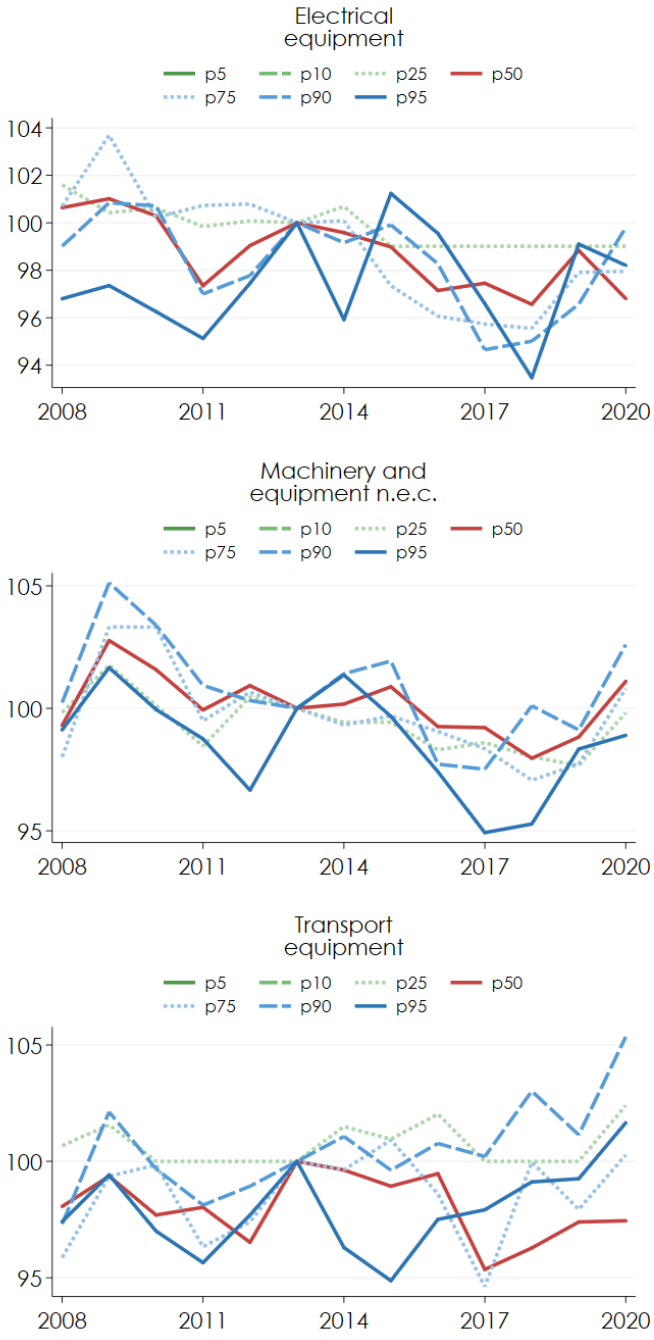
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.5: Development of average markups in selected sectors, index 2013 = 100



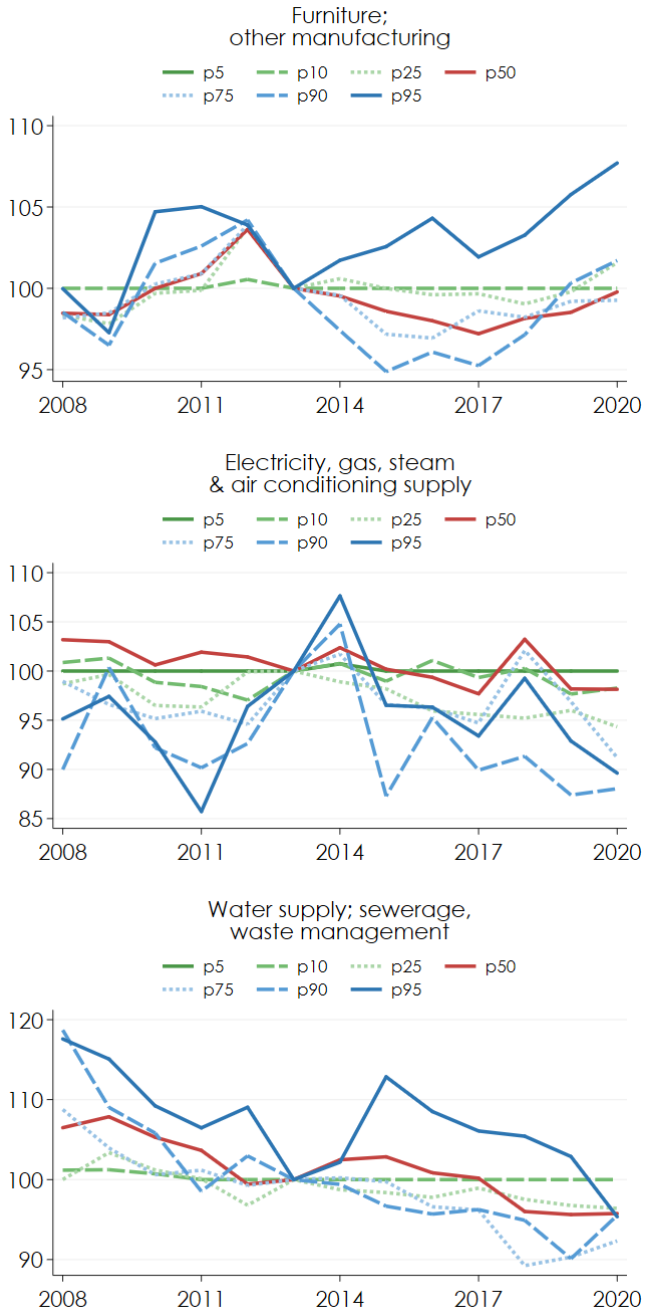
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.6: Development of average markups in selected sectors, index 2013 = 100



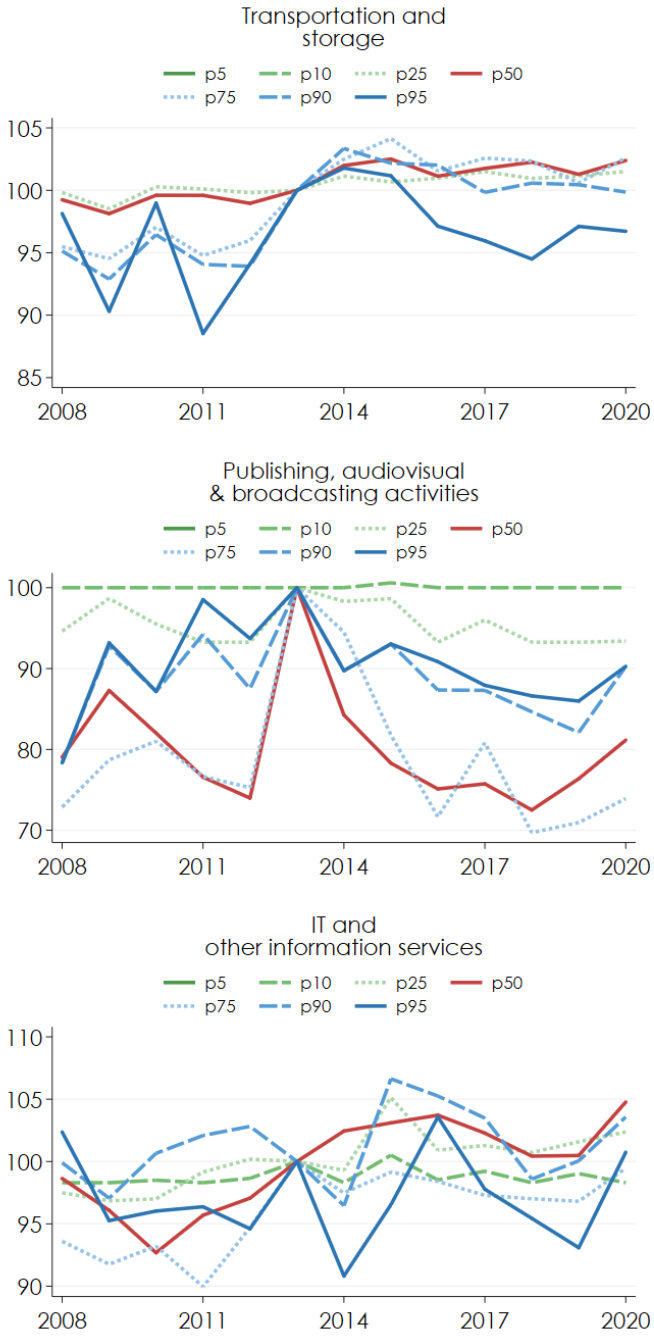
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.7: Development of average markups in selected sectors, index 2013 = 100



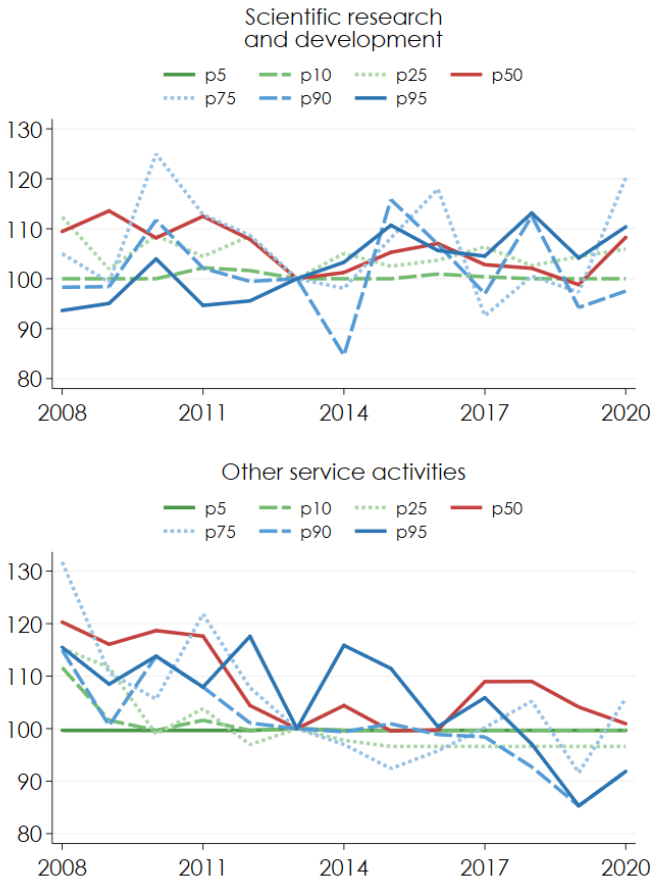
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.8: Development of average markups in selected sectors, index 2013 = 100



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

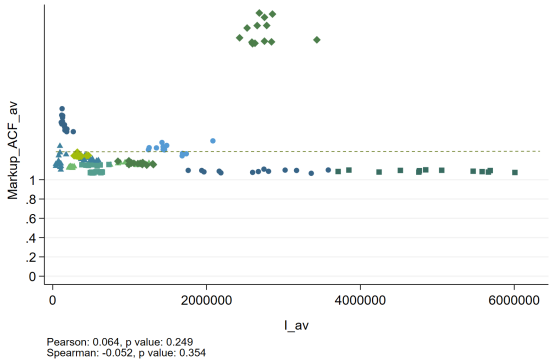
Figure A.9: Development of average markups in selected sectors, index 2013 = 100



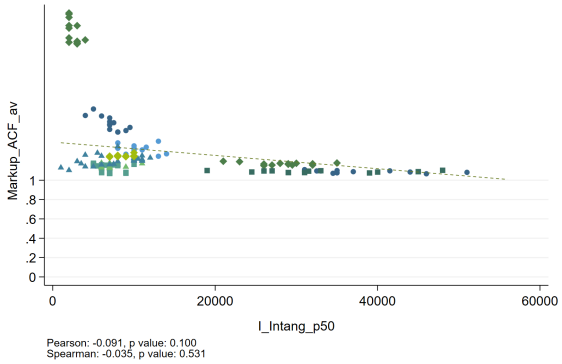
Source: Multiprod 2.0 - OECD, STAT, WIFO calculations.

Figure A.10: Average markups, fixed capital investments and intermediate inputs

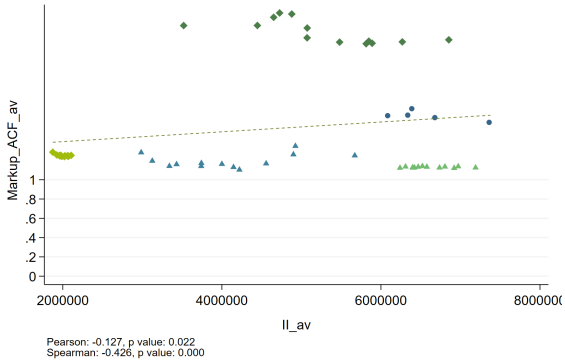
(a) Average tangible investments



(b) Median intangible investments



(c) Average intermediate inputs



Source: Multiprod 2.0 - OECD, STAT, WIFO calculations. Real estate activities dropped as outlier.