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Modelling the macroeconomic impact of competition policy: 2022 update and further development

Prepared by

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Modelling the macroeconomic impact of competition policy: 2022 update and further development

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Directorate-General for Competition

Joint Research Centre

Directorate General Economic and Financial Affairs

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EXECUTIVE SUMMARY

This report models and analyses various aspects of the macroeconomic impact of competition policy interventions by the European Commission over the period 2012-2021. Based on information provided by the Directorate-General for Competition (DG COMP) on its merger interventions, cartel prohibitions and other antitrust interventions, the Joint Research Centre (JRC) has used two models to simulate the macroeconomic impact of such interventions: the QUEST III macro-model of the EU economy, which was developed by the Directorate-General for Economic and Financial Affairs (DG ECFIN) for assessing the impact of EU policies, and an EU-wide input-output model, which allows for an investigation of the sectoral differentiation and spill-over effects of competition policy interventions.

The simulation carried out in QUEST III allows to evaluate the impact of competition policy enforcement on economy-wide measures of performance such as GDP, employment, prices and productivity. The impact includes the direct price effects of the Commission's competition policy interventions (as captured by the annual customer savings calculations) as well as the indirect, deterrent effects of these interventions. This report updates and improves the model simulation published in the previous edition (European Commission, 2022b) along several dimensions. First, it includes the straightforward update of results with the competition interventions by the Commission in 2021. Similar to 2020, the year 2021 is characterised by a relatively low number of interventions. Second, it includes improved data on the Commission's antitrust and cartel interventions for the period 2012-2021. Third, it includes a new approach to assess the deterrent effects of competition policy interventions based on models used to describe the diffusion of information (using the Bass model).

The new simulation results suggest a 1.17 percentage point reduction in markups (as measured by the Lerner index) resulting from the Commission's competition policy interventions. This reduction in mark-ups, applied to a (calibrated) mark-up level of 13.56 percent in the steady-state of the QUEST III model, triggers an increase of real GDP relative to the baseline in the range of 0.6% - 1.1% in the medium to long term (the equivalent of an uplift of EUR 80 - 150 billion in 2019 GDP), as well as a 0.3% - 0.7% reduction in the price level. All the main components of aggregate demand increase. More specifically, after 5 years, the results suggest an increase in consumption (0.5%) and investment (1.1%) despite the decline in profits associated with the negative markup shock. Investment is increasing because the negative direct effect of markups on future profitability is more than offset by the positive effect of the increasing demand due to the lower prices.

In a similar way as competition policy interventions are mapped onto the QUEST III model, the markup shocks can also be applied to an input-output model to assess price effects. The input-output model analyses how the price effects of competition policy interventions are transmitted across sectors using information on economic interdependencies retrieved from an input-output table of the European Union. On average, the Commission's competition policy enforcement is estimated to lower prices by around 0.83% (and slightly higher when putting more emphasis on recent years). Two thirds of the overall effect can be attributed to the "within-sector price-effect" including both the direct and deterrence effects of competition policy interventions with respect to that sector. The remaining part, i.e. the "spill-over price effect", results from amplification of this impact due to the input-output channels between sectors.

The report further discusses in more detail the insights derived from the economic literature as regards the link between corporate market power and macroeconomic performance. In addition, different avenues to model “the cost of non-competition” – defined here as the macro-economic costs associated with a state of the economy that appears less competitive compared to more competitive benchmarks – are explored. For this purpose, the report uses the evolution of different global markup estimates from the recent literature as a markup shock to assess the economic implication of non-competition through the lens of the QUEST III model. Finally, the report continues to explore the relation between market concentration and Commission policy interventions at the sector level. This analysis indicates a positive correlation between market concentration (measured by CR4) and the number of interventions made by the Commission.

1. INTRODUCTION

Competition policy interventions by the European Commission and other relevant agencies generate large benefits for consumers by ensuring that businesses and companies compete fairly with each other. By preventing the continuation of harmful conduct or harmful mergers, such market interventions help reduce prices, create a wider choice for consumers and improve quality and innovation.

Part of the savings for customers, which can be estimated in a rather straightforward manner, reflect the *direct* aggregate price effects of important interventions.[1] Nevertheless, these customer savings only reflect the "tip of the iceberg" in terms of positive effects of competition policy for society. Enforcement also generates (i) indirect deterrence effects and (ii) positive non-price effects on innovation, quality, and productivity in the markets concerned which are likely to be significantly larger, but also more difficult to estimate. Furthermore, the above-described benefits of competition enforcement at market level are likely to culminate in the improvement of economy-wide measures of performance such as GDP, employment, prices and aggregate productivity.

This report models and analyses various aspects of the macroeconomic impact of competition policy interventions by the European Commission over the period 2012-2021. Based on information provided by the Directorate-General for Competition (DG COMP) on its merger interventions, cartel prohibitions and other antitrust interventions, the Joint Research Centre (JRC) has used two models to simulate the macroeconomic impact of such interventions: the QUEST III macro-model of the EU economy, which was developed by the Directorate-General for Economic and Financial Affairs (DG ECFIN) for assessing the impact of EU policies, and an EU-wide input-output model, which allows for an investigation of the sectorial differentiation and spill-over effects of competition policy interventions. These two modelling tools are complementary. The QUEST III model captures the impact of competition policy enforcement on economy-wide measures of performance such as GDP, employment, prices and productivity. The input-output model explores the price effects of competition policy interventions at the industry/sector level, by exploiting information on the sector distribution of such interventions and by tracking the interlinkages between industries.

The present report updates and further develops the macro-model and input-output model simulations published in the previous edition (European Commission, 2022b) along several dimensions. First, it includes the straightforward update of results with the competition interventions by the Commission in 2021. Second, it includes improved data on the Commission's antitrust and cartel interventions for the period 2012-2021.[2] Third, it includes a new approach to assess the deterrent effects of competition policy interventions. Fourth, it discusses in more detail the insights derived from the economic literature as regards the link between corporate market power and macroeconomic performance. The report also explores different avenues to model "the cost of non-competition" (defined here as the macroeconomic costs associated with a state of the economy that appears less competitive compared to other,

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[1] For further background, see European Commission (2022a), *Competition Policy Brief:* Customer savings generated by the Commission's antitrust and merger enforcement, a 10-year perspective (1/10/2022). The sample of decisions ("interventions") used for the customer savings calculations in this Report consists of decisions concerning anticompetitive mergers, cartels and non-cartel antitrust conduct and agreements. Merger interventions include phase II prohibitions, phase II clearances subject to remedies, phase II abandonments and phase I clearances with remedies. Cartel interventions consist of prohibition decisions under Article 7 of Reg. 1/2003. Antitrust interventions include prohibition decisions under Article 7 and commitment decisions under Article 9 of Reg. 1/2003, as well as "informal interventions".

[2] The previous report still used preliminary data on antitrust interventions other than cartels.

more competitive benchmarks). Finally, it continues to explore the relation between market concentration and Commission policy interventions at the sector level.

This year's annual report has the same format as the previous year's report. It includes a core part that is a collaborative effort of two Directorates-General (DG COMP and the JRC), followed by a number of technical annexes drafted under the responsibility of different contributing teams. The main report is relatively concise, focusing on the main methods used and results obtained. More detailed explanations and exploratory work with a view to widening the scope of analysis can be found in the technical annexes.

In what follows, we analyse competition policy interventions by the Commission in the 10-year period between 2012 and 2021.[3] There are three types of cases: merger interventions, cartel prohibitions and antitrust interventions other than cartels.

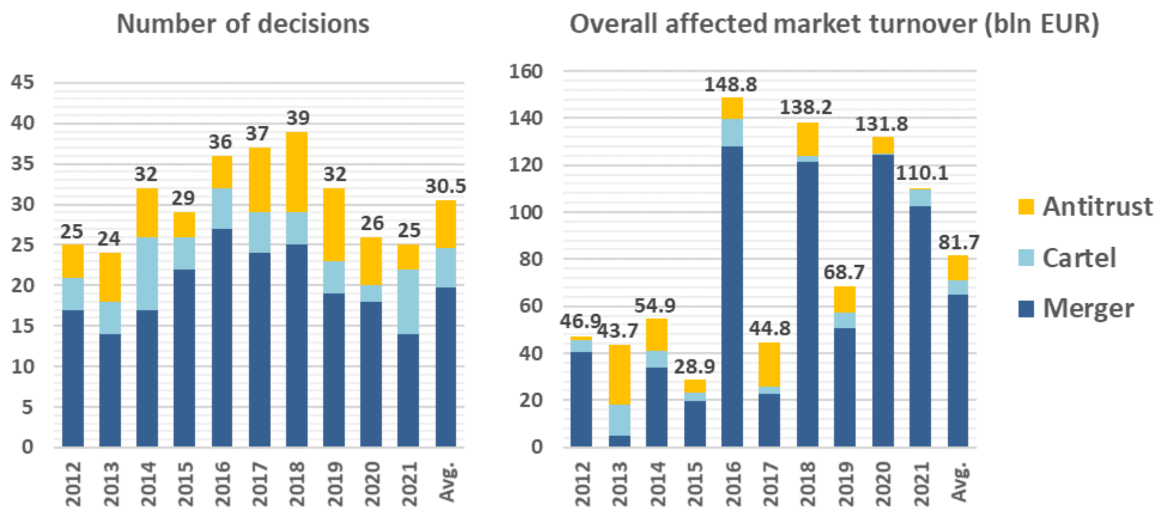
During the analysed period, the Commission intervened in the market 305 times: 197 merger, 49 cartel and 59 antitrust decisions were adopted. Taken together, the size of the markets directly affected by these interventions is worth a total of approximately EUR 816 billion.[4] The distribution of competition policy enforcement over time can be seen in Figure 1.1. The left-hand panel of the figure displays the number of decisions by type. In the right-hand panel, the overall turnover in the markets affected by those decisions is presented.

The smallest number of decisions in a given year is 24 (in 2013) and the maximum number is 39 (in 2018). The total size of the markets affected by decisions may change remarkably from one year to another because cases differ widely in terms of associated market turnover. In 2016, for example, the total affected market size was more than five times larger than the value for 2015 despite the difference in case count being relatively modest. The year 2021 ranks fourth in terms of overall affected market size after 2016, 2018 and 2020. Similarly, to 2020, the year 2021 is characterised by a relatively low number of interventions (25). In 2021, four high profile merger cases account for approximately 73% of the overall market size (i.e., *Veolia/Suez, LSEG/Refinitiv Business, AON/Willis Towers Watson, Fincantieri/Chantiers de L'Atlantique*).

3 For more details, see European Commission (2022a), *Competition Policy Brief*, quoted above.

4 Specifically, for the purpose of calculating turnover, the annual turnover of all firms in the affected market(s) is used in the case of merger interventions, while the annual turnover of the companies under investigation in the affected market(s) is used for cartel and antitrust cases. See also European Commission (2022a), *Competition Policy Brief*, quoted above.

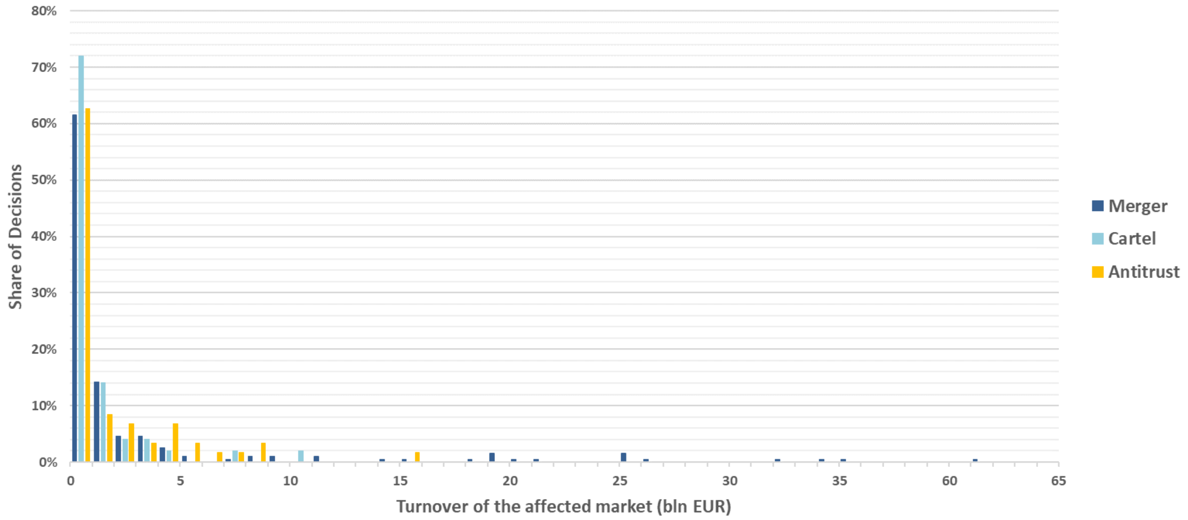
Figure 1.1: European Commission interventions 2012-2021 (Descriptive statistics)



Over the period of analysis (2012-2021), the average number of interventions per year is around 30 with merger cases being most frequent (65% of the total number of interventions), followed by cartels (16%), restrictive agreements and concerted practices under Article 101 (11%) and abuse of dominant positions under Article 102 (8%). In most years, mergers are also leading in terms of the share of affected market turnover, constituting about three quarters of the total on average. An exception to the pattern, however, is the year of 2013, in which antitrust and cartel cases accounted for 59% and 30% of the total affected turnover, respectively.

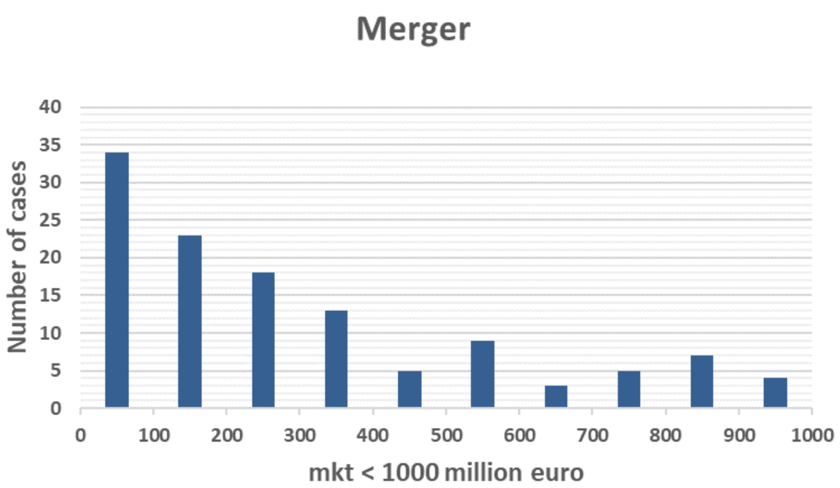
As measured by market turnover affected by the decisions, merger cases have a larger average size (EUR 3.2 billion) than antitrust (EUR 1.8 billion) and cartel cases (EUR 1.2 billion). These results are mostly due to a handful of important merger interventions made in the years 2016, 2018, 2020 and 2021. As can be seen from Figure 1.2 below, such large decisions are relatively uncommon. The overwhelming majority of cases – whether concerning merger interventions, cartel prohibitions or antitrust interventions – affect relatively small markets. Indeed, more than 60% of merger and antitrust interventions and more than 70% of cartel prohibitions concern affected markets with a total turnover lower than EUR 1 billion. This also explains why for all competition policy instruments the average size of the affected markets is substantially greater than the median size with median values of EUR 0.56 billion for mergers, EUR 0.55 billion for cartels and EUR 0.67 billion for antitrust cases.

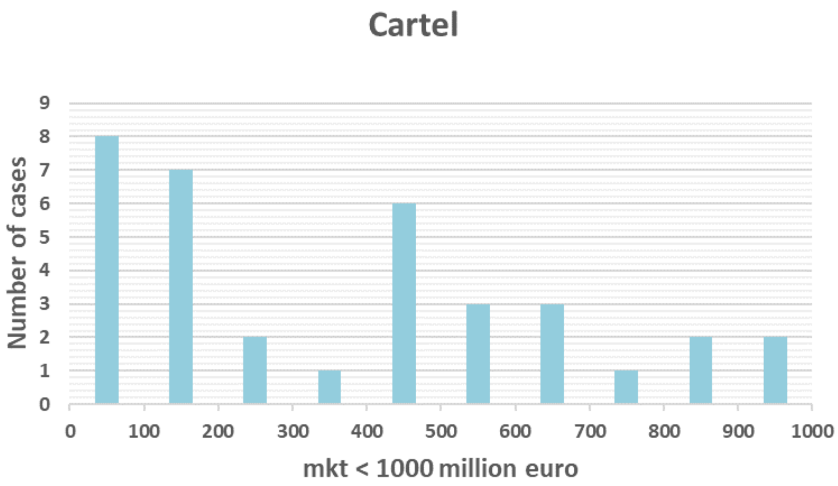
Figure 1.2: Distribution of affected market turnover by competition policy instrument



As most of the observations presented in Figure 1.2 have a relatively small turnover, we present in Figure 1.3 a histogram of cases for which the affected turnover is less than EUR 1 billion. Again, most observations concentrate on the left-hand side of the charts, indicating that interventions in affected markets with a relatively low total turnover are the more frequent, especially for merger and antitrust.

Figure 1.3: Distribution of affected market turnover by competition policy instrument (<1 EUR bn.)





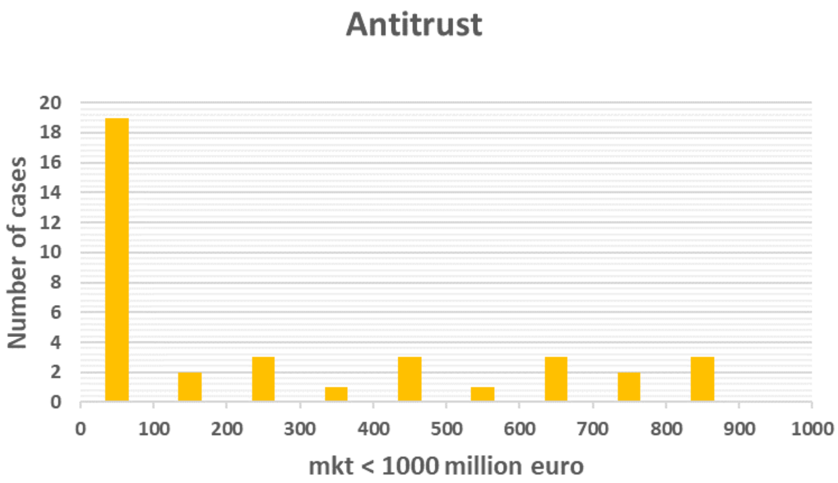
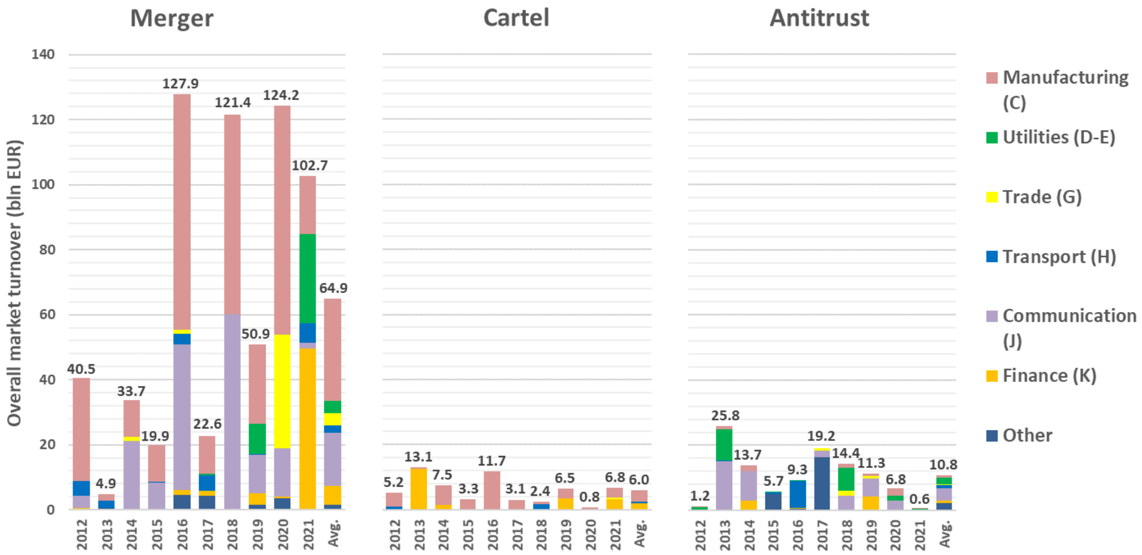


Figure 1.4 below presents the affected turnover of cartel, merger and antitrust interventions, by sector. It emerges that to a very considerable degree, the Commission's cartel prohibitions and merger interventions occurred in the manufacturing sector. In case of cartels, several important decisions, especially in the year 2013, are found in the financial sector. Regarding mergers, a significant share of the overall affected turnover is further accounted for by cases in the communication sector.

Figure 1.4: Affected turnover of cartel, merger and antitrust interventions, by NACE Rev. 2 sector



2. THE DIRECT EFFECTS OF COMPETITION POLICY INTERVENTIONS

As set out in the introduction, competition policy interventions generate large benefits for consumers by ensuring that businesses and companies compete fairly with each other. By preventing the continuation of harmful conducts or harmful mergers, market interventions help reduce prices, create a wider choice for consumers, improve quality and foster innovation. Part of the savings for customers, namely those reflecting the direct aggregate price effects, can be estimated in a rather straightforward manner. Following OECD guidance[5], these savings are typically obtained for a given decision by multiplying the estimated reduction in prices (or avoided increases in price) resulting from the intervention by the size of the market concerned and the expected duration of the price reduction. The annual aggregate customer savings correspond to the sum of customer savings from all interventions in a given year.[6]

It is worth noting that the customer savings estimated only reflect the “tip of the iceberg” in terms of positive effects of competition policy for society. Enforcement also generates: (i) indirect deterrence effects; and (ii) positive non-price effects on innovation, quality, and productivity which are likely to be significantly larger, but also more difficult to estimate. It is further worth bearing in mind that the customer savings estimations, as a general rule, may disregard special features of individual interventions, and assume the correctness of the decisions concerned (i.e., no Type I nor Type II errors are committed). Therefore, they complement, but do not substitute for proper ex-post evaluation of interventions.

Since 2012, the direct price effects of interventions have been estimated using the customer savings approach, initially for cartels and mergers. For the first time in 2022, annual (while preliminary) figures on customer savings for non-cartel antitrust decisions have also been considered. The current figures are based on data obtained from case teams over the ten-year period 2012-2021.

Table 2.1 and Figure 2.1 below summarise the main conclusions drawn from the calculation of an upper bound and lower bound for the direct customer savings. For the ten-year period under consideration, the estimated total customer savings from all competition policy interventions by the European Commission are in the range of EUR 124 billion to EUR 210 billion (depending on lower or upper bound assumptions made for the price effects of the different interventions) or, on average, EUR 12 to 21 billion per annum.

Table 2.1: Customer savings (2012-2021) in billion EUR

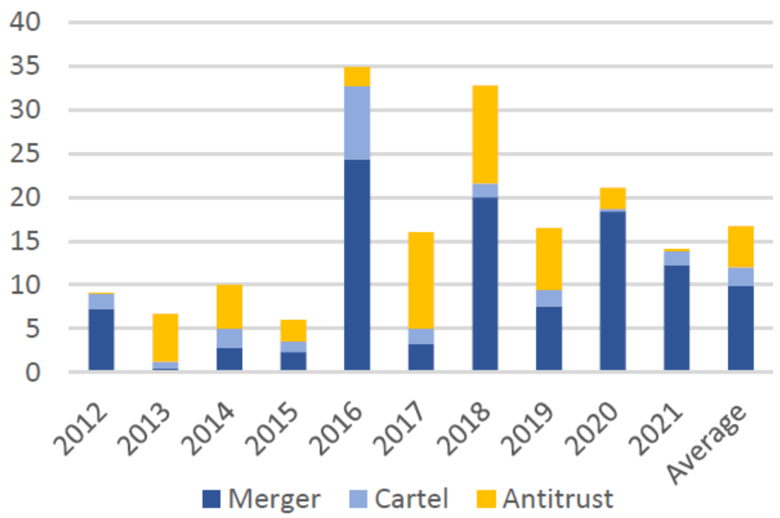
Year	Merger	Cartel	Antitrust	Total customer savings
2012	5.5 – 9.1	1.4 – 2.0	0.1 – 0.2	7.0 – 11.3
2013	0.4 – 0.6	0.6 – 0.9	4.3 – 6.6	5.3 – 8.1
2014	2.1 – 3.6	1.7 – 2.6	2.4 – 7.7	6.2 – 13.9
2015	1.7 – 2.9	1.0 – 1.5	1.6 – 3.3	4.3 – 7.7
2016	18.3 – 30.4	6.7 – 10.0	1.4 – 2.9	26.4 – 43.3
2017	2.4 – 4.1	1.4 – 2.1	7.8 – 14.3	11.6 – 20.5

5 OECD (2014), Guide for helping competition authorities assess the expected impact of their activities, available at https://www.oecd.org/daf/competition/Guide-competition-impact-assessmentEN.pdf.

6 Details of the calculation by the Commission can be found in European Commission (2022a).

2018	15.0 – 25.0	1.3 – 1.9	7.4 – 14.9	23.7 – 41.8
2019	5.7 – 9.4	1.5 – 2.3	6.4 – 7.7	13.6 – 19.4
2020	13.8 – 23.0	0.2 – 0.3	1.6 – 3.3	15.6 – 26.6
2021	9.2 – 15.3	1.3 – 1.9	0.2– 0.3	10.7 – 17.5
Total	**74 – 123**	**17 – 26**	**33 – 61**	**124 – 210**
Average per case	0.4 – 0.6	0.3 – 0.5	0.6 – 1.0	

Figure 2.1: Customer savings (2012-2021) in billion EUR



There is a significant variation in customer savings from one year to the next, which suggests the need to use long time series. Such variations can be attributed to several factors, such as the size of markets in which the Commission intervenes, the scope of the interventions and the number of cases investigated, as well as the assumptions and estimation methods used. Customer savings were particularly high in 2016 and 2018, with average annual amounts of over EUR 30 billion. In 2016, this was due to important merger interventions and cartel prohibitions, while in 2018, merger and antitrust interventions (specifically Art. 102) contributed to the high level of customer savings in that year. In 2021, the total customer savings amounted to EUR 14 billion with merger interventions playing a dominant role.

Overall, aggregate customer savings from merger interventions are larger (EUR 74 - 123 billion in total for the period considered) than those from antitrust interventions (EUR 33 - 61 billion) and cartel prohibitions (EUR 17 - 26 billion). This difference, in large part, reflects differences in the number of interventions over the 2012-2021 period with 197 interventions for mergers, 49 for cartels and 59 for antitrust (Art. 101 and Art. 102).

In addition, the range of customer savings associated with an average antitrust intervention (EUR 0.6 - 1.0 billion) lies above the ranges recorded for an average cartel prohibition (EUR 0.3 - 0.5 billion) or merger intervention (EUR 0.4 - 0.6 billion).

3. MODELLING THE DETERRENT EFFECTS OF COMPETITION POLICY INTERVENTIONS

As described in the previous section, the direct effects of competition policy interventions are often measured by the direct customer savings from such interventions. These direct effects provide, however, only a partial view of the benefits of competition policy since they do not consider the deterrent effects.

The deterrent effects consist in preventing and reducing in severity future anticompetitive behaviour of market participants. According to the economic literature, these deterrent effects are much larger than the observed effects of competition policy interventions on the markets directly affected (See Nelson and Sun, 2001; Clougherty et al., 2016). However, such deterrent effects cannot be easily measured because one needs to make inferences about changes in future behaviour by market players as a result of the interventions by competition authorities. Different methods have been applied in the past to estimate the deterrent effects of competition policy interventions (For an overview, see Dierx et al., 2020). The most commonly used estimation approach relies on surveys which have directly asked companies and their legal advisors to estimate the number of anticompetitive actions deterred for every anticompetitive action detected.[7]

This section presents an alternative approach to modelling the deterrent effects of competition policy, based on models used to describe the diffusion of information.[8] The primary purpose of this approach is to model the impact of competition policy interventions as (downward) markup shocks, reflecting both the direct effects and the deterrent effects of the competition policy interventions in the corresponding sectors.

3.1 Main principles underlying the modelling of the deterrent effects

The approach used in this report assumes that by detecting anticompetitive behaviour and intervening against anticompetitive mergers, the competition authority (i.e. the European Commission in this case) sends a signal as regards its enforcement actions that is diffused amongst market participants and amplified by interactions between them. This discourages market players from infringing competition law. This framework reflects the role of both the competition authority and the market players in the process of diffusion of information about competition policy interventions. Note that the mere existence of a competition authority can have deterrent effects depending on its reputation.[9]

The intensity of the signal sent by the competition authority to market players is captured by the strength of competition enforcement within a sector. More precisely, the strength of the signal is captured by the size of the market directly affected by the competition policy intervention relative to the sector to which this market belongs. This is in line with the results

7 The ratio of the number of “deterred” cases over the number of “detected” cases is often referred to as the “multiplier” ratio. Alternatively, the multiplier can be related to the ratio of “deterred” harm over “detected” harm.

8 For a more detailed description of this approach and a technical explanation of the model used, see Dierx, A., Ilzkovitz, F., Pataracchia, B. and Pericoli, F. (2023), “Modelling the diffusion of the deterrent effects of competition policy”, Journal of Competition Law & Economics, forthcoming.

9 This framework allows integrating the main determinants of deterrence identified by the literature: (i) the perceived probability for a company of being caught and convicted of anticompetitive behaviour by the competition authority; and (ii) the expected cost of being detected (e.g. fines being imposed or other adverse consequences). Both aspects depend, in large part, on the reputation of the competition authority, which in turn may again depend on its past enforcement record resulting from its detection and investigation activity, its (current) capacity to stop and punish anticompetitive behaviour and other characteristics of the competition policy regime.

of business surveys showing that anticompetitive behaviour is more likely to be halted in sectors where the authorities have conducted cartel or other antitrust interventions or where they have recently prohibited or imposed severe remedies on a merger.[10]

The diffusion of this signal is modelled by the Bass or mixed-influence model (Bass, 1969), which assumes that there is a positive (non-linear) relation between detection activity (the competition policy interventions) and deterrence. In this model, the marginal effect of an increase in detection activity is not constant: for small cases, the marginal effect is increasing (convex relation between case detection and deterrence) while for large cases, the marginal effect is decreasing (concave relation). Taken together, this gives rise to an 'S-shaped' relationship between detection and deterrence.

The 2021 report on "Modelling the macroeconomic impact of competition policy" used a different 'S-shaped' function, the logistic function, to describe the diffusion of the signal sent by the competition policy interventions. In the 2022 edition, this logistic function is replaced by the Bass function. In comparison with the logistic approach, this function offers two advantages. First, the Bass function is a mixed-influence model, comprising both an *external* triggering factor – the interventions made by the competition authority – and an *internal* propagation mechanism – the interactions between market participants. Second, it incorporates the impact of the reputation of the competition authority which may lead to deterrence effects even in sectors where the authority has not taken (recent) enforcement action.

According to the mixed-influence model, the information diffusion can be described by the following differential equation:

$$\frac{d\omega}{d\sigma} = (\alpha + \beta * \omega(\sigma)) * \{1 - \omega(\sigma)\} \qquad (3.1)$$

with the independent variable σ representing the signal sent by the competition authority to market players in the sector directly affected by the competition policy interventions and the dependent variable ω representing the deterrent effects of such detection activity.

The solution of this differential equation is:

$$\omega(\sigma) = \frac{1 - \frac{\alpha(1-\omega_0)}{\alpha+\beta\omega_0} * exp(-(\alpha+\beta)*\sigma)}{1 + \frac{\beta(1-\omega_0)}{\alpha+\beta\omega_0} * exp(-(\alpha+\beta)*\sigma)} \qquad (3.2)$$

Equation (3.2) shows that the deterrent effects of a given intervention ($\omega(\sigma)$) depend on ω_0, i.e. the initial level of deterrence which reflects the reputation of the competition authority; α, the sensitivity of market players to the external signals sent by the competition authority; and β, which is the strength of the interactions between market participants.

3.2 Measurement of model variables and calibration of parameter values

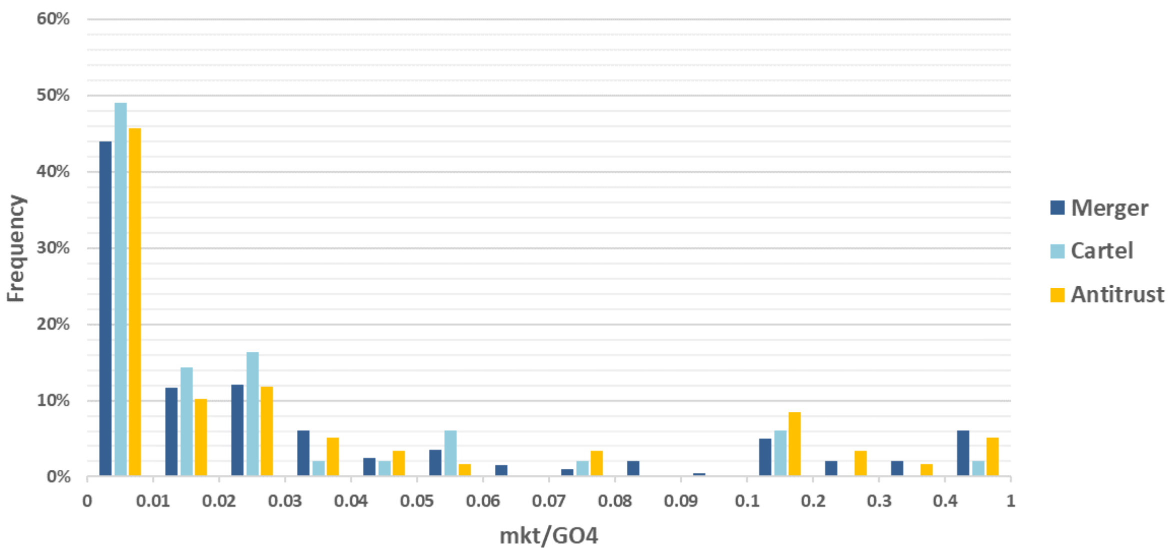
The strength of the signal sent (σ) is measured based on actual interventions made by the Commission over the period 2012-2021. More precisely, the strength of the signal sent is estimated by the size of the markets directly affected by the Commission's competition policy interventions (mkt) over gross output in the corresponding NACE four-digit sector (GO4).

[10] This assumption, while consistent with some findings in the literature, simplifies reality as the deterrent effects of important competition policy interventions can be diffused beyond the sector in which the direct effect is felt and affect a large part of the industry.

Accordingly, σ = mkt / GO4. The deterrent effects ω of a given intervention are defined as the share of deterred markets in the sector (mkt^D) over gross output in the corresponding NACE four-digit sector, not considering the markets directly affected by the intervention (GO4 – mkt). Accordingly, ($\omega(\sigma)$ = mkt^D / (GO4 – mkt)). On this basis, a deterrence multiplier associated with a specific competition policy intervention can be calculated as $\mathrm{mkt}^D \,/\, \mathrm{mkt} = \omega\,(1-\sigma)\,/\,\sigma$.

Figure 3.1 below shows the frequency distribution of the variable σ for each of the three competition policy instruments: merger interventions, cartel prohibitions and antitrust interventions under Articles 101 and 102 TFEU. For all the instruments, the distribution is skewed with a long right tail. This implies that for most of the interventions, the size of the market directly affected by the intervention is very small relative to that of the corresponding sector. In around 50% of all cases, the market size represents less than 1% of the size of the sector concerned and a large majority of the interventions have a market size corresponding to less than 5% of the sector concerned.

Figure 3.1: Frequency distribution of detection activity by policy instrument (in percentage of total, 2012-2021)



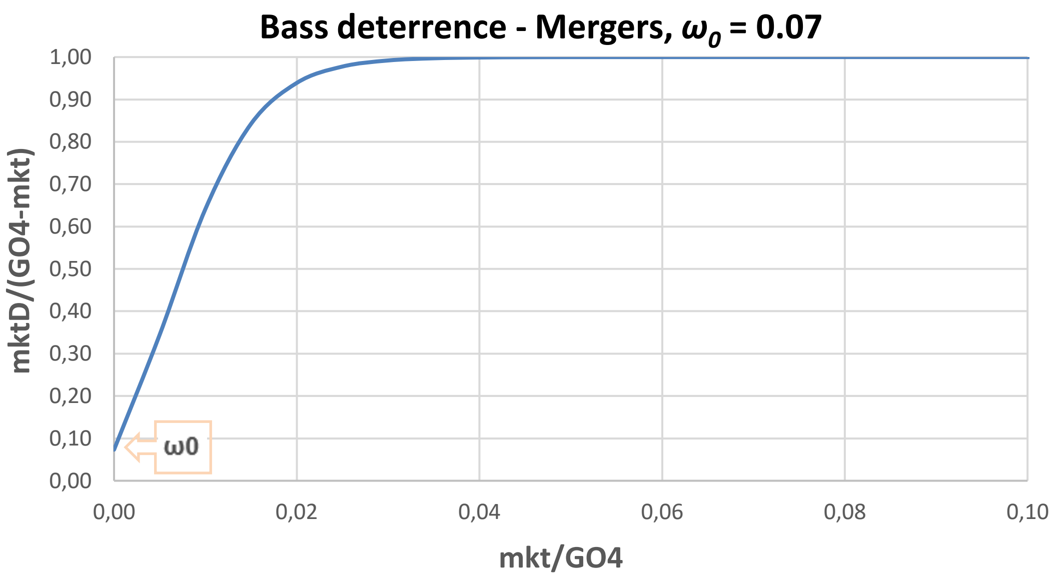
The parameters α and β used to model the diffusion of information about competition policy interventions are calibrated in such a way that the weighted average of deterrence multipliers is in line with evidence from surveys of market participants. These surveys provide evidence in support of our assumption to fix the weighted average deterrence multiplier at 10 for merger interventions, 20 for cartel prohibitions, 20 for antitrust interventions under Article 101, and 10 for antitrust interventions under Article 102. The ratio of β/α is set at 5 for all cases as this yields an S-shaped relationship between detection and deterrence, in line with the non-linear relation described in the literature.[11] Furthermore, as the reputation of the competition authority depends on its past enforcement record, the parameters ω_0 for the different competition policy

[11] Dierx et al. (2022) provide a more detailed explanation of the calibration of the mixed-influence model used including an extended sensitivity analysis.

instruments are set equal to the average annual intervention rates of the Commission over the period 2012-2021.

To illustrate, we report below the calibrated Bass function describing the relation between the signal sent by competition authorities based on their detection activity and deterrence for the Commission's merger interventions under the assumptions described above. Figure 3.2 illustrates that, in this model simulation, almost all anticompetitive mergers in the sector are deterred (i.e. not notified) following a merger intervention for which the affected market size exceeds 4% of the sector size. Data on the market size of merger interventions over the period 2012-2021 show that around one quarter of merger interventions fall in this category and that such merger interventions have occurred in sectors such as mobile telecommunications, energy, steel and metals and beer.

Figure 3.2: Illustration of the relationship between detection and deterrence in a mixed-influence model (mergers)



4. ASSESSING THE EFFECTS OF INTERVENTIONS USING THE QUEST MACRO-MODEL

Competition policy serves as an instrument to increase competition amongst companies and thereby contributes to a decrease in the level of markups. By assessing the extent of changes in markups due to the European Commission's policy interventions, it becomes possible to model and simulate the effects of these competition policy interventions using the QUEST III macro-model.[12] In this section, we outline the main features of the simulation analysis with the QUEST III model and present the main results.

[12] QUEST III belongs to the class of New-Keynesian Dynamic Stochastic General Equilibrium (DSGE) models widely used by international institutions and central banks. For more information about the features of QUEST and its applications the reader may refer to https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/economic-research/macroeconomic-models_en.

The logic of the simulations is as follows: for each merger intervention, cartel prohibition and antitrust intervention, DG COMP computes the annual value of sales in the affected market(s) in millions of euros at current prices. By making assumptions on the avoided price increase, its duration and the importance of deterrent effects, we convert these values into annual markup shocks (here: changes in the Lerner index[13]) at the two-digit sector level. The markup shock at the NACE two-digit sector level is the difference between the *observed* markup at the sector level, as impacted by the Commission's competition policy interventions, and the *counterfactual* markup computed in a macroeconomic scenario without competition policy interventions.

Subsequently, we aggregate these sector specific shocks into a single EU economy-wide markup shock (see European Commission, 2022b). Specifically, we compute a time-invariant, permanent markup shock generated by the Commission's competition policy interventions[14], and we use this shock to simulate the macroeconomic impact through QUEST III.

More specifically, in QUEST III, the aggregate change in markup ΔMUP_K due to merger interventions, cartel prohibitions and other antitrust interventions can be defined as follows:

$$\Delta MUP_K = \sum_{i \in \{I_K\}} \left[\frac{\Delta P_i}{P_i} (1 + MUP_i) \right] \frac{GO_i}{GO} \tag{4.1}$$

where I_K is the set of NACE two-digit sectors i in which competition policy interventions k have led to a change in customer prices.

Equation (4.1) shows that the aggregate markup shock depends on: (i) the price shocks ($\Delta P_i / P_i$) in the sectors affected by the Commission's competition policy interventions; (ii) the gross markup level (MUP_i) in the NACE two-digit sectors concerned;[15] as well as (iii) the gross output (GO_i) of the sectors affected by the Commission's competition policy interventions as a share of total gross output within the EU business economy (see European Commission, 2022b).

The price shock in each two-digit sector (or industry) i, in turn, is computed as the weighted sum of the price changes caused by competition policy interventions in that sector:

$$\frac{\Delta P_i}{P_i} = \sum_{k \in M_i} \frac{\Delta P_k}{P_k} MS_{ik} + \sum_{k \in C_i} \frac{\Delta P_k}{P_k} MS_{ik} + \sum_{k \in A_i} \frac{\Delta P_k}{P_k} MS_{ik} \tag{4.2}$$

where the sets M_i, C_i and A_i are comprised of merger interventions, cartel prohibitions and antitrust interventions, respectively, affecting markets in industry *i*. The market weights MS_{ik} depend on the size of the sectors directly or indirectly affected by competition policy interventions k in industry i.

When deterrence is taken into account, the total weights MS_{ik}^T include both the direct effects and the indirect deterrent effects of competition policy interventions. The total market affected

13 To apply the markup shocks to the QUEST III model, the markups are expressed in terms of the Lerner index (L), which is defined as the difference between price (P) and marginal costs (MC) over price (P). The markup shock is obtained as an absolute variation of the Lerner markup, i.e., the difference in the level of markup.

14 The permanence of the markup shock reflects companies' expectations that in the foreseeable future the European Commission will continue to enforce EU competition policy rules at the same average pace as the one observed over the period 2012-2021.

15 Markup levels are calibrated according to the method proposed by Thum-Thysen and Canton (2015), which extends Roeger's (1995) markup calculation method by including the effects of product market reforms (see European Commission (2022b), Annex A.1).

includes both the markets directly affected by intervention k (mkt_{ik}) and the markets affected indirectly through sectoral deterrence (mkt_{ik}^{D}):

$$mkt_{ik}^{T} = mkt_{ik} + mkt_{ik}^{D} \tag{4.3}$$

Finally, we also take into account information about the duration of the price increases avoided because of the Commission's competition policy interventions. This implies that the markup shock in a given year is the sum of the effects of competition policy interventions in that year and of interventions from previous years, which continue to have an effect in the current year.

Table 4.1 summarises the default assumptions underlying the permanent markup shock under the baseline scenario: the avoided price increase equals 3% for merger interventions, 15% for cartel prohibitions and 5% for antitrust interventions both under Articles 101 and 102 TFEU. These assumptions are broadly in line with the assumptions made for the direct customer savings calculations presented in Section 3, with some exceptions.[16]

Table 4.1: Baseline scenario under the Bass approach to deterrence

<table>
<tr><th></th><th>Merger</th><th>Cartel</th><th>Antitrust Art. 101</th><th>Antitrust Art. 102</th></tr>
<tr><td>Avoided price increase associated the direct effects</td><td>3%</td><td>15%</td><td colspan="2">5%
(unless case-specific information is available)</td></tr>
<tr><td>Avoided price increase associated with deterred cases</td><td>3%</td><td>15%</td><td colspan="2">5%
(unless case-specific information is available)</td></tr>
<tr><td>Weighted average of deterrence multipliers</td><td>10</td><td colspan="2">20</td><td>10</td></tr>
</table>

The simulation exercises presented below have been developed under the assumption that the economy is hit by a markup shock while being in the steady-state. Therefore, these simulations do not take into account possible nonlinear responses of the economy generated by sharp business cycle fluctuations such as those caused by the COVID-19 pandemic or the Russia's attack on Ukraine. Under the baseline scenario, the steady-state markup (here

16 For certain specific cases we have adopted a number of assumptions for the direct and deterrence effect. First, we consider cases where the investigation started more than three years after the end of the anticompetitive behaviour of concern (as sometimes may apply to e.g. leniency cases) as having no direct price effects but only deterrence effects. Indeed, the main objective of such interventions is typically to deter companies from engaging in anticompetitive behaviour, because of the fines imposed on the companies having participated in the cartel. For a number of cases concerning the manufacture of basic pharmaceutical products (two cases in 2013 and one case in 2014, 2020 and 2021), we have applied the case-specific avoided price increase for the estimation of the direct price effects while using the standard 5% avoided price increase as a basis for the calculation of the indirect, deterrent effects. For such cases, the application of the specific avoided price increase would have excessively large effects in the analysis of the deterrence.

expressed by the Lerner index) decreases by 1.17 percentage points, compared to an initial (calibrated) level of 13.56 percent.

Table 4.2 illustrates the macroeconomic impact of competition policy enforcement under the baseline. We observe that the 1.17 percentage point reduction in markup resulting from the Commission's competition policy interventions triggers an increase of real GDP to the baseline equal to 0.56% and a 0.32% reduction in inflation as measured by the GDP deflator after five years. All the main components of aggregate demand increase. More specifically, after 5 years we simulate substantial increases in consumption (0.48%) and investment (1.09%) in spite of the decline in profits associated with the negative markup shock. Evaluated over a longer horizon, the interventions trigger an uplift in real GDP relative to the baseline equal to 1.08% after 50 years (the equivalent of an uplift of EUR 80 - 150 billion in 2019 GDP).

Table 4.2: Macroeconomic impact of permanent markup shock to the steady state (in %)

	1	5	10	50
GDP	**0.33**	**0.56**	**0.75**	**1.08**
GDP deflator	-0.24	-0.32	-0.44	-0.70
Employment	0.26	0.40	0.48	0.48
Labour productivity	0.07	0.16	0.27	0.60
Consumption	0.33	0.48	0.66	0.96
Investment	0.52	1.09	1.33	1.71
Profits	-8.49	-11.52	-10.89	-9.54

It is also interesting to go beyond the aggregate macroeconomic impact of competition policies and to examine the impact of the different competition tools. Figure 4.1 provides a graphical representation of the relative importance of the various instrument considered. Mergers and cartels represent approximately one third of the total impact each (38% for mergers, 32% for cartels). The remaining one third (Antitrust, 30%) is mainly attributable to antitrust Art. 101 cases (25%) while Art. 102 cases account for only 5% of the total impact, in part due to the lower number of case interventions in this area and the lower values of avoided price increase and average of deterrence multiplier shown in Table 4.1. Table 4.3 decomposes the GDP impact of competition policy enforcement by the different competition instruments.

Figure 4.1: The markup level reductions associated with different competition tools (2012-2021)

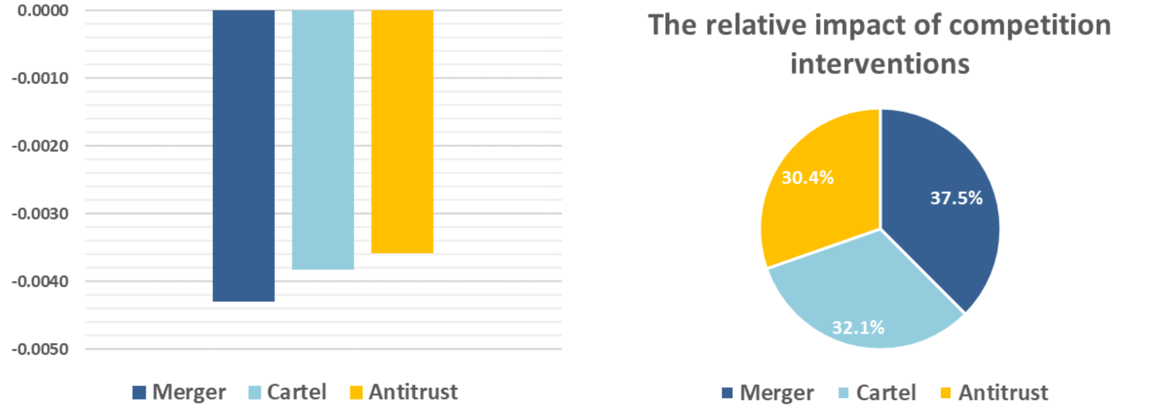


Table 4.3: GDP impact of different competition tools (2012-2021).

	1	5	10	50
Merger	0.12	0.21	0.28	0.39
Cartel	0.11	0.18	0.25	0.35
Antitrust	0.10	0.17	0.23	0.33

Box: Comparison between current and 2021 methodology

There are differences between the results presented in Table 4.2 and Figure 4.1, on the one hand, and the corresponding results shown in the previous version of the Report, European Commission (2022b), on the other hand. These differences are associated to changes in the data sample, in the treatment of the deterrence effect in some specific cases and in the modelling of the diffusion of deterrence.

First, the data sample has been extended to include **one additional year** of competition policy activity. In this Report, we include cases for mergers, cartels and antitrust relating to 2021. In addition, a number of informally settled cases have been added (see European Commission, 2022a, *Competition Policy Brief*, for further details).

Second, we have adopted **specific assumptions** for the direct and deterrence effect of certain cases. More precisely, we considered cases where the investigation started more than three years after the end of the anticompetitive behaviour of concern (as sometimes the case in e.g. leniency cases) as having no direct price effects but only deterrence effects. Indeed, the main objective of such interventions is typically to deter companies from engaging in anticompetitive behaviour, because of the fines imposed on the companies having participated in the cartel. For certain cases concerning the manufacture of basic pharmaceutical products (two cases in 2013 and one case in 2014, 2020 and 2021), we have applied the case-specific avoided price increase for the estimation of the direct price effects while using the standard 5% avoided price increase as a basis for the calculation of the indirect, deterrent effects. For such cases, the application of the specific avoided price increase would have excessively large effects in the analysis of the deterrence.

Modelling-wise, in the present report, we use the **Bass mixed-influence** diffusion framework to model deterrence diffusion, differently from the previous approach based on the **logistic function**. The Bass function is a more flexible framework that can feature a reputation parameter and includes both an external triggering factor and an internal propagation mechanism. The parameters of the mixed-influence diffusion model are calibrated using survey-based information on average deterrence multipliers. Given the reputation effect in place, the adoption of the Bass approach requires targeting a **weighted average** of deterrence multipliers rather than the arithmetic used in the previous approach. This is due to the fact that, with the reputation acting as a positive shift of the deterrence diffusion (vertical upward shift of the Bass diffusion function), implausible high levels of multipliers would correspond to very small cases. For the sake of comparability, we report in the Annex A.4 results of the current exercise using the logistic approach.

5. ASSESSING THE EFFECTS OF INTERVENTIONS ON THE PRICE LEVEL USING AN EU-WIDE INPUT-OUTPUT MODEL

In a similar way as competition policy interventions are mapped onto the QUEST III model, the markup shocks can also be applied to an input-output model, specifically to assess the effects on the overall price level in the economy. Interventions of the European Commission to sanction anticompetitive behaviour reduce prices in the relevant markets (or prevents them from increasing). This effect can then be transmitted to other markets via the interlinkages in the economy because firms downstream in the supply chain will face lower input prices. It is reasonable to expect that these firms will reduce the price of their own products. To analyse how the effects of competition policy interventions are transmitted across markets, we use information on economic interdependencies retrieved from the input-output table of the European Union. Specifically, the EU27 input-output table used is based on the results of the Figaro project,[17] which constitutes the official input-output framework of the EU and is produced by Eurostat with the support of the JRC.[18]

The input-output table used in our analysis contains 64 branches of economic activities (or "industries" for short) based on the NACE Rev 2 statistical classification. In any given industry, competition policy interventions lead to a "within-industry price-effect" (encapsulating both the direct and deterrence effects with respect to that industry), and a "spill-over price effect", which arises via the input-output interlinkages with other sectors. The total price reduction resulting from competition policy interventions in this industry is the sum of these two effects.

The within-industry effect reflects the immediate repercussions of merger interventions, cartel prohibitions and antitrust interventions on the markets affected. In a manner consistent with the analysis conducted with the QUEST macro-model (Section 4), the within-industry effect is computed according to Equation (4.1). However, in this case, the relative price drop computed through Equation (4.2) represents only one component of the overall price change in the sector (the other one being the spill-over effect). Deterrent effects are incorporated into the analysis as described in Equations (4.1) and (4.3).

The spill-over effect captures the ripple effects caused by the Commission's competition policy interventions. As price drops, this reduction is passed downstream along the supply chain. Spill-overs are computed from the within-industry effects using a standard input-output price model. The within-industry change of price represents the exogenous shock in this analysis. When an input becomes relatively cheaper as a result of a negative price shock, it is assumed that producers will entirely pass on the ensuing cost savings to their customers. In other words, the cost pass-through is assumed to be complete (one to one). Consequently, the prices of the products are expected to decrease. The overall price reduction in industry i (including the deterrent effects) is given by the sum of the within and spill-over effects. It should be noted that, as in all input-output models, our analysis assumes a relatively simple cross-industry price transmission mechanism. In this framework, for example, firms' use of inputs is not affected by changing prices. Therefore, we cannot rule out the possibility that our results somewhat overstate the price-reducing impact of competition policy.

In line with the economic literature, in the estimation of customer savings, we assume that the price reducing effects of merger interventions, cartel prohibitions and antitrust interventions last for more than one year, absent case-specific information. Therefore, in the spirit of the QUEST simulations, we take into consideration the fact that decisions by the Commission can produce effects over several years. Thus, interventions used for the computation of, for instance, the 2021 within-industry effect include not only the cases for which a decision was

[17] The Figaro tables became available for the first time in the spring of 2021.
[18] See https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/figaro

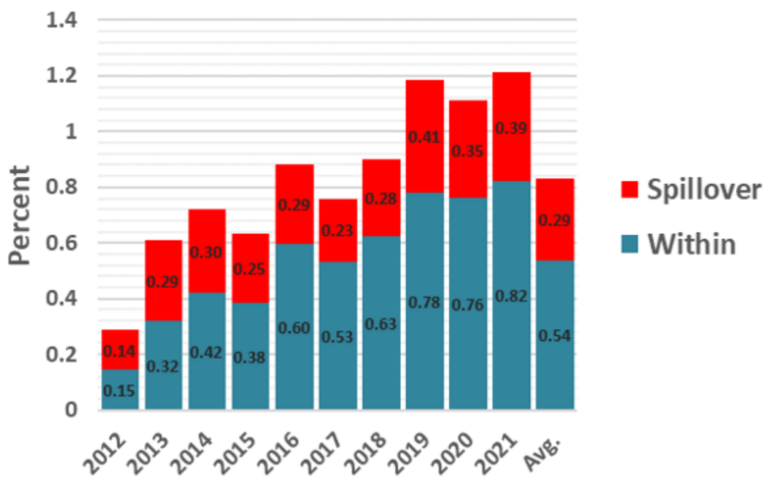
reached in 2021, but also those from earlier years that are deemed to be still producing their effects in 2021. However, due to the unavailability of data, the impact of decisions taken prior to 2012 is not taken into account. As a result, the analysis may somewhat understate the price reduction effects in the earlier years of the sample.

While this input-output analysis is performed at the 64-industry level, aggregating the results into a single economy-wide figure is a useful summary measure of the price impact of competition policy interventions. To this end, the industry-specific results are averaged using weights that reflect industry size (as measured by gross output).

The key results of the input-output modelling are outlined below. In all cases, we take deterrence effects into consideration. All price changes, in absolute terms, must be regarded as price reductions. In Figure 5.1, we provide an overview of the effect of merger interventions, cartel prohibitions and antitrust interventions on the overall price level in the EU.

On average, competition policy enforcement is estimated to lower prices by around 0.83% over the full ten-year period. Two thirds of the overall effect can be attributed to the within-sector impact of the Commission's competition policy interventions (WITHIN). The remaining part results from amplification of this impact between sectors (SPILLOVER) due to the input-output channels. The results vary from one year to another. The variations can be explained not only by the number of interventions, but also by their type; for instance, cartel prohibitions imply larger price decreases than other types of interventions. In addition, the analysis may somewhat understate the price reduction effects in the earlier years of the sample, as discussed earlier.

Figure 5.1: Impact of competition policy enforcement on the overall price level



Furthermore, taking duration effects into account, the 2021 WITHIN effect also includes the 2020 cases with an avoided price increase that lasts two or more years, the 2019 cases with duration of three or more years, etc. As a result, the year 2021 has the highest total effects of the period under analysis. Albeit to a lesser extent, the same mechanism can also be seen at work in other years.

This carry-over from one year to the next not only increases the estimated impacts on prices, but also tend to smooth the dynamics over time. Moreover, the impact of competition policy on

EU price levels tends to increase over time. This is because more recent cases in the sample have longer durations than older cases. It is important to keep in mind that in the early years of the series, the results are underestimated due to the lack of data on cases before 2012.

Compared to the price effects estimated last year (European Commission 2022b), this year's estimated price effects are somewhat greater. The main methodological differences with the previous year are summarised in the box at the end of the previous section. It is likely that the main increase in prices was determined by the changes in calibration. In this report, we equalized weighted average of deterrence multipliers to those from surveys of market participants, whereas last year we used an ordinary arithmetic average.

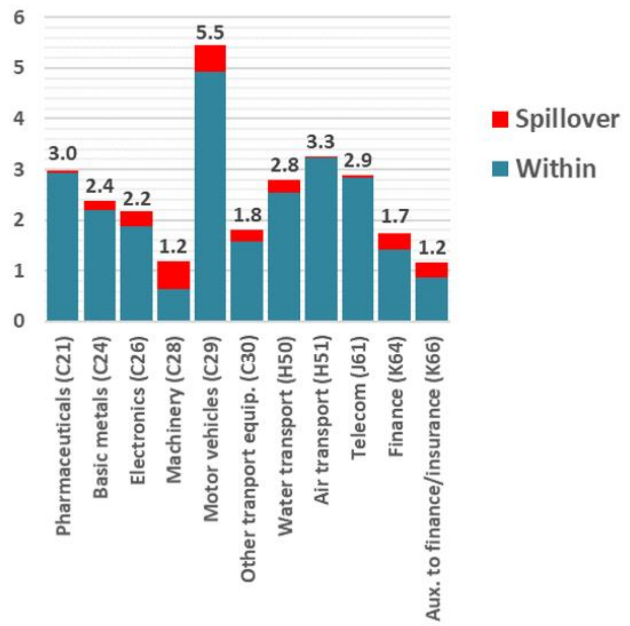
Table 5.1 below presents the relative significance of price spill-overs vis-à-vis the within-sector effects and total effects, respectively. Depending on the year, the spill-over effects account for thirty to fifty percent of the total impact on prices. The SPILLOVER/TOTAL ratio (and correspondingly the SPILLOVER/WITHIN ratio) is essentially determined by the distribution of the merger, cartel and antitrust cases across industries. Industries with many important downstream links (i.e., those that are located higher in supply chains) tend to produce stronger spill-overs than those with few downstream connections (i.e., those that sell a large share of their output to final users). Examples of activities with large spill-overs include finance, insurance and business services, resource extraction, the energy sector, basic manufacturing, and certain components of the transport network. As a result, the SPILLOVER/TOTAL ratio tends to be higher in years when the Commission's competition policy interventions are concentrated in high-spill-over industries. In 2021, spill-over ratios are at the lower end of the observed range, given that in the previous years the most significant cases were found in retail trade, transport equipment and electronics, which are industries with comparatively low spill-overs (Dierx et al. 2020).

Table 5.1: Relative significance of price spill-overs

Year	Spill-over/Within	Spill-over/Total
2012	0.97	0.49
2013	0.90	0.48
2014	0.72	0.42
2015	0.66	0.40
2016	0.48	0.32
2017	0.42	0.30
2018	0.44	0.31
2019	0.52	0.34
2020	0.46	0.32
2021	0.48	0.32
Avg.	**0.61**	**0.37**

Figure 5.2 presents the average (%) price changes over the entire period of analysis in the sectors with the largest effects. We distinguish between within-industry and spill-over effects, which arise through the input-output mechanism. The largest price reductions are found in the industries in which the European Commission made its most significant interventions (motor vehicles, water transport and telecoms services).

Figure 5.2: Industry-level price changes, 2012-2021 average, selected industries



6. FURTHER DEVELOPMENTS IN DATA ANALYSIS AND MODELLING

6.1. Corporate market power and macroeconomic performance: new insights from modelling the cost of "non-competition"

The measurement of market power is of primary importance for policymakers because market power may reduce consumers' welfare, reduce business dynamism, deter innovation and as a result, lower productivity.

There is growing evidence of increased levels of market power worldwide, notably reflected in increased industry markups, which has raised concerns in academia and among policymakers (Syverson, 2019). Additionally, the recent macroeconomic developments resulting from COVID-19 and Russia's attack on Ukraine have raised additional concerns about their impact on market structure. For example, suppliers might drop out of markets because of supply chain disruptions and rising energy prices, further increasing concentration in these markets. These dynamics may call for vigilance and potentially more pro-competitive action by the competition authorities.

Compared to the Annex in last year's report (European Commission, 2022b), we further extended the literature survey on the state of competition in advanced economies, and particularly on the rise in profits, margins and industry concentration, also in relation to the current wave of inflation worldwide. However, the main conclusions remain the same.

While most of the studies show that market power has increased in the last decades in the United States, empirical results for Europe are less outspoken, generating an intense debate in the economic literature. The debate on the extent of market power is twofold. On the one hand, it centres around the difficulties in measuring it. Traditionally, measures of market power were based on economy-wide or industry-sector data on markups from harmonised national accounts, which suffer from aggregation bias (Hall, 2018). Recent contributions are based on firm-level datasets, which have led to the development of new econometric techniques to address identification, causality issues and selection bias in the measurement of mark-ups. While De Loecker, Eeckhout and Unger, 2020) and De Loecker and Eeckhout (2021) estimate sizeable increases in mark-ups using data on listed firms, Díez et al. (2021) show how the inclusion of privately held firms may soften the conclusion regarding the evolution of markups. Raval (2023), however, shows how these results may be sensitive to measurement and estimation choices. Abraham et al. (2021) and Traina (2018) stress the importance of including fixed costs in the markup estimation. The underlying reason is that otherwise, one cannot identify cases where markup increases are due to changes in firms' cost structure (i.e., an increase in fixed costs) rather than an increase in market power.

On the other hand, the debate focuses on the causes of the rising market power, where observed. Several explanations have been proposed, such as a weakness in competition policy enforcement allowing firms to charge higher prices, technological progress within firms leading to efficiency gains resulting in cost reductions, or a reallocation of production and sales towards high markup "superstar" firms. Some economists argue that the increase in concentration and markups may signal a "winner takes most" competitive environment. Firms have become bigger thanks to technological changes that favour larger sizes, such as information technologies, making it feasible to operate on a larger or global scale (Van Reenen, 2018). Under this view, concentration and markups increase, but the competition level remains stable or even increases because the rise in market power is an expression of efficiency and superior technology due to new inventions and the adoption of innovations.[19] Other economists argue that higher concentration and markups result from inefficiencies in scale, increasing barriers, market power, lower investment, and productivity, which reduce competition (Gutiérrez and Philippon, 2023; De Loecker, Eeckhout and Unger, 2020). Therefore, there should be calls for increased antitrust enforcement, unleashing more jobs and higher growth.

In addition, we review the macroeconomic implications of market power at the aggregate level. Recent contributions (e.g., De Loecker, Eeckhout and Mongey (2022) have evaluated the implications of increasing market power on observed macroeconomic developments, such as the declining labour share, reduced business dynamism, lower investments, and slower productivity growth.

According to this strand of literature, a markup creates a wedge between the marginal revenue product of production factors (namely, labour and capital) and their prices (respectively, wage rates and the rental rate of capital) in the firm's cost minimisation problem. As Eggertsson et al. (2021) have observed, with higher factor wedges, factor prices are lower, and so are the factor supplies, decreasing the share of factors to output. This means that the increase in market power leads to a (sharp) reduction in the labour and capital share to output. At the same time, a lower capital share triggers a lower investment rate since firms have less incentive to invest given their position of market power. Reduced business dynamism may be also the result of greater barriers to entry associated with the increased market power. As a result, increased market power may cause a slowdown of productivity via allocative inefficiency, productive inefficiency and dynamic inefficiency (less innovation).

19 As acknowledged by these authors, this does not mean to say that vigilance is unwarranted. The superstar firms may have attained their market position in large part through superior performance and efficiency, but that does not mean that they may not seek to cement and protect this market position via anticompetitive means going forward.

Alternative explanations other than the increase in market power have been proposed to explain the observed trends. For example, some economists argue that the decline in the labour share and business dynamism are mainly due to the transition of the economy, from manufacturing to service industries (among others, Elsby et al., 2013), or due to the role of intangibles (Bajgar et al., 2021; Calvino et al, 2020; Calligaris et al. 2018), which lead to increasing returns to scale. However, proponents of the market power explanation (primarily, De Loecker et al., 2021) observe in this regard that most of the transition from manufacturing to services happened already before the late 1980s.

Motivated by such findings, we aim to quantify the possible cost of "non-competition". For this purpose, we look at the recent literature which has measured the global markup dynamics, allowing for a comparison across databases, methodologies and periods. Among those contributions, we select the studies of Díez et al. (2021), Akcigit et al. (2021) and De Loecker and Eeckhout (2021)[20] to assess the economic implications of the reported markup variations through the lens of the QUEST III model.

Simulation results suggest that the increased market power as observed in the past two decades can be associated with a decrease in GDP by 1 to 4 percentage points (see details in Annex A.2). However, results would become much more adverse if we base our consideration on the full size of the market shock reported by Akcigit et al. (2021) and De Loecker and Eeckhout (2021) over longer historical periods. In such a case, GDP would reduce by 8 to 10 percentage points.

However, the uncertainty regarding the macroeconomic effects on GDP suggests that further efforts are needed to benchmark the "cost of non-competition", for example, estimating the evolution of the markup using the same data source as the one used to calibrate our model. We reserve for future work the possibility of comparing the current state of competition against a counterfactual without functioning competition and against a counterfactual where competition is effective or at least 'workable'.

In Annex A.1, we provide an overview of the recent contributions to the evolution of concentration and markup trends in Europe and North America, highlighting some limitations and measurement issues. Finally, we focus on the link between market power and selected stylised facts and "secular trends." In Annex A.2, we assess the macroeconomic effects through the lens of the QUEST III model based on the emerging research on global markups and we discuss further developments in our agenda.

6.2. Competition and economic performance at the sectoral level

This section reports on the correlation between market concentration and the number of interventions by the European Commission at the sector level. Market concentration is measured by the CR4 ratio, which corresponds to the aggregate share of production of the four largest companies within the industry. A distinction is made between the Commission's three competition policy instruments: merger interventions, cartel prohibitions, and other non-cartel antitrust interventions.

For the purpose of this study, we used the information on the number of merger interventions, cartel prohibitions and antitrust interventions in each industry, collected for the customer

[20] As mentioned above, it should be noted that some recent contributions have questioned the findings of De Loecker and Eeckhout (2021) (see, for instance, Traina, 2018; Raval, 2023; Abraham et al., 2021), showing how their results may be sensitive to measurement and estimation choices.

savings calculations for the period 2012-2021. The data on interventions is at four-digit sectoral level (NACE rev. 2). In addition, we used data on market concentration levels for 156 sectors from Euromonitor International's Passport Industrial database[21], which is based on ISIC rev. 3.1 sectoral classification. Depending on the size of the sectors, they are expressed in the latter database at 2, 3 or 4 digit level of granularity. The data on interventions was converted from NACE rev. 2 classification to ISIC rev. 3.1 to be able to match the two datasets. As part of the analysis, we excluded 10% of sectors with the highest percentage of exports. We took this step due to the fact the production figures of some sectors and/or companies account for a large share of exports to other countries, while having fewer sales within the country of production. Our focus is primarily on sales (and not on production per se) as sales are more directly linked to market power. Additionally, we removed sector '233' (processing nuclear fuel), because there were not enough observations to calculate a measure of market concentration (CR4). More detailed information on the data used and results obtained can be found in Annex A.3.

A priori, one would expect the Commission to intervene more frequently in highly concentrated markets where companies may achieve high markups. An environment with weak competitive pressures may indeed give rise to anticompetitive behaviour. Over the period 2012-2021, the European Commission intervened in 77 different industries. In general, our results indicate a positive correlation between market concentration (measured by CR4) and the number of interventions made by the Commission. The correlation is significant at 5% significance level. This result holds for both ordinary (Pearson) correlation and robust (Spearman) correlation. However, if sectors with zero interventions are excluded from the analysis, the correlations between CR4 and the number of antitrust interventions become negative but close to zero. Therefore, our estimates confirm that, in general, the Commission intervenes more often in sectors with greater market concentration. However, other factors besides market concentration may influence interventions made by the Commission. For example, the number of interventions in a sector may also depend on the size and duration of previous interventions, which determine deterrent effects.

If we compare our results with those in the previous year's report (European Commission, 2022b) we notice that last year we found a negative, but statistically insignificant correlation between the number of interventions and concentration ratio in the field of cartels. This year, the correlation is estimated to be positive and statistically significant. The main difference, which determined this change, was that last year, 24 two-digit sectors based on the NACE rev. 2 classification were analysed, and this year we shifted to 156 sectors with ISIC rev. 3.1 classification.

7. CONCLUSION

This main report updates and improves the macro-simulation of competition policy interventions by the European Commission in a number of directions. Firstly, it includes the straightforward update of results with the competition interventions by the Commission in 2021. The year 2021 was characterised by a relatively low number of interventions. Secondly, it includes improved data on the Commission's antitrust and cartel interventions for the period 2012-2021. Thirdly, it presents a novel approach to assess the deterrent effects of competition policy interventions. The new approach relies on a widely used and robust theoretical model used to analyse the diffusion of information (the Bass function approach). The model considers the characteristics of the competition authority, and more precisely its reputation, as well as

[21] This database was previously used in sectoral concentration analysis by Koltay and Lorincz (2021), Competition Policy Brief, 2021.

the interactions between market players to better capture and model the process of diffusion of information.

The simulation results suggest a 1.17 percentage point reduction in markups (as measured by the Lerner index) resulting from the Commission's competition policy interventions. This reduction triggers an increase in real GDP relative to the baseline in the range of 0.6% to 1.1% in the medium to long term, the equivalent of an uplift of EUR 80 – 150 billion in 2019 GDP. All the main components of aggregate demand increase. More specifically, after 5 years we simulate increases in consumption (0.5%) and investment (1.1%) despite the decline in profits associated with the negative markup shock. Investment is increasing because the negative direct effect of markups on future profitability is more than offset by the positive effect of the increasing demand due to lower prices.

The main report also explores how the price effects of competition policy interventions are transmitted across sectors using information on economic interdependencies retrieved from an input-output table of the European Union. On average, the Commission's competition policy enforcement is estimated to lower prices by around 0.83% (and higher in recent years). Two-thirds of the overall effect can be attributed to the "within-sector price effect" including both the direct and deterrence effects of competition policy interventions with respect to that sector. The remaining part, i.e. the "spill-over price effect", results from amplification of this impact due to the input-output channels between sectors.

The macro-simulation exercises would merit further research to improve it in several dimensions. In particular, the calibration of the model of deterrent effects would benefit from further work to collect evidence on the size and determinants of the deterrent effects of competition policy interventions. The model is currently calibrated based on simple measurements (called multipliers) derived from surveys of companies and their legal advisors, which are scarce and limited in terms of time and geographical coverage. In this regard, DG Competition has commissioned a study to improve the knowledge of the deterrent effects by providing an update of the existing survey-based evidence of the deterrent effects of EU competition policy.

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TECHNICAL ANNEXES

A1. THE IMPACT OF OBSERVED INCREASES IN CONCENTRATION AND MARKUPS ON MACROECONOMIC PERFORMANCE: A REVIEW OF THE LITERATURE[22]

Measuring competition's strength in industries or in the economy is quite complex because competition is not directly observable. It follows that economists should rely on some indicators and methodologies, which can provide helpful information but also have some limitations (OECD, 2021).

In recent years, there has been a growing concern among policymakers and academia regarding the increasing trend in market power[23] across the world, and its possible macroeconomic implications, such as reduced levels of investment, a declining labour share, growing inequalities, or lower productivity growth. In addition, the recent COVID-19 crisis and Russia's attack on Ukraine have raised additional concerns in terms of their impact on market structure. For example, suppliers may have dropped out of markets because of supply chain disruptions and rising energy prices, further increasing the levels of market power in certain markets.

Two compelling explanations have been provided in the literature regarding the source of increased market power.[24] Some economists argue that the increase in market power indicators such as industry concentration and markups signal a "winner-takes-the-most" competitive environment (Autor et al., 2020; Van Reenen, 2018). Firms have become bigger thanks to technological changes that favour larger sizes – as is the case of the ICT intensive sectors – making it feasible to operate on a large or global scale. Under this view, market power has increased, but the overall level of competition (consumer welfare) has either remained stable or has increased because of efficiency gains and superior technology due to new inventions and the adoption of innovations.

On the contrary, other economists argue that higher concentration and mark-ups result from increasing barriers to entry, market power, lower investment and productivity, which all imply a lower level of competition and welfare (Gutiérrez and Philippon, 2023 ; De Loecker, Eeckhout and Unger, 2020).[25] Therefore, there should be calls for strengthening antitrust enforcement, in order to boost job creation and support economic growth.

It should be noted that disentangling the source of the two types of market power is difficult in practice. Moreover, competition law has profound implications, even in the "winner-takes-the-most" case, particularly if it is proved that such firms exploit relative market dominance to erect entry barriers and other obstacles to competition.

In the case of the ICT sector, for example, intangibles (among others, software, patents, copyright, and trade secrets) are important drivers of economies of scale, network externalities and technological change. These factors could be the source of higher barriers to entry and technology diffusion, reduced innovation rates and potential market foreclosure, as reported by Calvino et al. (2020).

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22 Appendix prepared by Roberta Cardani (DG-JRC). I thank Alexis Stevenson for his useful comments.

23 Market power is defined here as the ability of firms to maintain prices above their marginal cost (short run market power).

24 In Covarrubias et al. (2021)'s terminology, the two compelling explanations are defined as "good" and "bad concentration".

25 To put it in the words of Shapiro (2018, p. 737), "Profits necessary to induce risky investments are one thing; incumbency rents are quite another."

This Annex reviews contributions to the evolution of concentration, markups and profits in Europe and the United States, presenting an overview of the current state of the empirical literature. Section A1.1 presents the most common measures of concentration, markup and profits and other indicators used in the literature, discussing some advantages, limitations and measurement issues. Sections A1.2, A1.3 and A1.4 review empirical literature in the US and Europe about the recent trends in concentration, markups and profitability. Section A1.5 discusses the macroeconomic implications of rising market power in terms of reduced business dynamism, labour share, investment and productivity. Section A1.6 concludes.

A1.1. Definitions

Competition cannot be observed directly. Therefore, economists evaluate the state of market competition and measure market power through various indicators (Syverson, 2019)[26]. These indicators capture different dimensions of competition, reflecting market concentration, market contestability (entrenchment at the top, entry barriers), and market performance, such as markups, productivity and profit dispersion, among others. An observed change in industry concentration can then be due to the competition environment (e.g., changes in the number of firms active in the market) but also to technological progress, globalisation, or changes in regulation.[27]

In what follows, we outline measures of concentration, markup, profitability and other indicators used in the literature to evaluate the state of competition and briefly discuss some of their advantages and limitations. Note that given the limitations of each individual indicator, results based on one category cannot offer a conclusive view of the intensity of competition. However, they are informative, mainly when common trends are observed across other competition indicators (OECD, 2022).

A1.1.1 Measuring concentration

Industry concentration measures the extent to which economic activity is concentrated within a small number of large companies or business groups within an industry (Bajgar et al., 2019).[28]

The two most common measures of concentration are the concentration ratio and the Herfindahl-Hirschman index.

The **concentration ratio**, CR(N), is based on the market shares of the N largest firms. For example, CR(4) or CR(8) represent the combined market share of the four or eight largest firms in a given market/industry. A high concentration ratio indicates that the industry/market output is produced by only a few firms and therefore, it may be a signal of elevated market power in the industry/market. An alternative measure refers to the market shares of the largest percentage of firms (e.g., the top 10% of firms). By focusing only on the sum of market shares, the concentration ratio does not take into account the firms' market share distribution.

Unlike the CR, the **Herfindahl-Hirschman index** (HHI) is based on the full distribution of the firm market shares. More precisely, the HHI is defined as the sum of the squared market

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[26] For more details on the methodological approach to evaluate market power, see Annex A.1, European Commission (2021).

[27] Among others, refer to OECD (2021).

[28] Under some circumstances, high concentration may reflect highly competitive pressure, with all but the most efficient firms being driven from the market. For example, if an industry with a high concentration ratio faces significant foreign competition, it may behave competitively. An industry with a high concentration ratio may not be able to restrict output very much if there are no barriers to restrict other firms from entering the industry in response to high monopoly profits.

shares. In a theoretically perfectly competitive market/industry, the HHI approaches 0, while in the case of a monopoly, it is 1 (or 10,000 if whole percentages are used). The HHI is more data-intensive than the concentration index, as it requires information on the entire firm size distribution.

Concentration-based metrics are straightforward to calculate when the needed information is available. However, some caution is required when interpreting the results of the analysis. Three main drawbacks are outlined in the literature.

Firstly, concentration does not measure market power directly. In Syverson (2019)'s words, concentration measures are the market outcome, meaning that they are the results of the competitive interactions of firms rather than determining the competitive environment. Cavalleri et al. (2019) observe that the (positive) correlation between market concentration and market power only holds when firms compete under certain assumptions, such as under Cournot competition (Tirole,1988). Furthermore, in the case of product differentiation, there is no longer necessarily a direct relation between market concentration and market power.

Secondly, the choice of dataset is important, especially when using firm-level data to calculate sector turnover, where the coverage of firms varies across industries or countries and over time, as in the case of the (widely used) firm-level databases such as Orbis.[29] Practically, total sales in each industry (the denominator in the market share calculation) can be calculated by summing sales across all firms in the dataset. Bajgar et al. (2020) assess the coverage and the representatives of Orbis data compared to OECD MultiProd, DynEmp and STAN datasets. They note that as the sample size in Orbis has increased in recent years thanks to the inclusion of small firms, market shares (incl. trends) are not appropriately measured.[30] Changes in the coverage of firms will artificially affect the concentration index.

Thirdly, most of the literature on concentration focuses on sector or industry trends, which are not the same as trends in antitrust markets. Many studies rely on industry-level data (usually 4, 5 or at best 6 digits NAICS/SIC), which are normally much more aggregated than relevant antitrust markets. Therefore, some trends in antitrust markets may be missed when looking at industry trends because of aggregation and averaging problems.

The links between industry concentration and concentration in antitrust markets are not always straightforward, and there are important open questions related to the definition of the "relevant market" and its boundaries. Concentration measures necessarily raise the question of market definition, as one needs to know what firms and products to include in the "numerator" and "denominator" when calculating the market shares. For example, firms' market shares may be too large if firms are diversified with sales across industries. In such a case, allocating sales to only one industry may overestimate market shares. On the contrary, firms' observed market shares may be too small, as in the case of subsidiaries being measured separately while belonging to a larger group. In such a case, the market shares may be underestimated.

In this context, it is also important to note that many firm level databases (including Orbis) are based on *production figures* (i.e. the value of production) of establishments located in a given country, rather than on the value of sales of these firms *into* different geographic markets. To the extent that a significant part of production is exported to other countries, there is a risk that market shares based on production figures overestimate the market position of the firm in the

[29] Bajgar et al. (2020) assess the coverage and the representatives of Orbis data compared to OECD MultiProd, DynEmp and STAN datasets. They note that as the sample size has increased in recent years thanks to the inclusion of small firms, the concentration ratios are not appropriate. Changes in the coverage of firms will artificially affect the concentration index.

country where production is based and underestimates the market position of the firm in the countries into which it sells.

A1.1.2 Measuring markups

The markup is the ratio of the price to the marginal cost of producing an additional unit of output. It is also alternatively expressed as the Lerner index, defined as the ratio of the welfare gains from one additional unit of output (price minus marginal cost) to the price. The bigger the gap between the price of a product and its marginal cost, the greater the firm's market power. In a perfectly competitive market, competition should drive prices close to the marginal cost, whereas in a monopoly market, the producer exerts market power and has the ability to set a higher price, thus reducing the quantity supplied.

As the markup is not observable, its estimation is challenging due to the lack of data on marginal costs and production function. Thus, various estimation methods have been developed based on the firm balance sheet, each with advantages and disadvantages. For example, specific drawbacks of markup estimation techniques include validity only under the returns-to-scale assumption or market structure hypothesis (e.g., not valid in case of monopolistic competition).

At the microdata level, two approaches are generally used to estimate markups: the demand approach and the production approach.[31]

The **demand approach** exploits the first-order conditions of consumer choice to derive the marginal cost, as in the discrete choice model developed by Berry et al. (1995). This framework requires a specific model of how firms compete, generally in an oligopolistic market, and a model of consumer behaviour, using data on prices, market shares and product characteristics.

Suppose that the economy is composed of a number of consumers, who are differentiated by their tastes. The i-th consumer chooses to buy one unit of the product j in order to maximize her utility, u_{ij} :

$$u_{ij} = u(x_{j,} P_j, \varepsilon_{ij}, \xi_j; \theta^d) \qquad \text{(A1.1)}$$

where x_j are the non-price observed characteristics, P_j indicates the price level of the product j, ε_{ij} captures an individual-specific component of utility; ξ_j is an unobserved characteristic for product j which is the econometric error term. To characterize the demand function, one determines the cut-off point at which the consumer is indifferent between buying the two goods. This allows for estimating the structural parameters of the model θ^d pinning down the distribution of consumer preferences.

The matrix of own- and cross-price elasticities at the observed prices and quantities is obtained from the system of demand functions and is used to compute the markups. The first order-condition of pricing is a function of the markup, μ and the unobserved marginal cost, c_j:

$$P_j = \mu_j \left(M(s, \theta^d) \right) + c_j \qquad \text{(A1.2)}$$

31 De Loecker and Scott (2022) estimate markup using demand and production data in the US beer industry with both demand and production approaches. They find that markup estimates are statistically similar, even if the demand approach is more sensitive to the choice of the instrument variable.

Note that the markup depends on the competition model, $M(s, \theta^d)$, assumed, on the vector of relevant market shares, s, and the estimated demand parameters, θ^d. We can use observed prices as well as information on demand derivatives and firm conduct to recover the markups μ_j.

It should be noted that such an approach requires detailed information on market-level shares, prices, and product characteristics which are sometimes supplemented with data on demographics and consumer characteristics. Because of the stringent data requirement, this approach is unsuitable for estimating markups at the economy-wide level or across many sectors.

The **production approach** relies on the estimation of production function parameters and the output elasticity of variable inputs (at least one input) by means of accounting data (among others, see the pioneering work of De Loecker and Warzynski, 2012; Hall, 1988; Roeger, 1995; Hall, 2018). This approach allows to estimate markups using either aggregate or firm-level data, depending on the methods used.[32]

The approach of De Loecker and Warzynski (2012) assumes that firms minimize their variable costs. The markups can be estimated using the information on the cost of input as a share of the firm's revenue and the extent to which the firm's output varies with the use of these inputs, as measured by the output elasticity. Formally, given the production function for firm *i* producing in industry *j* in period t:

$$Q_{it} = F_j(M_{it}, K_{it}, L_{it})\Omega_{it} \qquad \text{(A1.3)}$$

which uses variable material input, M_{it} , capital, K_{it} , and labour, L_{it}. Ω_{it} denotes the Hicks-neutral technological progress.

In the absence of fixed costs, the markup is obtained by computing the marginal cost of production from the cost-minimization conditions, which yields the following expression:

$$\mu_{it} = \left(\frac{P_{it}Q_{it}}{P_{it}^M M_{it}}\right)\left(\frac{\partial Q_{it}}{\partial M_{it}}\right)\left(\frac{M_{it}}{Q_{it}}\right) = \frac{\alpha_{it}^M}{\theta_{it}^M} \qquad \text{(A1.4)}$$

where P_{it} denotes the output price, P_{it}^M is the input price of materials, $\theta_{it}^M = \left(\frac{P_{it}^M M_{it}}{P_{it}Q_{it}}\right)$ is the ratio of expenditure on materials to observed firm's revenue[33] and $\alpha_{it}^M = \left[\left(\frac{\partial Q_{it}}{\partial M_{it}}\right)\left(\frac{M_{it}}{Q_{it}}\right)\right]$ is the elasticity of output with respect to material input.

The (weighted) average markup over all the sample firms is used to assess the market power within a sector or an economy.

Under perfect competition, input shares are equal to the output elasticity, so the markup is equal to 1. When firms have market power, the markup is a wedge between the output elasticity

32 See Basu (2019) and Syverson (2019) for more comprehensive reviews of different firm-level markup estimation methods.

33 The input share can be measured directly by firm or establishment level data, as noted by Foster et al. (2022).

and the input's share of total revenues. In such a case, a firm could slightly produce more output only at the cost of a smaller margin on its existing output.

The estimation method proceeds in two steps. In the first step, one obtains estimates of the expected output that removes measurement error and unanticipated shocks at the second-order approximation. In the second step, the output elasticity for each sector is estimated by the method of moments, following the procedure developed by Olley and Pakes (1996). Markups are the deviation between the elasticity of output with respect to a variable input and that input's share of total revenue.

Unlike the demand approach, the production approach does not rely on any specific model of competition. However, to identify the elasticity of output, one does need to impose a specific production function (Cobb-Douglas, Translog, etc.).[34] It also requires information on revenues, costs, and assets, combined with information on output and input prices (deflators) and assumes that all firms are cost-minimizers.

This approach suffers from some drawbacks. For example, Traina (2018) notes that there is a selection bias in extrapolating firm markups for the aggregate economy, which tends to overestimate the markup. Moreover, the author shows that measuring the variable costs as the cost of goods sold or as selling (as in De Loecker et al., 2012 and 2020)[35] may lead to an opposite conclusion than measuring it as general and administrative.[36]

Calligaris et al. (2018) also show that the estimation of De Loecker and Warzynski (2012) is subject to a mismeasurement due to overhead costs when labour costs are used to estimate markups, while Bond et al. (2021) stress the difficulties in estimating the proper output elasticity from revenue data, that are needed for markup estimation.

De Loecker and Warzynski (2012) simplify the problem by considering that the output elasticity is time-invariant, i.e., α_i^M constant over time. In a subsequent paper, De Loecker, Eeckhout and Unger (2020) show that the previous results are robust even when output elasticity varies over time. To this purpose, they use a control function approach to avoid the simultaneity bias in the production function estimation[37]. Moreover, the authors do not observe outputs but use revenue functions to estimate elasticity. In addition, they approximate the output elasticity of an input factor by calculating the input factor's share of total variable costs.

A different method is the cost share approach, which consists in approximating the output elasticity of an input factor by measuring the input factor's share of total variable costs. Differently from the previous methods, this approach does not require the specification of a production function, but it requires that the first condition for cost minimization holds for all inputs in any given year and assumes that firms have constant returns to scale. This approach has been used by De Loecker, Eeckhout and Unger (2020) as sensitivity checks and by Autor et al. (2020).

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[34] While the share of expenditure on the input is directly observed in the data, the output elasticity is not. Therefore, this method requires a key assumption on the production function.

[35] This procedure allows obtaining a bundle of variable input expenditures to calculate firm- level markups. However, implicitly the authors assume that labour and materials are perfectly substitutable.

[36] While the cost of goods sold measures indirect input to productions, such as materials and most of the labour, the selling, general, and administrative expenses include indirect inputs to production and mostly marketing and management costs.

[37] The bias is due to the fact that firm productivity is unobserved and is likely correlated with the error term: a firm may decide to use less labour or input, which will introduce a bias in the general proportion of inputs used in production.

One corollary of the production approach is that under Hicks' neutrality any flexible input identifies the markup. Raval (2023) compares the markups estimated using labour, materials, or cost of goods sold (COGS) and obtains that Hicks neutrality may not hold. Labour markups are found to be much more dispersed than materials markups, negatively correlated and have opposite time trends. Non-neutral technologies across establishments can resolve the puzzle because it allows having different firm-specific output elasticity of labour and materials.

Unlike De Loecker and Warzynski (2012), Hall (1988) infers the price-cost margins relying on very mild assumptions using industry data. The author estimates the Solow residual[38] in a perfectly competitive environment, taking the first-order approximation of the production function and applying the first order condition of the cost minimization:

$$SRQ = L(\Delta Q - \Delta K) + (1 - L)\Delta\theta \qquad \text{(A1.5)}$$

where $L = (p - MC)/p$ is the Lerner index. In the absence of market power, $p = MC$ and SRQ captures the Solow residual for technological change which is obtained by subtracting the share-weighted input growth from the output growth. SRQ is interpreted as the productivity term and is not correlated with the growth rate of capital. In the presence of market power ($L > 0$), $\Delta\theta$ should be estimated econometrically using an instrumental variable that is correlated with the input choice but uncorrelated with the technical change.

Roeger (1995) exploits the difference between the error term and the dual Solow residual to produce an unbiased estimation of the Lerner index.

Hall (2018) parameterizes each industry-level markup as the sum of a constant and a time trend and estimates the markup using the instrumental variables technique to address the concern that the input variables are correlated with the error term (endogeneity).

A novel approach has been proposed by Abraham et al. (2021), which build upon Roeger (1995) by exploiting information from data on expenditures of inputs and revenues and modelling the fixed costs in the production function. Through a difference-in-differences approach, their methodology allows the evaluation of the markup time variation jointly with the evolution of fixed costs and profits. According to this approach, the rise in markup power is the consequence of the rise in fixed costs associated with production, such as overhead cost (which firms should cover in the long run) and changes in profitability. Unfortunately, it does not allow estimating the markup distribution while relying on specific functional assumptions concerning the relationship between the increases in the shares of fixed factors and the firm size (European Commission, 2021).

A1.1.3 Measuring profitability and other indicators

Measures of profitability have been widely used as complementary indicators of change in market power. As explained in the CMA (2020), in a properly competitive market, firms are rewarded with a "normal" profit. Consequently, profits above the estimated "normal" level might suggest a deterioration of competition. However, it should be noted that "extraordinary" profits may also result from successful innovation processes or unexpected increases in demand or falls in production costs, which translate into a windfall profit not related to the competitive environment. Following this reasoning, what is informative is not the level of profit *per se* but the variation of the indicator of profitability over time.

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[38] The Solow residual is the most common method of calculation of total factor productivity (TFP), which consists in calculating the difference between the growth rate of output and a weighted average of the growth rate of factor inputs.

The main profitability indicators used in the literature are the profit rates calculated as the firms' market value (De Loecker, Eeckhout and Unger, 2020) and the corporate saving (i.e., undistributed gross profits) obtained as a residual share of gross value added after reducing labour costs and indirect taxes on production (Barkai, 2020, and IMF, 2019).

Aghion et al. (2005) construct a price-cost margin indicator measured by operating profits net of depreciation. Similarly, Gutiérrez and Philippon (2017b) estimate the financial cost of capital divided by firms' sales. Furman and Orszag (2015) use Return on Invested Capital (ROIC), which is obtained as a ratio of the net operating profit after tax to the invested capital, while the earnings before interest and taxes (EBIT) margin considers the fixed costs (CMA, 2020). Finally, Grullon et al. (2019) consider the operating income before depreciation (OIBDP) scaled by the book value of assets.

The estimation of profits is challenging because of the possibility of omitted or unobserved capital, such as intangibles. Additionally, profitability indicators calculated using accounting data may be influenced by changes in accounting standards over time. Finally, firms registered in a country may have a large part of their business overseas. Therefore, profitability may be influenced by competition in foreign markets rather than changes in domestic competition.

The entry and exit rates are other indicators widely used in the economic literature as dynamic structural measures of competition (Calvino et al., 2020). In well-functioning markets, less efficient firms exit the markets and are replaced by more efficient firms in the absence of entry barriers. The entry (exit) rate is calculated as a ratio between the number of new (exiting) firms each year to the total number of active firms in the same year. While these indicators are considered good proxies of Schumpeter's creative destruction, high entry and exit rates may not necessarily indicate dynamism when large firms have a significant and stable share of the market.

Similarly, the job reallocation rates measure simultaneously the job creation and destruction (i.e., is the rate at which workers change jobs) occurring within an industry or sector.

A1.2. The evolution of concentration in the United States and European Union

The empirical literature suggests that industry concentration has increased – using different concentration metrics – in most OECD economies. Almost all the empirical studies agree that the US has experienced an increasing trend in concentration over the last two decades.[39]

One of the first to acknowledge such a trend is Grullon et al. (2019). They show that firms in concentrated industries exhibit higher profits, more profitable M&A, and abnormal stock returns. The authors demonstrate that the concentration index declined from the beginning of the 1980s and remained low until the late 1990s, reaching its lowest point in 1996-97. Since then, the HHI has risen steadily until the end of their sample, which is 2014. This pattern also remains unchanged when the authors consider alternative indicators, such as the share of employment in firms or when they exclude the multi-segment firms.[40] According to the authors, the increase in concentration is widespread across US industries. US firms' increased profitability and abnormal stock returns are highly correlated with industry concentration, especially after 2001. The reason is that higher barriers to entry have increased the ability to generate higher profit margins by discouraging competitors. These may generate a surge in M&A deals motivated by gains associated with increased market power. The authors conclude

39 See, among others, Covarrubias et al. (2021) and Basu (2019).
40 The authors eliminate the year observation when the non-core segments account for 30% of the sales.

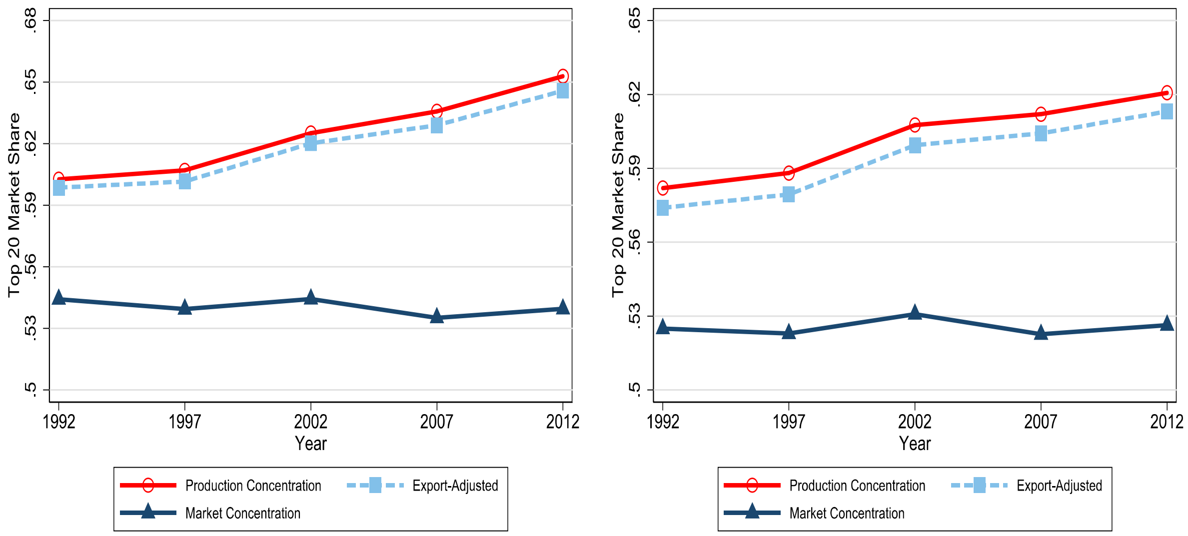
that the combination of lax enforcement of antitrust laws in the United States and technological innovation might have contributed to increased concentration and barriers to entry.

Other authors, such as Autor et al. (2017, 2020), have also documented increased concentration in the US, testing the hypothesis of superstar firms, defined as the most productive firms in each sector, with above-average markups and below-average labor share. More precisely, using US Census Bureau data over the period 1982-2012, Autor et al. (2017) report an increase in CR4 on average by 4% in services, 5% in manufacturing, 6% in wholesale, 8% in utilities, 11% in finance and 15% in retail. The authors argue that industry consolidation and technological innovation have resulted in a relatively small number of efficient firms with superior products exerting significant market power. Autor et al. (2020) show that qualitative findings are also robust to alternative measures of market power based on value-added and HHI.

Exploiting US confidential Census data over the period 1992-2012, Amiti and Heise (2022) have evaluated whether the rising concentration in the US manufacturing sector indicates that large firms have greater market power. To answer this question, they challenge the conventional wisdom of market shares based on where the sales originate (*production* concentration), including sales to foreign markets. On the contrary, they focus on the concept of destinations of sale (*market* concentration), which excludes exports but includes imports.

Figure A1.1 The role of imports according to Amiti and Heise (2022)

(a) Unweighted concentration (b) Weighted concentration



Source: Amiti and Heise (2022).

Amiti and Heise (2022) show that Top 20 market concentration (e.g., calculated irrespective of where firms are located) stayed constant, while production concentration (e.g., calculated considering where firms are located) or the one adjusted for foreign exporters increased during the same period, as depicted in Figure A1.1 (panel a). The authors conclude that the rise in production concentration is mainly due to the intense competition caused by the entry of foreign competitors, which reduced the market share of the top twenty US firms by an average of around 0.8 percentage points since 1997. They also establish that the growth of foreign firms' market shares was mainly concentrated at the bottom of the sales distribution, balancing out the increase in concentration among US-based firms. These results also hold when weighted concentration index averages across all NAICS 5-digit manufacturing industries is considered (panel b).

Rossi-Hansberg et al. (2021) show that the positive trend observed in the US concentration becomes negative when focusing on measures of local concentration. While national concentration measures may aggregate different geographical markets, local concentration measures may better capture consumer behaviour at the market level. In this sense, local concentration in some sectors such as the retail sector, is more informative than national concentration, as consumers primarily choose among local stores.

However, Smith and Ocampo (2022) have reached a different conclusion on local concentration using Census retail data. According to the authors, the US product HHI increased from 1.3 to 4.3[41] between 1992 and 2012, while the local HHI increased in 57% of commuting zones between 2002 and 2012.[42] Possible explanations for these trends are the different data sources used, the different methodology and different definition of product market. However, Eeckhout (2020) argues that this conclusion is mainly due to population growth: the number of establishments increases, while the extent of the market remains unchanged, implying that HHI decreases by construction.

Covarrubias et al. (2021) interpret the evolution of the US industry concentration in terms of the dichotomy of "good" and "bad" concentration.[43] Using a principal-component analysis, the authors find that "good concentration" characterizes durable goods and computer manufacturing, computer services, and nondurable industries. These industries remain competitive despite increases in intangibles and concentration, likely due to foreign competition. On the other hand, information (telecom), banking, and air transportation are characterized by "bad" concentration. Accommodation/food (i.e., restaurants) is an industry with limited use of intangible assets that mainly remains competitive. Examining the evolution of concentration over time, the authors show that "good" concentration was substantially higher and increased faster between 1997 and 2002, while "bad" concentration caught up afterwards. By 2012, most industries weighted heavily on principal component capturing theories of bad concentration, while the average principal component capturing theories of good concentration score remained close to zero. According to the authors, this could be rationalized by the change in the US lobby starting in 2000.

Compared to the US, evidence for Europe's concentration trend is quite limited and mixed. On the one hand, some papers show an increasing concentration trend. For example, Bighelli et al. (2022) exploit CompNET data to show that the EU HHI index rose by 43% from 2009 to 2016. Looking at the country level, the authors point out that firm concentration falls in 10 out of the 15 countries. Decomposing[44] the aggregate change of the HHI into changes "within" and "between" countries and sectors, the authors show that even in the presence of a negative covariance, the reallocation effects towards more concentrated countries and sectors drive the aggregate increase in European concentration. Moreover, using a dataset on German firms, Bighelli et al. (2022) also show that the German manufacturing sector accounts for most of the European concentration level (69% in 2009 and 84% over the sample).

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41 HHI measures the probability that two dollars spent at random are spent in the same firm. In other words, the probability that two dollars are spent in the same firm in the US goes from 1.3 percent to 4.3 percent between 1992 and 2012.

42 The authors explain that product-based measures emphasize competition in the sale of goods, while industry-based measures emphasize competition in retail services.

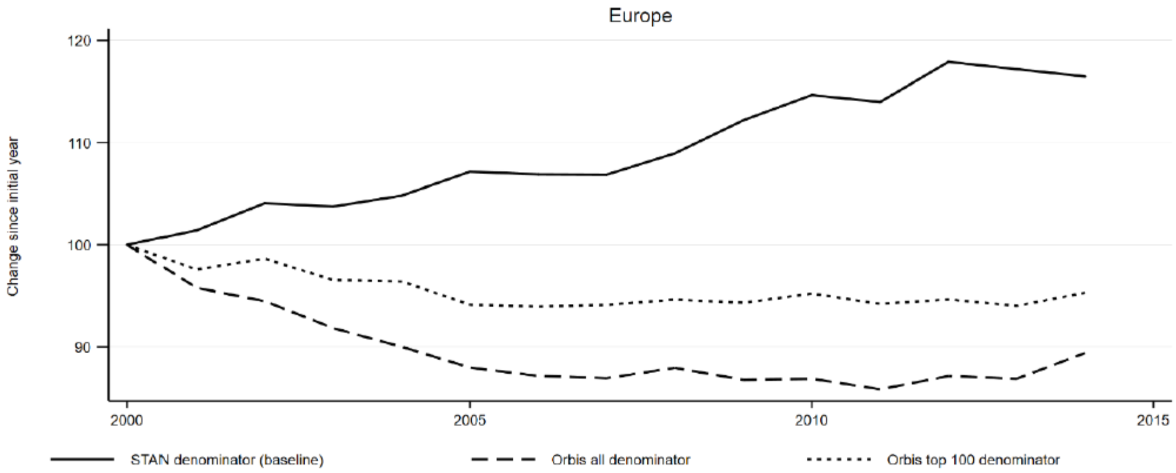
43 De Loecker et al. (2021) quantify the contribution of both channels and conclude that reallocation gains were dominated by welfare loss in the US.

44 The decomposition approach is similar to Olley and Pakes (1996).

Bajgar et al. (2019) exploit MultiProd and Orbis data over 2001-2012 to compare the evolution of industry concentration in North America and Europe. They use concentration indices based on the concentration ratios (CR4, CR8 and CR20).

The authors also show how the choice of the denominator (total sales) on the industry concentration trends could affect the measure of concentration.[45] As illustrated in figure A1.2, the authors note that scaling their numerator with the denominator from Orbis concentration is found to fall over time because the coverage of firms in the dataset varies across industries and over time. On the other hand, MultiProd is representative at the country level, so total firm sales for a country are close to STAN aggregates.

Figure A1.2 The denominator effect according to Bajgar et al. (2019)



Source: Bajgar et al. (2019)

Bajgar et al. (2019) also show that manufacturing and services are equally concentrated in output growth, value-added and total employment. The authors conclude that in EU countries, the sales concentration has increased more than employment concentration, and more in non-financial market services than in manufacturing. The overall concentration increased by 4 percentage points in Europe, compared to around 8 percentage points in the average North American industry. While for EU countries, the growth in concentration is more significant for larger industries, North America displays a lower increase in weighted mean concentration. In the manufacturing industry, the rise in concentration in North America is similar to the increase in the EU. In both areas, the trend does not seem to be driven by the digital-intensive sectors. Similar trends are reported by IMF (2019), which estimated concentration levels over the period 2000-2015 in the advanced economies, although the reported magnitude is lower than Bajgar et al. (2019).

The fact that concentration in the US has grown much more strongly might be in line with Gutiérrez and Philippon (2023)'s hypothesis of a lack of antitrust enforcement and increasing level of lobbying. Using Orbis data, the authors find that concentration ratios have remained broadly stable in Europe, both when calculated within countries and when treating all of Europe as a single market. Specifically, the authors find that concentration increased in Europe during

45 In the literature, the total sales in each industry can be calculated by summing sales across all firms in the dataset or obtained from the industry-level database.

the financial crisis and immediately afterwards, the levels of concentration have been stable since the early 2000s and have fallen since the late 1990s.

Koltay et al. (2022) assess the evolution of the industry concentration index in Germany, France, Italy, Spain, and UK over the period 1998-2019 using Orbis data. To avoid bias in the denominator of their concentration measure, the authors use the industry size obtained from the respective national accounts (from Euromonitor International's Passport Industrial database). This has been done to properly address the geographical segmentation of imports and exports in the Orbis dataset, which, unfortunately, does not record the direct import activity performed by a domestic subsidiary. Moreover, firms registered in a particular country may not declare the consolidated financial statement. The authors find that the average concentration (CR4) increased moderately between 3.6 and 7 percentage points. They also show that the European economic structure tends to be more oligopolistic rather than monopolistic due to an increased concentration of low and mid-concentration industries. In the service sector, the most significant increase in concentration has been registered in the communication, transport, and finance sectors. In the manufacturing sector, transportation accounts for the highest increase in the level of industrial concentration. Moreover, concentration growth was most substantial in the boom period before the 2000 crisis and the period of the 2008-2009 crisis. Among the European countries considered, France and UK experienced a substantial increase in concentration, while Spain and Italy showed a minor increase.

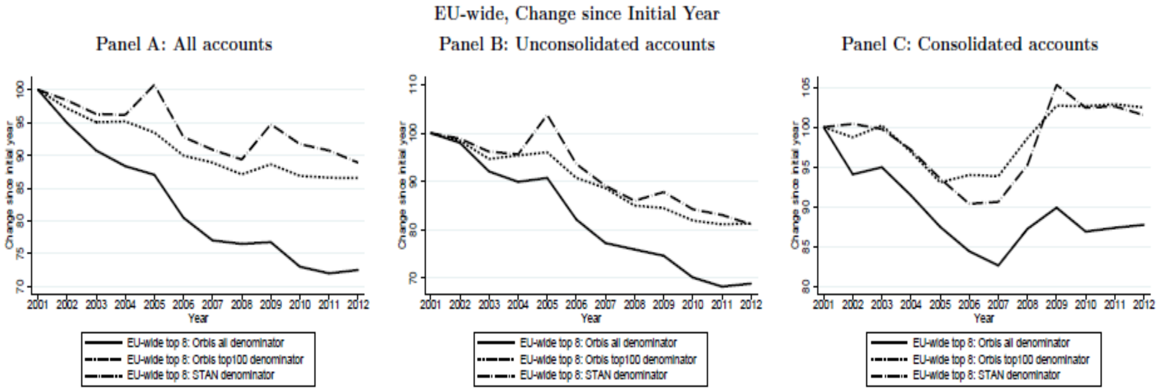
Bauer and Boussard (2020) also report an increase in concentration ratios and top shares in France between 1984 and 2016. They find that concentration has increased in more than half of the 211 French industries since 1995, quantifying the increase in the concentration ratios median in about 2 percentage points.

Kalemli-Ozcan et al. (2022) observe that the Orbis dataset, although representative, may not cover the universe of firms in an economy. The authors use the Structural Business Statistics (SBS) data to validate[46] the representativeness of the European firms in the Orbis sample and the OECD data to validate the sample of foreign firms in the Orbis database. In their exercise, Kalemli-Ozcan et al. (2022) validate their sample using the firm-size distribution from Eurostat SBS, which is essential to avoid assigning too much weight to large foreign firms, whose market shares have gone up due to the easing of cross-border regulations during the European integration process. When the sample is not validated (and thus, larger weights are attributed to foreign firms), the authors obtain an increasing concentration trend over time.

In figure A1.3 Kalemli-Ozcan et al. (2022) compare the effects of the choice of the denominators on the top 8 concentration measure, using three different denominators to calculate the market shares: the entire Orbis total, Orbis-100 (i.e., the output from the top 100 firms in Orbis) and gross output aggregate reported in the OECD Structural Analysis database. When using representative samples of firms, the authors find a declining industry concentration trend in Europe of about 10% when considering the entire sample and 20% when considering the sample of firms reporting unconsolidated (panels A and B). Conversely, among firms reporting consolidated accounts in panel C, the concentration decreased until 2007 and increased afterwards, as in Bajgar et al. (2019). The top 8 concentration index increased by 2.5% between 2001 and 2012 in Europe due to the exclusion of critical large firms in the top 8 firms and to the regulatory change (from unconsolidated to consolidated reporting account) that occurred in 2007. The authors argue that among the firms who adopt the switch reporting are foreign-owned firms.

[46] Ali et al. (2008) also show that Compustat-based industry concentration measures are poor proxies for actual industry concentration. The correlation between the Compustat and US Census-based Herfindahl indexes is only 13%.

Figure A1.3 The denominator effect according to Kalemli-Ozcan et al. (2022)



Source: Kalemli-Ozcan et al. (2022)

Cavalleri et al. (2019) and Gutiérrez and Philippon (2023) have also reported decreasing trends for the European concentration index. Using micro and macro data over the period 2006-2015, Cavalleri et al. (2019) show that concentration is higher at the country level than at the single market aggregate level. Italy appears to be the least concentrated, while Germany is the most. Over time, concentration has been broadly flat in most countries, albeit declining slightly in Germany and increasing marginally in Spain. In contrast to other papers using the same dataset, Cavalleri et al. (2019) calculated the industry size directly from the Orbis data. As explained by Kalemli-Ozcan et al. (2022) and Bajgar et al. (2020), this may cause an underestimation of the concentration index.

Monopolkommission (2022) comes to a different conclusion. The German Monopolies Commission evaluates the evolution of the average industry concentration using data from the German Federal Statistical Office. The report shows that, after a mild increase between 2009 and 2011, the HHI displays a flat trend until 2019. The HHI concentration aggregated by turnover at the upper tail distribution slightly fell: the 90th and 95th percentiles show a fall of 11% and 5%, respectively, from 2017 to 2019. Additionally, the CR6 measure remains unchanged over the sample. However, diverging trends are detected at the sectoral level. For example, the HHI in the service sector fell by 17% since 2007, while the trade HHI concentration rose by 30%. It should also be noted that among the service sector, highly concentrated sectors of telecommunications, postal activities, and interurban passenger rail transport show a rising trend.

Gutiérrez and Philippon (2023) exploit Orbis, Compustat and CompNET data to compare the evolution of European industry concentration with the US over the period 2000-2015. While US markets experienced a rise in concentration starting in the 2000s, EU markets did not, thanks to the strong pro-competitive policies undertaken by the European antitrust authorities compared to the US institution.

CMA (2022) reports a marked increase in the UK concentration metrics in the years after the 2008 financial crisis. Since 2011, CR5, CR10 and CR20 have fallen until 2021, but they remain above the levels seen prior to 2008. Also, the pattern of the HHI is similar to the one displayed by the concentration ratios. The concentration has increased for most of the high turnover sectors (e.g., Manufacturing, Wholesale and retail trade, and Professional, Scientific and Technical Activities). The HHI shows a different pattern for Finance and Insurance whose concentration level has more than doubled since 1998. ONS (2022) confirms the CMA (2022) findings.

A1.3. The evolution of markups in the United States and in Europe

Recent empirical research suggests that the increase in concentration has been accompanied by a rise in markups across advanced economies over the last decades, raising further concern about the rise in market power. [47]

In a nutshell, there is an emerging consensus in the economic literature about the direction of global markup trends, with few exceptions. While the assessment for the US is more debatable in quantitative terms, the evidence on markup for Europe remains less conclusive.

Among the studies focusing on global market power, De Loecker and Eeckhout, (2021) have calculated markups for around 70,000 firms across 134 countries. They find that, on average, global markups increased from 1.1 in 1980 to 1.6 in 2016 using Orbis data. In other words, average prices were 10% above marginal costs in 1980, but by 2016 they were 60% above marginal costs. In the US and in Europe there is a sharp variation, respectively, of 0.59 and 0.62 from 1980 to 2016. The biggest increase among the European countries has been seen in Denmark, Switzerland, and Italy. Surprisingly, the pattern also shows a similar trend: the markup lifted from 1980 till 2000, remained flat until the Great Recession, and then increased again in recent years. There is a difference between the EU and the US when analysing markup decomposition: while in the US, most of the rise is due to the reallocation of sales from low to high markup firms, in Europe, it is mainly driven by an increase in the markup itself. [48]

Diez et al. (2018) replicate the above-mentioned results using De Loecker and Warzynski (2012)'s methodology for 74 economies. Using Worldscope data over the period 1980-2016, the authors report an increase in the sales-weighted average markup from 1.12 in 1980 to 1.59 in 2016 for the US listed firms. The advanced economies (excluding the US) account for a slightly less increase since 1980. In Europe, markups have mainly increased since 2000.

Calligaris et al. (2018) find evidence that markups are increasing by around 6% over the period 2001-2014 using Orbis data for 26 high-income economies. The majority of the increase is due to firms in the top decile. Their result holds even when US firms are excluded from the sample. In their study, large firms are more likely to show high markups. Moreover, they report a positive cross-sectoral link between the intensity of digitalisation and markups.

Diez et al. (2021) document a modest increase in global markups during the period 2000-2015 using the same dataset (Orbis). Global markups have increased from around 1.22 to 1.29[49] when weighted by revenue and from almost 1.17 to 1.21 when weighted by costs. According to the authors, the discrepancy shown in figure A1.4 is mainly due to the different sets of countries considered and the inclusion of private firms, which are estimated to have a lower markup increase than listed firms. However, the authors argue that relying solely on listed firms (as most of the empirical studies do) can be misleading as the mass spread throughout the entire distribution of markups (including the right tail driving markup dynamics). As in De Loecker and Eeckhout (2021), the increase in markups is mainly explained by the top-decile high markup firms.

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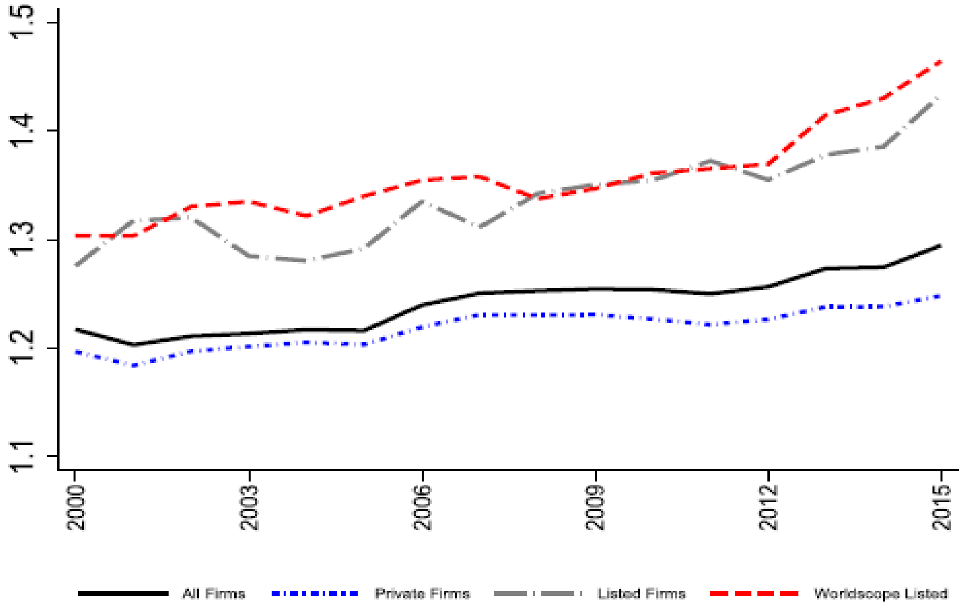
[47] See Archanskaia et al. (2022) for an interesting literature review on recent trends in markups.

[48] The role of the reallocation effect for the US has also been outlined in De Loecker, Eeckhout and Unger (2020), where the authors find that average markup rose from 21% above marginal costs in 1980 to nearly 61% in 2016, using Census data.

[49] A slightly higher global markup increase has been reported by IMF (2019) using Orbis data over the period 2000-2015 for the advanced economies. Specifically, the authors estimate that the average markup rose by 7.7% versus 1.8% for emerging markets. Considering only listed firms, but a broader sample of countries and a longer period, Díez, Leigh, and Tambunlertchai (2018) also find much smaller increases in markups in the emerging market than in advanced economies.

Figure A1.4 Global markup trend according to Diez et al. (2021)



Source: Diez et al. (2021).

At the sectoral level, Diez et al. (2021) find that while manufacturing markups remain stable, global markups in services increase modestly from 1.21 to 1.32 due to the presence of big tech firms. Moreover, the authors find that some sectors present significant increases (such as accommodation and food services, financial services, real estate, or utilities). In contrast, some sectors have experienced smaller increases (like wholesale and retail trade or transport and storage) and finally some sectors have flat markups (construction or administrative services).

Akcigit et al. (2021) confirm the presence of cross-industry heterogeneity. The increase among firms in the healthcare and technology industries is more than three times larger than among firms in the industrials and consumer goods industries. Traina (2018) finds a considerable heterogeneity across sectors, ranging from 2% over marginal cost in Mining and Wholesale Trade up to 20% over marginal cost for Transportation, Communication and Services.

The markup trends reported by De Loecker and Eeckhout (2021), De Loecker, Eeckhout and Unger (2020) and De Loecker, Eeckhout and Mongey (2021) have been challenged by a number of studies based on different micro and macro datasets and different techniques.

Differently from them, Traina (2018) measures variable costs for public firms using both the Costs of Goods Sold (COGS) and Selling, General and the Administrative Expenses (SGA).[50] This change is sufficient to draw a different conclusion: the market power of US public firms remains around 10% over the marginal cost and has not significantly increased since 1980 because the decline in COGS is fully offset by a rise in overhead costs (SGA) in the US. According to Covarrubias et al. (2021), Traina (2018)'s critique also applies to the European Union, where their measure of profits remains flat over the period. In response, De Loecker et al. (2021) maintain that COGS is a better measure of variable costs, whereas SGA captures the overhead costs. . Basu (2019) notes that some inputs have been reclassified from COGS to SGA and outsourcing may have reduced COGS and increased SGA.

50 Berry, Gaynor, and Morton, (2019) stress that there can be diverse reasons for rising markups apart from increasing market power, in particular, a rise in sunk or fixed costs.

Exploiting the Belgian data, Abraham et al. (2021) report that fixed costs and price-cost margins have declined by 4.6 percentage points between 1985 and 2014, pushing excess profit margins (beyond what is needed to cover fixed costs) close to zero, and suggesting competitive markets. Increasing fixed costs mean that higher markups are needed to maintain the Belgian firms' profitability without resulting in a higher market power level. The exclusion of the fixed costs from profit definitions may lead to an overestimation of the excess profits and thus, increasing market power.

Using Belgian administrative data over the period 1980-2016, De Loecker, Fuss and Van Biesebroeck (2018) estimate markups distinguishing between materials and service inputs and find that the aggregate markups increased until the 1990s while they remained relatively stable after 1995. Conversely, according to De Loecker and Eeckhout (2021), Belgian markups almost doubled over the same period. The increase is mainly driven by within-firm markup growth.

Ciapanna et al. (2022) estimate markup trends in the euro area, employing both macro and micro data. Using sectoral EUKLEMS data for European countries and applying the Hall/ Roeger methodology, the authors find either flat or slightly decreasing markup dynamics, quantifying an average level of 1.1 in Italy, France, and Germany and of 1.2 in Spain (against 1.6 in the United States). However, at the sectoral level, markup displays a more significant heterogeneity. By decomposing the change in markup, Ciapanna et al. (2022) also find flat dynamics for European countries even at the top-firm percentile, though larger firms show higher markups on average.
Focusing on the micro dimension for Italy, the authors document results in line with the reported macro evidence. The diverging conclusions compared to De Loecker and Eeckhout's (2021) approach are mainly due to a broader sample selection (not limited solely to listed firms but also limited companies better representative of the total Italian economy) and to the estimation of a sector-specific production function across different countries.

Gradzewicz et al. (2019) report that the average Polish markup fell by 18.6% from 2002 to 2016. Such an evolution is unrelated to sectoral composition changes or to firms' demography. They also argue that the declining trend may be due to globalization trends and more specifically to the fact that Polish exporting companies are integrated into the intermediate stages of the global values chains.

According to Bighelli et al. (2022), markups estimated using CompNet data also remain small and stable in Europe during the period 2009-2016. The same conclusion has been reached by Cavalleri et al. (2019), which show that the aggregate Euro area markup has been stable (around 13%) and has even declined marginally since the late 1990s/early 2000s, driven potentially by the impact of trade and monetary integration. This downward trend is mainly due to manufacturing, given the tradable nature of the goods. Differently from the EU trend, the average markup in the US is estimated to have increased by 9% and 12% in the total economy and manufacturing, respectively.

Mertens (2022) exploits a German manufacturing sector database and finds that markups are low and increase by only 4 percentage points between 1995 and 2014, despite strong increases in manufacturing sector firm concentration during that time.

Conversely, Monopolkommission (2022) identifies opposing markup trends in the manufacturing and service sectors in the German economy, using AFiD data over the period 2008-2017. Specifically, the markup fell by 6% in the services sector, while it rose by 1.8% in manufacturing.[51] Decomposing the aggregate sectoral markup into subcomponents[52] shows that in both sectors, markup dynamics are explained by changes within firms, i.e., markup variations are due to an increase/fall in firms' markups with high turnover shares. Moreover, a positive correlation exists between firm size and markups, showing that the service sector firm markup increases with size (measured by turnover).

Using EUKLEMS data, Hall (2018) calculates the marginal cost as a ratio of adjusted expenditure on inputs to adjusted change in output using productivity data. He finds that the mean of the US markup ratio for 60 industries is about 1.31 and the standard deviation of the ratio across industries is 0.24. The markup ratio grew from 1.12 in 1988 to 1.38 in 2015. More specifically, markup grew in sectors experiencing the growth of "superstar mega-firms". However, there is no evidence that superstar[53] sectors have higher price/marginal cost markup.

Following De Loecker, Eeckhout and Unger (2020), CMA (2022) estimates that in the UK, markup has risen from 1.22 to 1.34 since 2000,[54] despite a short decline in 2020, likely due to the Covid-19 pandemic. In line with other studies on markups in the UK, the upward trend occurred mainly in the last ten years and more prominently in the upper end of the distribution.

Similar conclusions have been drawn by Aquilante et al. (2019) and ONS (2022). The first study is based on the extraction of 3500 U.K.-listed companies from Worldscope over 1987-2016. They find that markup rose from 1.2 to 1.6 and show that heavily internationalized firms are the driving force behind the increase in markups of UK- listed firms. The latter study concludes that average markups have increased by 9.14% in the UK between 1997 and 2019 using Annual Business Inquiry (ABI) and Annual Business Survey (ABS) data. Upward markups occur mainly at the top of the markup distribution, while for the median firm in most industries, markups have remained stable in the sample. Regarding the sectoral dimension, markups are generally higher in service than in manufacturing sectors. This happens because services are generally less tradable and may be characterized by a higher share of fixed costs. For example, ONS (2022) shows that the rise in average markups has been driven by a broad-based rise in services markups, while markups in manufacturing, gas extraction and oil have limited the overall rise.

More recently, a few studies have examined whether the recent inflationary wave due to global value disruptions and the Russia's invasion of Ukraine can be exacerbated by the firms' market power. For example, IMF (2022) investigate the role of market power in the recent inflationary trends in Australia, Canada, France, Germany, Italy, Japan, Spain, the UK, and the US, based on the Worldscope dataset. The authors assess whether firms were taking advantage of weak competition to shelter their profits by increasing prices or whether they used part of their sizeable initial profit margins to absorb cost increases without incurring losses. Surprisingly, they show the latter mechanism to be more substantial during the pandemic: the top 20 percentile of the pre-COVID-19 markup passed only 60% of their cost increases through prices.

A different conclusion is reached by Konczal and Lusiani (2022), who replicate the analysis of De Loecker, Eeckhout and Unger (2020) to account for the size and distribution of markups in the US for 2021. They find an increase in markup across the entire distribution in 2021 and a sharp increase driven by the top 10th of the distribution during the pandemic. They also

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[51] The highest increase in markup occurred for the manufacture of coke and refined petroleum products.

[52] The authors decompose the aggregate markup into i) markup change within firms, ii) economic activity reallocation and iii) net market entry effect.

[53] Hall (2018) defines superstar firms as mega-firms with 10.000+ workers.

[54] According to De Loecker and Eeckhout (2020), the UK estimated gross markups increases from just above 1 to 1.68.

demonstrate that firms facing less competition before the pandemic have been able to take advantage of the one-time demand-and-supply shifts to increase their markups.

A1.4. The evolution of profitability in the United States and in Europe

Another way to capture market power is to study firms' profitability measures. Recent empirical evidence shows an increase in the mean and dispersion of profitability, especially for advanced economy, while some degree of heterogeneity remains among countries/industry. For example, Akcigit et al. (2021) estimate that profitability, measured as the ratio of cash dividends to sales, increased by more than 140% in advanced economies, with the ratio rising from 1.5% to over 3%, while it remained constant in emerging markets. Covarrubias et al. (2019) argue that profits (calculated as gross operating surplus over production) have increased in the US, but have remained stable or decreased in Europe, Japan, and South Korea. At the industry level, McKinsey Global Institute (2015) shows that variance in firm profits has increased over time, both within industries (i.e., the more efficient firms benefit from a considerable growth in profits relative to their competitors) and between industries.

Most of the studies focus on the United States. Philippon (2021) reports the after-tax non-financial corporate profits in the US since 1946. It increased from around 6% of GDP for most of the post-war period to around 9% of GDP after 2000. Such an abnormal increase seems to be confirmed under alternative profitability measures for the US. For example, Furman and Orszag (2015) show data on the evolution and distribution of Return on Invested Capital (ROIC) among US publicly traded non-financial firms between 1965 and 2014. The data shows an increase in ROIC, especially since the early 2000s, concentrated on the firms at the top of the ROIC distribution.

Some economists point out technological change as a possible explanation for the rise of profitability. However, Gutiérrez and Philippon (2017a) demonstrate that tangible and intangible investments have been lower than expected in the past two decades. On the contrary, high profits have led to high payouts to shareholders. The authors also indicate that the lax of US antitrust laws may be a possible cause of increasing market power.

Several papers connect the accrual of high profits (measured by different indicators) to market concentration. For example, Barkai (2020) demonstrates that a significant increase in the share of pure profits offsets the declining shares of both labour and capital. Specifically, he estimates that the decline in the capital share (22%) is much larger than the decline in the labour share (11%). Such trends are offset by a significant increase in the pure profit share (USD 14.6 thousand per employee in 2014, nearly half of the median personal income in the US). According to the author, the source of the decline in the shares of labour and capital is a decline in competition. In a companion paper, Barkai and Benzell (2018) extend the measurement of capital costs and pure profits over the period 1946 to 2015 and find that the profit share is declining from 1946 to the early 1980s and has been increasing since then.

Using Compustat data, Grullon et al. (2019) confirm that US firms' increased profitability and abnormal stock returns are highly correlated with industry concentration, especially after 2001. The reason is that higher barriers to entry have increased the ability to generate higher profit margins by discouraging competitors. These may generate a surge in M&A deals motivated by gains associated with increased market power. The authors conclude that the combination of lax enforcement of antitrust laws in the United States and technological innovation might have contributed to increased concentration and barriers to entry.

De Loecker, Eeckhout and Unger (2020) provide evidence of increasing profitability measured by the average profit rate for US-listed firms, from 1% in 1980 to 8% in 2016. US profits follow the same trend of a rise in markup during the same period. As for the markup trend, the increase in the average profits is driven by a change in the upper-tail distribution. The authors also argue that intangibles may explain part of the rise in markups. Firms exert market power by creating entry barriers: they charge higher prices to compensate for higher overhead costs and obtain higher profits. Crouzet and Eberly (2019) also document the rise of intangible assets in the last decades for the US.

Konczal and Lusiani (2022) extend the analysis of De Loecker, Eeckhout and Unger (2020) for US to include the year 2021. They show that the operating profit margin increases to 19% in 2021, even after controlling for the SGA costs.

Fewer papers provide evidence for European countries, and the conclusions drawn are divergent. ONS (2022) reports that mean UK profit shares (measured as profits divided by gross output) increased by 15.7% from 1997 to 2019. The increase skews heavily towards the top end of the distribution. A different conclusion has been reached by CMA (2022), which finds that Earnings Before Interest and Taxes (EBIT) and Return on Capital Employed (ROCE) indicators have been stable or declining gradually over time since the financial crisis. Differently, ONS (2022) show that across sectors, profit margin trends also mirror markup trends, showing an overall increase of 15.7% over the period 1997-2019 due to substantial growth in construction (47%), services (28%) and falling profit margins in non-manufacturing production (-30%). Profit margins in manufacturing grew only by 2.3%.

Using CompNet data over the period 1995-2016, Vallés et al. (2022) provide evidence for Germany, France, Italy, and Spain. Specifically, the authors document the increase in profit share to total output of non-financial firms. The increasing trend reflects the increasing price-cost markup starting in 2000s, especially in the manufacturing sector. However, the authors report some heterogeneity across countries. While the increase in German profits is driven by a growing competitive advantage, especially in the upper tail of the markup distribution, Spanish firms experienced a profit decline during the financial crisis. In France, profit shares have been consistently decreasing since the introduction of the euro and have been close to zero since 2008. Finally, the evolution of Italian profits is explained by the nominal convergence in the run-up to the introduction of the euro, which substantially reduced the capital cost share from 1995 to 1999.

Using the EU KLEMS database and excluding the real estate sector, Gutiérrez (2017) also reports significant differences in profit shares across European countries, with profit shares declining in France, Italy, and Spain during the 2000s.

Koltay et al. (2022) find an increase in profitability in Europe using Ameco data, in line with the trend in the US. They estimated that profits shares rose by 15% over the period 1980- 2019 for the EU and the US. European countries reached the American level only in the 2010s. EU and US saw their profits fall significantly during the Great Financial Crisis.

Differently, Abraham et al. (2021) show that profits of Belgian firms have increased by only 2.5%, as a share of sales in the last three decades. This indicates that the rise in market power is the consequence of the increase of fixed costs associated with production, including the overhead costs (e.g., rents, advertising, and administration) that firms must bear in the long run.

A1.5. The macroeconomic impact of rising market power

The literature has proposed several explanations for the rise in market power, such as a weakness in competition policy enforcement, allowing firms to charge higher prices; technological progress within firms, leading to efficiency gains and cost reductions; globalization or reallocation of production and sales to high markup “superstar” firms.

However, market power is of great interest also to macroeconomists because empirical evidence suggests that market power can have important macroeconomic implications. Some contributions relate the rise of market power to several “Kaldor facts”. For example, Eggertsson et al. (2021) use the decline in real interest rates and the above-mentioned rise of profits in the US to explain four macroeconomic developments, including an increase in firms’ Tobin’s Q, a decrease in labour share and an increase in market power. De Loecker et al. (2020) develop a general equilibrium model with an oligopolistic structure to quantify the contributions of market structure and technology in explaining the secular trends for the US economy. They find that both factors are essential features: while technological change leads to an increase in markups through rising fixed costs, changes in market structure reduces the number of potential competitors, leading to a decline in business dynamism. This suggests that increased market power could have effects that extend beyond a single industry and impact the entire economy (Syverson, 2019).

In this subsection, we provide an overview of the main studies that contribute to the broader literature on the consequences of market power, focusing specifically on declining labour share, reduced business dynamism, lower investment rate and the slowdown of productivity growth, as well as compelling explanations of such secular trends.

A1.5.1 Lower labour share

Several papers investigate the causes behind the decline in labour share,[55] a phenomenon that began trending down in advanced economies since the 1980s, as reported by IMF (2017). While there is a consensus on the existence of this secular trend, there is a wide diversity of results on the magnitude of these factors obtained using various econometric techniques on different country, industry- and firm-level data.

The impact of technology has been proposed as the main culprit: the declining labour share is a combination of rapid progress in information and technology and a high share of tasks that could be automated. Karabarbounis and Neiman (2014) estimate that the elasticity of substitution between labour and capital in a CES production function is bigger than 1. Thus, the decline in the relative prices of investment goods due to IT and digitalisation has induced firms to shift away from labour toward capital, causing a drop in labour share. They also estimate that automation is responsible for about half of the decline in labour share in the US and dominates other effects such as increasing profits, capital-augmenting technology growth, and the changing skill composition of the workforce.

Conversely, Elsby et al. (2013) also test the investment-specific technical change and demonstrate that this hypothesis is rejected by the data as it cannot explain the joint

[55] Usually, the literature refers to the total economy labour shares, which have highlighted some measurement issues due to self-employment and residential income. Consequently, the literature started to focus on the corporate labour share (i.e., the ratio of income paid to labour to nominal gross value added) as the measure of allocation of business output between owners and workers, assuming that self-employment and residential income are excluded.

movements in real wages, productivity, and capital-labour ratios in the last decades. According to the authors, a more plausible explanation is the offshoring of labour-intensive components of the US supply chain, which makes the US economy more capital-intensive. Note that the effect of globalisation is to lower labour shares in tradable sectors.

An alternative explanation links the declining labour share to the rising market power. This strand of research relies typically on firm-level microdata and argues that higher markups tend to depress the demand for production factors, and thus higher markup and increasing profitability imply a smaller share of value added to labour and/or capital. Moreover, increasing markups determines the decline in the aggregate share of income going to workers, raising concern about inequality.

Using aggregate data, Barkai (2020) disentangles capital costs from pure profits and shows that the shares of both labour and capital are jointly declining and offset by a significant increase in the share of pure profits. Moreover, he shows that industries where sales concentration rose the most saw the largest declines in the labour share.

Gutiérrez and Piton (2020) test the capital-biased technological change explanation (i.e., automation, intangible capital deepening and declines in the relative price of equipment) as a potential driver of the decreasing labour share trend. When controlling for housing[56] and self-employment income, the authors do not find any evidence in favour of a global decline in the business labour share. The labour share in advanced economies increased in the 1970s and fell in the 1980s, returning to its initial level by 1990. It then declined slightly until the Global Financial Crisis and recovered afterwards. According to the authors, the labour share increased in the UK, decreased in the US and Canada, and remained stable in the other major economies.[57] Technological change may be a relevant factor only in some specific sectors, such as manufacturing. In a companion paper, Gutiérrez and Philippon (2023) suggest that declining labour share may result from increasing profit shares due to increased market power in the 1990s and 2000s, before the acceleration of the labour share decline. Meanwhile, Gutiérrez et al. (2023) argue that declines in industry-level labour shares in the EU are driven by a reallocation of value-added towards low labour-share firms and not by a fall in the within-firm labour shares.

Autor et al. (2020) provide evidence suggesting that the declining labour share results from the concomitant increase in aggregate markups triggered by a reallocation of market share towards *superstar* firms characterized by both low labour shares and high markups. Using Census firm-level data for the US, the authors show that large firms charge higher markups than small firms. Since 1980 larger and more productive firms have become even larger and raised their market share, making industries more concentrated in a small set of “superstar” firms with low labour shares. Employment concentration has grown significantly more slowly than sales concentration, particularly in the manufacturing industry. This suggests that the firms with the highest market shares tend to have a relatively smaller workforce. The authors also discuss a few potential drivers of the rise of *superstars*, such as greater market competition (e.g., through globalization) or scale-biased technological change driven by intangible capital investment and information technology.

IMF (2017) documents the downward trend in the labour share income worldwide since the 1990s, as well as a heterogenous pattern across countries. The authors find support for compositional shift related to the prediction of Autor et al. (2020): trends in the labour share are determined by a shift in employment from labour-intensive to more capital-intensive sectors, where labour shares are lower. Additionally, they quantify the contributions of

56 Gutiérrez and Piton (2020) observe that, outside of the US, the decline in the labour share is driven by housing.
57 Similar results are obtained by Cette and al. (2019).

alternative drivers: a decline in the price of investment goods (as a proxy of technological change) explains half of the decline in labour share in advanced economies, with industries having a higher degree of exposure to automation experiencing a higher decline. In emerging economies, one-fourth of the declining labour share is explained by the participation in global value chains (imports for assembly and re-exports) and financial integration (external assets and liabilities).

Exploiting French administrative data, Bauer and Boussard (2020) show that the French labour share has remained stable or even increased over the past decade. Decomposing the labour share variation since the 1990s, they provide evidence in favour of the link between declining labour share and firm size. They find evidence of two potentially offsetting forces that can explain the labour share trend, consistent with Autor et al. (2020). On the one hand, the reallocation towards high-markup firms that gained market shares reflects a rise in concentration, indicating an improvement in allocative efficiency. On the other hand, the aggregate markup decreased, suggesting a reduction of the distortive effect of markups. Given that the first effect prevails, the labour share remains constant.

Similarly, Bajgar et al. (2019) find that employment concentration is positive in Europe. This result is consistent with the fact that "superstar" firms employ fewer workers compared to their revenues. In a companion paper, Bajgar et al. (2021) report that the increasing trend in concentration is strongly related to intensive investment in intangibles, particularly innovative assets, software, and data. In that study, among the 37 industries at the 2-digit level, concentration increased in 29 of them, including retail, ICT (Information and Communications Technologies), transportation and manufacturing. Large firms in more globalised and digital-intensive industries tend to experience increasing market share. However, the concentration increase is not associated with increasing globalisation, more significant M&A activity or changes in product market regulations.

Kehrig and Vincent (2021) find similar patterns among manufacturing establishments (plants) in the US. They show that since the late 1960s, there has been a massive reallocation toward "hyper-productive" low-labour-share establishments in the US manufacturing sector and that this reallocation accounts for all the decline in the labour share in the manufacturing sector.

A common element in the argument of the papers mentioned above is that the elasticity of substitution between equipment or intangible capital and labour is assumed to be greater than unity. They are also silent about the role of labour market power in explaining the trend in the labour share. Mertens (2022) has bridged the gap considering the interplay between market power in the labour market and the final good market. According to the author, the fall in the labour share can be attributed to the decreases in the wage share in sales that can result from increasing product market power, increasing labour market power, or decreasing labour output elasticity. Using a database containing data on German manufacturing sector firms and firm-specific prices, the author finds that the labour share fell from 0.27 to 0.22 with a fall in the output elasticity of labour, a moderate increase in market power and a substantial rise in labour market power. Decomposing the contribution of each channel according to Olley and Pakes (1996)'s methodology, Mertens (2022) estimates that increasing firm market power account for half of the observed decline in the labour share, and most of this contribution is due to increasing firm labour market power.

A1.5.2 Reduced business dynamism

Business dynamism[58] is an important driver of economic and productivity growth. The causes behind the declining trend in business dynamism have been the subject of a lively debate. Gourio et al. (2014) estimate that the lower entry rate costs more than 1.5 million jobs over the period 2006-2011. Pre-existing structural trends may have been further exacerbated by the COVID-19 pandemic and the disruptions in global value chains, leading institutions to foresee long-term economic effects (OECD, 2020).

Several papers documents that the US economy has been experiencing a decline in business dynamism since the 1980s and even more since the 2000s. According to Decker et al. (2016), this decline is reflected in the decreasing share of young firms' activity, in the reduction of job creations, and employment (aged five or less). This trend has also been accompanied by a substantial decline in the share of high-growth firms, especially the young ones. Decker et al. (2020) report that the pandemic has destroyed nearly 1.2 million jobs in the US in the second quarter of 2020. The slowing rate of entry is concerning, as new firms have historically contributed significantly to growth. Moreover, the authors claim that, whereas in the 1980s and 1990s, the decline in dynamism was observed in selected sectors (such as retail), it has spread to all sectors, including the high-tech sectors, in the 2000s.

Evidence for other countries is still scant, and the use of different measures to assess this phenomenon does not allow comparison across countries. An exception is the recent work of Calvino, Criscuolo and Verlhac (2020), which shows that similar trends are also visible in other advanced economies. They estimate that global entry rates have declined by 3 percentage points and job reallocation rates by 5 percentage points.

The causes behind the decline in business dynamism have been widely debated. On the one hand, some economists show that reduced business dynamism may be linked to the decline in knowledge diffusion. For example, Andrew et al. (2015) exploit Orbis data to characterise firms at the global productivity frontier. They find that these firms are, on average, more productive, larger, and more profitable. They are also younger, and more likely to patent and to be part of a multinational group than other firms. Moreover, the authors claim that global frontier technologies only diffuse to laggards once they are adapted to country-specific circumstances by the most productive firms in each country (i.e., national frontier firms).

Akcigit and Ates (2021) present a theoretical model in which the nexus between endogenous markup and innovation can replicate several empirical trends associated with declining business dynamism. The decline in the intensity of knowledge diffusion from the frontier to laggard firms is a key factor behind the declining trend, producing aggregate responses in line with empirical trends. In a companion paper, Akcigit and Ates (forthcoming) calibrate their model for the US economy and replicate the dynamics observed in the last three decades. The authors document a higher concentration of patenting in the hands of firms with the largest stock and a changing nature of patents, especially in the post-2000 period. More precisely, the results suggest that market leaders heavily use intellectual property protection to limit the diffusion of knowledge. This means that the distortions to the diffusion of knowledge among firms are responsible for the declining business dynamism, accounting for at least half of the decrease.

[58] We define business dynamism as the process of firm entry, growth and exit and the simultaneous creation and destruction of jobs.

On the other hand, some economists attribute the cause of the declining trend to the increasing importance of intangibles,[59] (i.e., inputs that are used in production that are not physically embodied), which are related to increased market power.

Cavalleri et al. (2019) compare the evolution of business dynamism in the US to that of the four largest European countries in terms of the birth and death rates of new establishments and jobs. They find that the US economy remains more dynamic than the euro area, but recently, changing market structures have led to drops in dynamism, more specifically in the US. According to them, a possible explanation for such declines appears to lie in the high-tech sectors.

De Ridder (2022) emphasizes that the rise of firms that are better at using intangibles (as intangibles make other factors more productive) is an explanation for the rise in markups, the decline in business dynamism, and productivity growth. Specifically, he finds that intangibles cause a decline in the long-term productivity growth of 0.4 percentage points in the US calibration and 0.2 percentage points in the French calibration. Intangibles reduce marginal costs and raise fixed costs, which gives firms with high-intangible adoption a competitive advantage, and results in deterring new firms from entering.

Finally, Bajgar et al. (2021) find that sectors with high intangible investments experienced a greater increase in concentration. Using OECD MultiProd and Orbis-Worldscope databases, the authors show that increasing concentration is associated with lower churning among top firms. Top firms can protect their market share by patenting to prevent competitors from contesting their intellectual property or through M&A activity (especially in the technology sectors).

Market power is another factor that contributes to declining business dynamism. For example, Diez et al. (2021) decompose the overall increase in the global firm markup into the contribution by incumbent, entering and exiting firms. They conclude that 95% of the overall markup increase between 2000 and 2015 is explained by the markup increases by incumbent firms. The remaining 5% is explained by the extensive margins, where firms' entry positively contributes to the markup growth during the period, while the contribution of exiting firms is more limited and decreases the markup growth rate. The authors find evidence of a non-monotonic relationship between firm markup and size: markups decline with firm size until a (large) size threshold is reached, after which the authors find a positive relation.

De Loecker, Eeckhout, and Mongey (2021) document that the rise in fixed costs (due for instance to technological innovation) and the decline in the number of potential entrants (market structure change) can jointly explain the rise in markups and lead to the decline in business dynamism in terms of lower job creation and higher destruction rates. The authors decompose the markup variation into changes in technology (through productivity or rising fixed costs) and changes in market structure (through a reduction in the number of potential competitors) and show how these two elements generate a decline in business dynamism. On the one hand, rising markups, which may be an indication of the change in the pricing power of firms, lead to a decline in labor demand and low wages, as firms produce less at higher prices, which can explain the declining labor share. On the other hand, rise in fixed costs lead to much higher job destruction and job creation by exiting and entering firms, which also determines a reallocation of sales activity away from low-markup firms toward high-markup firms.

[59] Intangibles are scalable in the sense that they can be duplicated at close-to-zero marginal cost (Hsieh and Rossi-Hansberg, forthcoming). According to the author, this means that intangible inputs shift costs from variable to fixed costs and that firms differ in the efficiency with which they deploy these inputs.

Exploiting the OECD database, Calvino et al. (2020) analyse the trends in business dynamism focusing on entry rates and job reallocation rates, using harmonized data across 18 countries and 22 industries over the period 2000-2015. They confirm that the decline in business dynamism is pervasive, with some heterogeneity observed across countries and sectors. For instance, Telecommunications, IT, Scientific R&D and Media clearly show the sharpest decline in business dynamism, while Food and Beverage and Textile exhibit the lowest declines, suggesting that intangible-intensive sectors experience the largest fall in dynamism. Market structure plays a major role as the winner-takes-most dynamics and barriers to technology diffusion, reinforced by the transition to a digital and knowledge economy, may be important drivers of the slowdown in business dynamism. This is because more concentrated sectors may also be characterized by discouragement effects, barriers to entry and more stable job flows linked to lower levels of creative destruction and competition. However, the authors admit that market structure and firm heterogeneity may be interlinked with the rising importance of intangibles and digital technologies.

Biondi et al. (2022) provide evidence for EU countries using CompNet data. The authors find that job reallocation rates and share of young firms in total firm counts decline in almost all EU19 countries (i.e., firms are getting older, and the growth rate of young firms has slowed down). This decline is common to all sectors and is mainly driven by within-sector dynamics rather than cross-sectoral reallocations. This result is consistent with Decker et al. (2020), who explore the role of adjustment costs in the decline in business dynamism and the impact on the aggregate productivity decline. In these models, reallocation arises as a business response to individual productivity.

A1.5.3 Lower investment levels

There is widespread concern about the decrease in investment and investment growth across advanced economies, including Europe (IMF, 2019), despite the easy financing conditions globally. However, a strong consensus has not yet emerged on the reasons behind the puzzling investment trend.

One strand of the literature argues that low investment may be explained by weak aggregate demand since 2008, which does not provide strong incentives for firms to invest significantly, as shown by Bussière et al. (2017).

Another compelling explanation is the increased uncertainty, which may deter firms from investing today and lead them to postpone investment decisions (among others, Bloom et al., 2007).

Additionally, some authors emphasise financial constraints, which may be particularly relevant explanation for stressed economies, as the global financial crisis has reduced the supply of credits to businesses. If such frictions are sufficiently strong, they may delay the investment recovery and consequently, the global recovery. This is particularly the case for Europe's so-called "periphery" countries during the great financial crisis (financial market fragmentation), as noted by Kalemli-Ozcan et al. (2019).

More recent literature observes that the rise in corporate saving in advanced economies has coincided with an increase in the concentration of firms (IMF, 2019), which occurred together with the rising market power and profitability of large firms. As in the case of labour, an increase in market power results in a low demand for capital from firms and, consequently, a decrease in investment.

For example, Barkai (2020) focuses on the trade-offs between labour and physical capital at the firm and industry level. He shows that labour costs have not been replaced by capital costs. Specifically, he disentangles capital costs from pure profits and finds that both the labour share and capital costs share have been decreasing in the US, respectively, by 11% and 22%. At the same time, he documents a substantial rise in profit share related to higher concentration in various industries: the share of US profits raised from 2.2 percent in 1984 to 15.7 percent in 2014 because of the higher markups, which rose from 1.02 to 1.19. This trend is more pronounced in industries that experienced significant increases in concentration. However, Gutiérrez and Philippon (2019) do not find any rising concentration and profits in major EU countries, a finding that is also confirmed by Ciapanna et al. (2022).

In a companion paper, Gutiérrez and Philippon (2017b) integrate the methodology developed in Barkai (2020) and argue that US total investment in tangible and non-tangible capital has been weakened starting in the early 2000s when measured as Tobin's q ratio due to the rising markups. Underinvestment is due to show that a lack of competition and firm short-termism. The authors also find that more concentrated industries with lower entry rates invest less, even after controlling for current market conditions. Philippon (2019) and Gutiérrez and Philippon (2023) show that it is possible that successful firms are increasingly able to erect barriers to entry and extract rents, thanks to lobbying and regulation. Moreover, lower competition may lead firms to underinvest.

IMF (2019) estimate a non-monotonic (inverted U-shape) relationship between markups and investment and finds that higher markups are associated with initially increasing and then decreasing investment and innovation rates. The relationship between markups and investment and innovation rates is also stronger in more concentrated industries. These results are broadly consistent with the inverted U-shape prediction of the theoretical model proposed by Aghion et al. (2005). IMF (2019) also supports Aghion et al. (2005) 's hypothesis, which suggests that the relationship between markups and investment is steeper for firms closer to the technological frontier.

Cavalleri et al. (2019) also provide evidence supporting the results of a non-monotonic relationship between concentration and investment for Europe. According to their findings, a heavy cluster of firms belongs to either high labour-intensive sectors (with low capital investment demands) or un-dynamic sectors. Moreover, the authors also identify a cluster of firms that invest a lot despite not being highly concentrated, which is consistent with the neck-and-neck competition hypothesis.

Crouzet and Eberly (2019) show that the decline in investment is linked to market power. Specifically, the authors argue that the increase in intangible investment is attributable to industry leaders and coincides with the increase in their market share and, therefore, the increase in industry concentration. They also demonstrate that when capital intangible is treated as an omitted factor in production, it can fill a substantial part of the gap due to weak physical capital investment. Quantitatively, the US firm-level investment gap only decreased by one quarter by adjusting for intangibles.

A1.5.4 Slowdown of the productivity growth

Productivity growth is widely seen as the main long-run determinant of per capita output growth and improving living standards. Therefore, evidence of declining productivity growth is a concern in advanced economies. In the US, there is a broad agreement that productivity began to slow down around 2004-2005 (Fernald and Inklaar, 2020).

Several explanations have been proposed for this trend. One set of explanations refers to weak demand, financial constraints and globalisation which have weakened investments, and, as a result, productivity (see section A1.5.3).

Another compelling explanation is related to the increase in market power. Theoretically, market competition can foster productivity growth through three different channels: i) the reallocation of resources, which implies allocative efficiency; ii) productive efficiency due to the improved use of inputs by firms; iii) dynamic efficiency due to the increased incentives for firms to innovate (Nicodème et al., 2007).

As previously mentioned, empirical assessment is complex and debated, as there is no consensus on whether market power is good or bad for productivity and welfare (Covarrubias et al., 2021). Concentration can reflect output-restricting dominant positions or a better allocation of resources to highly productive firms in an economy operating under increasing returns to scale due to intangible investment. The non-linear relationship between competition and innovation depends on the initial level of competition (Aghion et al., 2005).

Philippon (2019) and Gutiérrez and Philippon (2023) show that successful firms may be increasingly able to erect barriers to entry and extract rents, possibly thanks to lobbying and regulation. Moreover, lower competition may lead firms to underinvest.

Baqaee and Fahri (2020) develop a general equilibrium model for the US with a production network, allowing them to quantify the misallocation effect. In their model, increasing markup can result from two factors with different outcomes: i) top markups firm have increased their markups; ii) top markup firms have gained market shares. In the first case, the increase of markups at the top of the distribution increases the dispersion in markups, creating gains from removing higher markups (i.e., the misallocation effect). In the second case, the reallocation of sales toward top decile markup firms favours allocative efficiency. The authors estimate that the latter case phenomenon accounts for about half of aggregate US TFP growth between 1997 and 2015.[60] Eliminating the US markups (as in 2015) would raise aggregate TFP by about 10-25% (depending on the markup series), showing that the obtained gain is more significant than the one estimated by Harberger (1954).

Bighelli et al. (2022) assess whether higher concentration in Europe reflects a more efficient market environment or excessive market power. The authors observe that, between 2009 and 2016, European labour productivity grew by 7.5%. Decomposing the productivity into allocative efficiency and misallocation, the authors estimate that reallocation processes have contributed not only to rising concentration, but also to aggregate productivity growth, generating a positive link between allocative efficiency and concentration. Specifically, productivity growth within firms and increasing allocative efficiency of the European market each account for one-half of European productivity growth in past years. Germany seems to account for most of the European concentration level.

Monopolkommission (2022) investigates the relationship among investments in intangibles, the degree of digitalisation, and productivity effects. In principle, digitalisation may generate competition-enhancing effects by lowering marginal costs and increasing productivity; or competition-reducing effects via the rise of entry barriers. However, they conclude that high markups cannot be explained only by investment trends and the associated increases in productivity. Looking at the industry level, on average, manufacturing firms in digitalised sectors exhibit 3% higher markups than those in non-digitalised sectors, while service sector firms show a 7.5% lower markup in digitalised industries. In the service sector, rising markups

[60] Their result is in line with evidence of reallocation towards low-labour-share firms in Autor et al. (2020) and Kehrig and Vincent (2021), as discussed below.

are positively correlated with increasing investment in intangible assets related to digitalization, which implies a 5% productivity increase in the service sector. In the manufacturing sector, there is a non-linear relationship, with productivity increasing by 6.5% below a markup of 1.6, but turning negative above that threshold. High investments in fixed costs and intangible assets may lead to entry barriers, despite initial positive productivity effects.

These results support the findings of Autor et al. (2020) and van Reenen (2018). In particular, Autor et al. (2020) point out that large productive ("superstar") firms hold considerable market power. The reallocation of sales and value-added toward the most productive firms in each sector could contribute to productivity growth. Rising concentration may result from adopting technologies that favour large and more efficient firms, as suggested by the "superstar firm" hypothesis. Specifically, the authors find that industries with an increase in concentration also tend to experience faster technological changes, measured as an increase in patents per worker, but slower diffusion, measured by a drop in the share of citations received within five years.

De Loecker et al. (2020) find that the rise of markups is primarily driven by the upper tail of the distribution, generated by a reallocation of economic activity from low to high markup firms. However, as in Baqaee and Fahri (2020), the authors also show that the increased dispersion in markup reduces efficiency.

Using Census data, Ganapati (2021) estimates that a 10% increase in the market share of the four largest firms produces a 2% increase in labour productivity and in recent years it has been even lower (or negative).

According to De Ridder (2022), high intangible-intensity firms are characterized by high fixed costs and low variable costs; these high economies of scale lead them to have high markups, but also be competitive and gain market shares.

Crouzet and Eberly (2019) document a positive relationship between productivity and competition in the United States only in a few sectors, such as Retail, Wholesale trade and High-Tech sector.

A1.6. Conclusion

This section provided an overview of the literature investigating increasing market power. Even if there is almost a unanimous consensus on the increase in market power for the US, there is still no established consensus for the European countries. However, economists tend to agree that the trend in Europe is less worrying than in the US. The increase in markups seems to be driven by the upturn of top-decile firms.

Part of the disagreement on the extent of market power may be due to the lack of a standardised method for measuring it. Results may differ widely, depending on the methods and database used.

Increasing availability and quality of microdata source allows to use firm-level databases. However, some drawbacks still exist. For example, accounting data standards[61] and coverage[62] may vary over time, making cross-country comparability broadly weak and

[61] For a discussion about the characteristics of the database, see Bighelli et al. (2022) and Bajgar et al. (2020).
[62] Koltay et al. (2022) identify three conditions to obtain a proper concentration measure: 1) it should cover a long enough time span for each aggregate; 2) it must be aggregated at the correct level; 3) it should be representative of the whole economy's industrial structure.

questioning the reliability of firm-level data because trends may not reflect fundamental changes but rather changes in the construction of the database.

Different methods used in the literature on the assessment of market power may influence the results as well. Thus, it is essential to bear in mind the assumptions of the different methods when interpreting the extent of market power. Traditionally, such measures were based on economic-wide or industry-sector data from harmonised national accounts, which suffer from aggregation bias (Hall, 2018). Recent contributions are based on firm-level datasets, which has led to the development of new econometrics techniques to address identification, causality issues and selection bias.

Several explanations are provided to account for the increased market power, such as a weak competition policy enforcement, allowing firms to set higher prices; technological progress within firms, leading to efficiency gains resulting in cost reductions; or a reallocation of production and sales to high markup “superstar” firms. At the same time, increased market power could have effects that extend beyond a single industry and affect the whole economy (Syverson, 2019). Some efforts have also been made to assess the implications of increasing market power on recent macroeconomic developments, such as declining labour share, reduced business dynamism, lower investments, and the slowdown of productivity growth.

However, a comprehensive assessment of the market power developments is premature, at least for Europe. Further research should be devoted to shedding light on the methodology and data used. For example, Diez et al. (2021) show how the inclusion of privately held firms may alter the conclusion regarding the evolution of markups. In addition, Abraham et al. (2021) and Traina (2018) stress the importance of including fixed costs in the markup estimation. The underlying reason is that otherwise, one cannot distinguish between cases where markups increase is due to changes in firms' cost structure (i.e., an increase in fixed costs) and those where it is not due to a reduction in competition (OECD, 2021).

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A2. Modelling the macroeconomic impact of "the cost of non-competition"[63]

The empirical literature reported in Annex A1, which documents increased market power among the advanced economies, has raised concerns among policymakers and practitioners about the state of the competition and the possible consequences of these increased markups in terms of efficiency and productivity for the whole economy (Philippon, 2019).

Motivated by such findings and concerns, this Annex aims to evaluate the economic cost of possible malfunctioning competition (hereafter referred to as the "cost of non-competition") for the EU. For this purpose, we look at the recent literature which has measured global markup dynamics, allowing for a comparison across databases, methodologies and time periods. Among those works, we select the contributions of Diez et al. (2021), Akcigit et al. (2021) and De Loecker and Eeckhout (2021)[64]. These works provide a diverse range of markup estimates that can be used to assess the economic implications of reported markup variations through the lens of the QUEST III model.

Measuring the cost of non-competition is a challenging exercise, but it is of primary importance for policymakers as competition affects economic performance via several channels, such as allocative efficiency, productive efficiency, and dynamic efficiency. The QUEST III model provides a suitable framework to measure the impact on GDP and other macroeconomic variables of interest.

Various recent papers focus on a quantification of the economic impact of markups by considering their development over a given time horizon and by estimating the opportunity cost (or gain) of eliminating the observed increase. Baqaee and Fahri (2020), for example, develop a non-parametric model for the US with a production network and markups, which allows them to quantify resource misallocation (i.e., the overall distance to an ideal situation) and the resulting change in allocative efficiency. The authors find that the potential gains from reducing markups have increased since 1997 between 5% and 15%, depending on the methods used. Baqaee and Fahri (2020) assess that eliminating this increase in markups would increase aggregate TFP between 11% (using the accounting profits approach) and 25% (production function approach according to De Loecker and Warzynski, 2012).

Edmond et al. (2018) study the welfare costs of markups in a dynamic model with heterogeneous firms and endogenous variable markups. In their model, the endogenous variable markups act as a uniform output tax, which reduces employment and investment, generating a misallocation of production factors. The authors assess that increased markups account for two-thirds of misallocation, while the costs linked to entry are negligible. They report that the representative US consumer would gain 7.5% in consumption-equivalent terms if all markup distortions were eliminated.

IMF (2019) estimates a modest increase (6%) in global markups during the period 2000-2015, using De Loecker and Warzynski's (2012) methodology. This increase in markups (modelled as a 'shock') is then applied to an estimated dynamic general equilibrium model à la Jones and Philippon (2016) for the Euro Area and the US to match the estimated within-firm component of the observed markup increase. According to their analysis, the output gap might have been about 0.3 percentage point wider by 2015 than if markups had stayed at their 2000 levels (excluding the impact of the 2008 financial crisis). The shock is modelled as an unanticipated decrease in the elasticity of substitution among intermediate goods: the lower

[63] Appendix prepared by Roberta Cardani (JRC) and Marco Ratto (JRC).

[64] As mentioned in Annex A1, it should be noted that some recent contributions have questioned the findings of De Loecker and Eeckhout (2021) (see, for instance, Traina, 2018; Raval, 2023; Abraham et al., 2021), showing how their results may be sensitive to measurement and estimation choices.

the demand elasticity of substitution, the higher the markup. As demand becomes inelastic, firms cut production and charge higher markups, so the amount of labour and capital hired falls, causing a decline in capital and investment.

Eggertsson et al. (2021) develop a neoclassical model where increasing markups and low-interest rates are the key elements to explain the secular trends characterizing the US economy, such as increasing profits and declining labour and capital shares. To test their model quantitatively, the authors estimate the change in markups in the US and calibrate their model accordingly, along with a decline in the real interest rate of 2 percentage points. They obtain an explanation for several puzzling trends. They find that rising markups are responsible for an increase in pure profits and Tobin's Q, which leads to a decline in labour and capital share and investment. On the contrary, decreasing interest rates keep the return on capital low.

Similarly, De Loecker et al. (2021) quantify the importance of technology and market structure for the increase in market power and the decline in business dynamism using US data from 1980 to 2016. While technological changes lead to an increase in markups through rising fixed costs, changes in market structure reduce the number of potential competitors, leading to a decline in business dynamism. The authors decompose the output growth into the individual drivers (technological change and changes in market structure), finding that the increase in markups over the period has generated a net 10% decline in US GDP due to two opposite forces. While there are 5% output gains due to technological change, reflecting dominant firms' superior efficiency, there is a 15% output loss due to higher markup (8%) and fixed costs (7%) set by dominant firms.

This Annex proceeds as follows. Section A2.1 provides information on the transformation of the price-cost margin into the markup shock. Section A2.2 provides the macroeconomic effects of the increased markup according to the selected literature. Section A2.3 provides some concluding remarks.

A2.1 Quantification of the markup shock

As noted in Annex A.1, a few papers assess the evolution of market power for advanced economies. Among the exceptions, Diez et al. (2021) and IMF (2019) exploit Orbis data to quantify the increase in global markups from 2000 to 2015, using De Loecker and Warzynski's (2012) methodology. They report a 6% relative rise, from a price cost markup of 1.22 in 2000 to 1.29 in 2015, explained mainly by an increase in the markup of the top-decile high markup firms.

Using Worldscope on publicly listed firms, Akcigit et al. (2021) estimate a cumulative markup increase of about 35% for advanced economies from 1980 to 2016, with the markup normalized to 1 in 1980. By contrast, De Loecker and Eeckhout (2021) show that the aggregate global markup has increased by 39%, from 1.15 in 1980 to around 1.6 in 2016, using the same Worldscope database, confirming that the upper tail of the distribution drives such a rise. Surprisingly, similar dynamics have been depicted for European countries, where the markup rose by 61%, from 1.01 to 1.63.

The above-estimated markups are expressed in terms of the price to marginal cost ratio. In contrast, in the QUEST III model, the markups are expressed in terms of the Lerner index (L), i.e., price minus marginal costs (MC) over price (P). As explained by Thum-Thyssen and Canton (2015), the conversion is obtained by the following formula:

$$\frac{P}{MC} = \frac{1}{1 - L} \qquad (A2.1)$$

The markup shock is obtained as an absolute variation of the Lerner markup, disregarding the effect of the initial point.[65]

To allow for a fair comparison among the size of the shock reported in all the three papers, we restrict the period to 2000 onwards. Over this period, De Loecker and Eeckhout (2021) report an increase in European markups from 1.39 to 1.63, while in Akcigit et al. (2021) markups increase from 1.21 to 1.35 in the advanced economies, which are more in line with the findings of Diez et al. (2021).

The size of the markup shock is displayed in the following table:

Table A2.1: Markup quantification according to the selected studies and periods

	Markup shock (2000-end)	Markup shock (1980-end)
Diez et al. (2021)	0.04	--
Akcigit et al. (2021)	0.09	0.26
De Loecker and Eeckhout (2021)	0.11	0.38

Note also that differently from IMF (2019), we calibrate the shock to match the total increase in markup reported by De Loecker, Eeckhout and Mongey (2021), as Akcigit et al. (2021) show that the reallocation effect accounts for most of the markup variation.

A2.2 Macroeconomic implications of the increased markups in the EU

Based on the shock size calculated in the previous section, we assess the macroeconomic effects of the increased markup through the lens of the QUEST III model.[66]

The shock propagates in our economy as follows. The increase in markup generates inflation, which reduces consumption and aggregate demand. Consequently, firms reduce their investment and output to earn higher profits. At the same time, employment reduces.

Table A2.2: GDP impact of a permanent markup shock (%) with a size calculated from 2000

	1	5	10	50
Diez et al. (2021)	-1.41	-1.99	-2.63	-3.72
Akcigit et al. (2021)	-3.08	-4.38	-5.87	-8.59
De Loecker and Eeckhout (2021)	-3.72	-5.30	-7.14	-10.68

65 This has been done because Akcigit et al. (2021) report a normalized markup for which in 1980 it is equal to 1. Similarly, De Loecker and Eeckhout (2021) estimate a markup value close to 1 in 1980. This implies unrealistic shock values.

66 In the context of the QUEST III model, the markup has been estimated as an average over the period 1997-2015, using EUKLEMS data.

Table A2.2 reports the simulation results calibrating the size shock according to the selected literature considering the evolution of markups from 2000. After a year, the positive markup increases generate a GDP loss between 1 and 4 percentage points. The potential loss in GDP mounts when longer time horizons are considered.

As shown in Table A2.3[67], the impact on GDP is particularly concerning when we simulate the total markup variation estimated by Diez et al. (2021) and Akcigit et al. (2021), as they report an even more substantial increase in markups before 2000.

Table A2.3: GDP impact of a permanent markup shock (%) increase from 1980

	1	5	10	50
Akcigit et al. (2021)	-7.57	-10.81	-15.04	-28.59
De Loecker and Eeckhout (2021)	-10.48	-14.60	-20.82	-39.59

In such a case, after one year, the GDP loss ranges between 7 and 11 percentage points. The potential loss in GDP mounts when longer time horizons are considered.

A2.3 Concluding remarks

The empirical literature has reported an increasing trend in markups among advanced economies, noting that European countries may have different dynamics than the US. Such evidence has raised some concerns about the state of competition among policymakers and practitioners and the potential consequences in terms of efficiency and productivity for the entire economy.

Motivated by these findings, we aim to assess the possible costs of "non-competition". For this purpose, we look at the recent literature which has measured the global markup dynamics, allowing for a comparison across databases, methodologies, and periods. Among those contributions, we select the works of Diez et al. (2021), Akcigit et al. (2021) and De Loecker and Eeckhout (2021) to assess the economic implications of the reported markup variation through the lens of the QUEST III model.

Simulation results suggest that the macroeconomic implications of increased market power will lead to a modest deterioration of the GDP if we consider the increase in markups reported for the period 2000 onwards. However, the impact is larger if we base our consideration on the full size of the market shock reported by Akcigit et al. (2021) and De Loecker and Eeckhout (2021).

Nevertheless, the uncertainty regarding the macroeconomic effects on the GDP suggests that further efforts are needed to benchmark the "cost of non-competition". For example, an improvement could be to estimate the evolution of the markups according to the source of data used to calibrate the model.

We reserve for future investigation the identification of potential benchmarks to measure a given state of competition in the EU economy. We would like then to compare a benchmark against a counterfactual without functioning competition and against a counterfactual where competition is effective or at least “workable”.

[67] Given the extraordinary size of the markup shock increases, we use a linear extrapolation method to obtain the order of magnitude of the macro impact.

Those extensions are in line with papers focusing on the counterfactual macroeconomic impact of rising markups, either arising from the lack of competition in the Single Market or from the implementation of structural reforms.

For example, In 't Veld (2020) ran a counterfactual scenario in which tariffs and non-tariff barriers are reintroduced to evaluate the macroeconomic benefits of the Single Market agreement for trade in goods and services in the EU28 using the QUEST model. The shock - calibrated at 26%, as found in Badinger (2007), captures the effects of trade barriers and the lower competitive environment.

Papers focusing on the implementation of structural reforms adopt a distance-to-frontier approach, i.e., they define a gap for each indicator relative to the three best performers. For example, Varga and In 't Veld (2014) quantify the potential impact of structural reforms in the EU Member States using the semi-endogenous growth QUEST (QUEST3RD). The authors evaluate the effects of reforms by assuming a gradual and partial closure of (half of) the gap vis-à-vis the average of the three best performers.

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A3. Descriptive analysis of competition indicators at the sector level and analysis of correlations with competition policy interventions[68]

In this Annex, we analyse possible correlations between the interventions by the European Commission and the degree of industry concentration in the sectors concerned.

Commission interventions consist of merger interventions, cartel prohibitions and antitrust interventions under Articles 101 and 102 TFEU. We use information on case interventions in each industry as collected for the customer savings calculations for the period 2012-2021. The data on interventions is at four-digit sectoral level (NACE rev. 2).

Industry concentration is measured by the CR4 ratio, which corresponds to the aggregate share of production of the four largest companies within the industry. Concentration data are available for 156 sectors from Euromonitor International's Passport Industrial database[69], which is based on the ISIC rev. 3.1 sectoral classification. Depending on the size of the sectors, they are expressed at 2, 3 or 4 digit level of granularity.

In order to match the Euromonitor dataset on concentration at the sector level (based on the ISIC rev 3.1 classification) with DG COMP data on case interventions (based on the NACE rev.2 classification), a transformation from the NACE classification to the ISIC classification was necessary using a table of correspondence.[70] Due to the parties involved in a case potentially being active in multiple areas of activity, individual cases might have been assigned to several NACE codes by the case teams in DG COMP. For the analysis, only the primary NACE code selected by DG COMP, was used. The sample includes 305 cases in total; as there are general conversion tables publicly available, each case was assigned to a set of possible suitable ISIC codes. In total, 156 cases had a one-to-one matching between the NACE Rev.2 code and the corresponding ISIC Rev. 3.1, which means that 149 out of 305 cases are linked to at least two options. These latter cases have had to be assigned on a case-by-case basis.

For most of the cases with more than one ISIC code option, there were sufficient arguments to assign a suitable ISIC code by analysing the press release and/or the decision text of the Commission. For some cases, however, this was not possible. By way of illustration, one can refer to case M.6447 involving air carriers. Whereas the NACE classification segments the aviation sector into Passenger air transport (NACE 51.10) and Freight air transport (NACE 51.21), the ISIC classification segments it into the categories Scheduled air transport (ISIC 6210) and Non-scheduled air transport (ISIC 6220). It is not possible to unambiguously assign this case to one of the two ISIC codes. To address this issue, the Euromonitor dataset on industry concentration (and its sector descriptions) has proved helpful to select an ISIC code. The corresponding ISIC codes for cases obtained from correspondence tables are sometimes more granular (four-digit codes) than the Euromonitor dataset, which may only have data at the two-digit level. In this instance, the more general two-digit code (and not the four-digit one) has been chosen, which would be Air Transport (ISIC 62) in the case described above. For some cases, this approach was not possible as there were no data points in the two-digit or four-digit segment or there was no clear match. In this case, it was not possible to assign an ISIC code and the observation had to be excluded from the sample. In total, 16 cases, were excluded.

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68 Appendix prepared by Igor Fedotenkov (JRC) and Niklas Angelov (COMP).

69 This database was previously used in sectoral concentration analysis by Koltay and Lorincz (2021), Competition Policy Brief, 2021.

70 https://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL.

We analyse the industry concentration ratio (CR4). Only data from France, Germany, Italy, and Spain are considered and the analysed period is 2012-2019. For each sector, we calculated CR4 for every year and country. Next, we calculated weighted average of these indicators by country, with weights being equal to the turnover of the market. We then averaged the obtained values in time.

The Euromonitor data contains information about industry concentration in 156 economic sectors. We removed 10% of the sectors with the highest share of exports. The remaining number of sectors equals 140.

Figure A3.1 presents the distribution of the CR4 measure across the sectors. The largest concentration (CR4 > 0.7) is observed in Transport via railways, Air transport, Manufacture of refined petroleum products and Telecommunications. The largest number of interventions is made in Manufacture of pharmaceuticals, medicinal chemicals and botanical products, Manufacture of motor vehicles, trailers and semi-trailers and Telecommunications.

Figure A3.1: Distribution of concentration (CR4)

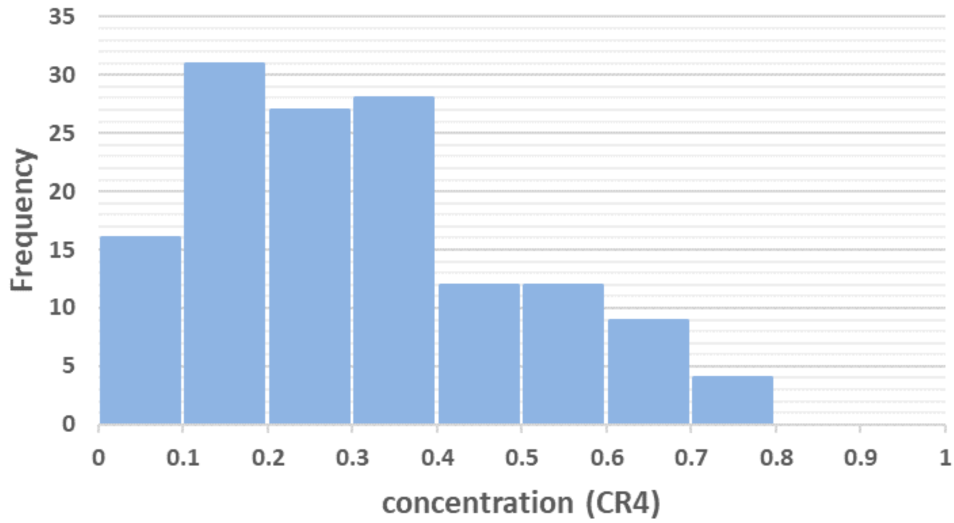


Table A3.1 presents correlations between industry concentration (CR4) and the number of competition policy interventions. As the results can be sensitive to outliers, we present not only ordinary (Pearson) correlation, but also Spearman rank correlation. All estimated correlation coefficients are positive. In all cases, apart from cartel prohibitions, rank correlations are somewhat greater than ordinary correlations. The result shows a positive association between industry concentration and the number of cases in which the Commission intervened.

Table A3.1: Correlation between industry concentration (CR4) with the number of competition policy interventions

	Pearson correlation	Spearman rank correlation
Number of merger interventions	0.3224***	0.3227***
Number of cartel prohibitions	0.1550**	0.1550**
Number of antitrust interventions	0.1813**	0.2311**

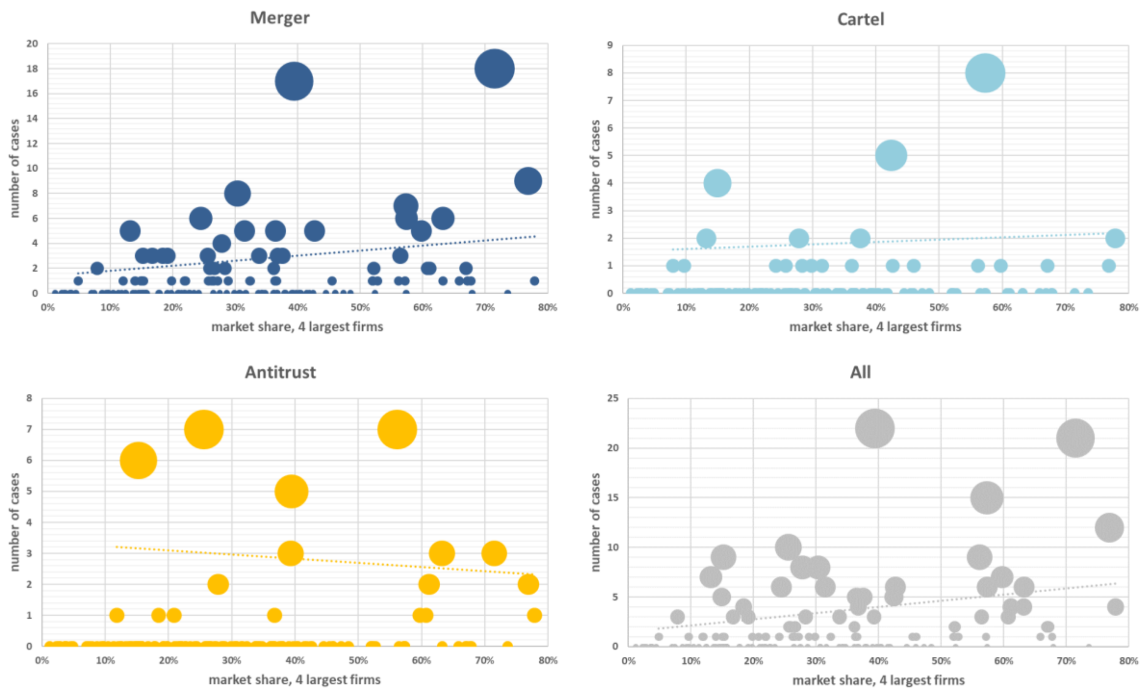
Total number of competition policy interventions	0.3395***	0.3445***

** - 5% significance level
*** - 1% significance level

In Figure A3.2 we present scatterplots of the number of interventions and industry concentration (CR4) for all sectors considered in the analysis. The size of bubbles visualises the number of interventions. The visualised trend-lines only account for sectors with non-zero number of interventions. (In Table A3.1 all sectors, including sectors with non-zero number of interventions are considered.). For mergers and cartel prohibitions, more cases are observed in the sectors with greater industry concentration which shows that the European Commission makes more interventions in the markets with greater market concentration. However, in case of antitrust interventions, the trend-line is not upward sloping. A comparison of the negative slope in Figure A3.2 and the positive correlation for antitrust interventions in Table A3.1 shows a positive association between industry concentration and the binary decision of the Commission to intervene (makes at least one intervention in that sector or not). However, the positive association does not hold when comparing industry concentration with the number of interventions.

In terms of future research agenda, one could consider looking at correlations between industry concentration and other measures of the intensity of competition enforcement, e.g., the number of interventions in mergers *relative to* the number of merger cases (mergers notified).

Figure A3.2: Number of cases and industry concentration (C4), scatterplots



A4. Modelling the effects of competition interventions: the Logistic Approach

In this section we present the impact results of competition policy interventions using the Logistic Approach, which is the methodology used in the 2021 Report for assessing the corresponding interventions up to 2020. Hence, this section intends to ensure continuity relative to the last year Report.

In the Logistic Approach, the model used to describe the diffusion of the signal sent by the competition authority is a logistic function which may be represented by an S-shaped curve. In this model, the marginal effect of an increase in detection (σ) on deterrence (ω) is proportional to the level of deterrence already present in the sector (ω(σ)):

$$\frac{d\omega}{d\sigma} = \beta * \omega(\sigma) * \{1 - \omega(\sigma)\} \qquad (4.1)$$

with σ being the strength of the signal sent to market participants by a competition authority, and ω being the deterrent effects associated with this signal. σ is approximated by the relative importance of the detection activity of the competition authority as measured by the size of the market directly affected by competition policy interventions (*mkt*) in relation of the level of gross output in the NACE four-digit sector to which to this market belongs ($\sigma = mkt/GO_4$).

The strength of the signal σ resulting from the detection of competition policy infringements is amplified by interactions among market players which generate further deterrent effects. As in the Bass approach, the deterrent effects are expressed as the share of deterred markets in the part of the four-digit sector not directly affected by the intervention mktD/(GO4-mkt)). The marginal effect of an increase in detection on deterrence (dω/dσ) initially increases until the share of deterred markets reaches a certain level and then it declines. When the share approaches unity, the second term in Equation 4.1 approaches zero and there is no further increase in deterrence effects.

The parameters of the logistic function used to model the diffusion of information about competition policy interventions are calibrated in such a way that the arithmetic[71] average of the deterrence multipliers matches the values reported in Table 4.1.

Table A4.1 reports the macroeconomic impact of competition policy interventions over the period 2012-2022 using the Logistic approach.

[71] In the Bass approach introduced in Section 3, the weighted average of deterrence multipliers is used to calibrate the parameters of the Bass function.

Table A4.1: Macroeconomic impact of permanent markup shock (in %) – Logistic model Markup Variation by -0.86 pp

	1	5	10	50
GDP	**0.24**	**0.41**	**0.55**	**0.79**
GDP deflator	**-0.17**	-0.24	-0.32	-0.52
Employment	**0.19**	0.3	0.35	0.35
Consumption	**0.24**	0.36	0.49	0.7
Investment	**0.38**	0.8	0.97	1.25
Profits	**-6.2**	-8.4	-7.94	-6.95

*Numbers represent percentage deviation from the equilibrium un-shocked values. Columns report the impact after 1,5,10, and 50 years.

The results show that the macroeconomic impact of competition policy interventions is larger in the Bass model (0.55% increase in GDP after 5 years) than in the logistic model (0.41%). This difference is mainly due to the different assumptions made about the deterrence effects, thus translating into a different calibration of the parameters in the two models. Specifically, in the Bass-model reference scenario, the parameters are calibrated to ensure that the case-weighted average of the deterrence multipliers equals 10 for merger interventions, 20 for cartel prohibitions, 20 for antitrust interventions under Article 101 TFEU and 10 for antitrust interventions under Article 102 TFEU. On the contrary, in the logistic model baseline scenario, an unweighted arithmetic average is used.

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