



# Modelling the macroeconomic impact of competition policy: 2021 update and further development

Prepared by



**EUROPEAN COMMISSION**

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# **Modelling the macroeconomic impact of competition policy: 2021 update and further development**

Prepared by

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## EXECUTIVE SUMMARY

This report provides an update of the macro-model simulations of the impact of the competition policy interventions of the European Commission over the period 2012-2020. The novelties of this year's report include the transition from EU28 to EU27, the inclusion of preliminary data on antitrust enforcement for the period 2012-2020, and the regular update with data for the year 2020 on merger interventions and cartel prohibitions. The year 2020 saw a relatively small total number of interventions, but the 25 interventions included four merger interventions with affected markets of substantial size. Taken together, 2020 was an 'average' year in terms of the macroeconomic impact of the Commission's activities.

The report presents the results of the macroeconomic impact of competition policy interventions by the European Commission using the QUEST III macro-model of the EU economy and an EU-wide input-output model. The simulations make use of the information provided by DG Competition on the European Commission's merger interventions and cartel prohibitions as well as preliminary data on antitrust interventions other than cartels.

The simulations carried out in QUEST III illustrate that competition policy has a positive impact on GDP of 0.37% in the medium term. This impact includes the direct price effects (as captured by the customer savings calculations) as well as the indirect, deterrent effects of the Commission's competition policy interventions. The difference between the five-year GDP impact of 0.37% reported here and the 0.27% reported in last year's report can be explained by three factors: (1) the transition from the EU-28 to the EU-27 due to Brexit; (2) the impact of the Commission's antitrust interventions (in the report of the previous year, only merger interventions and cartel prohibitions were considered); and (3) the effect of the Commission's competition policy interventions of 2020.

Similarly, the calculations carried out using the input-output framework suggest that, on average over the period 2012-2020, competition policy enforcement has reduced the EU's overall price level by 0.63 percentage points, including both within-sector and cross-sector spill-over effects. Industries with many important downstream links (i.e. those that sit higher up in supply chains) tend to produce stronger spill-over effects than industries with few downstream connections (i.e. those that sell a large share of their output to final users). 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.

Finally, the report presents new developments in data analysis and modelling, including in particular: (i) the on-going research on the assessment of the evolution of mark-ups in the EU; (ii) improvements in the mathematical approach chosen to model deterrence; and (iii) the possible correlation between mark-up levels and Commission interventions at the sector level. On this last point, the report finds that the Commission's competition policy interventions (excepting cartel prohibitions) tend to focus on industries with high mark-ups and concentration ratios.



## 1. INTRODUCTION

This report models and analyses various aspects of the macroeconomic impact of competition policy interventions by the European Commission over the period 2012-2020. Based on information provided by the Directorate-General for Competition (DG COMP) on its merger interventions, cartel prohibitions and 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 allows evaluating 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 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 January 2021 (European Commission, 2021) along several dimensions. First, to take account of Brexit, both models have been recalibrated for an EU economy of 27 Member states, as opposed to 28 Member States previously. Second, the underlying database has been revised to reflect: (1) changes in the distribution of EU gross output at the four-digit sector level, which are to a large extent a reflection of Brexit as well. However, Commission interventions affecting UK companies and markets have not been excluded from the sample of cases because of their cross-border effects on the EU economy; (2) the inclusion of preliminary data on the Commission's antitrust interventions other than cartels – in previous reports only merger interventions and cartel prohibitions had been considered – and (3) the straightforward update with competition policy interventions for the year 2020.

This year's annual report has the same format as previous year's report. It includes a main report that is a collaborative effort of the three Directorates-General (DG COMP, the JRC and DG ECFIN) involved, 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. This year's annexes consider the following issues of interest: (i) the measurement and determinants of the evolution since the early 2000s of mark-ups, which are a key indicator of market power; (ii) the correlation between mark-ups and Commission interventions at the sector level; (iii) a new approach to modelling the deterrent effects of competition policy interventions with the Bass model of diffusion; and (iv) an attempt at linking labour augmenting productivity to changes in mark-ups. These annexes provide valuable insights on how to improve the quality and relevance of the model simulations going forward.

The main report is structured as follows. Section 2 describes the database of European Commission competition policy interventions, which has been updated to include preliminary data on antitrust interventions other than cartels for the period 2012-2020 as well as data on merger interventions and cartel prohibitions for the year 2020. Section 3 considers possible measures of the direct and indirect effects of the Commission's market interventions, and section 4 shows how these effects have been modelled in the current report. Section 5 presents the results of the QUEST III macro-model simulations, and section 6 uses an input-output model to illustrate how the effects of competition policy interventions are transmitted from one sector to another. Section 7 summarises the on-going research aimed at analysing the intensity of competition, at modelling the deterrent effects of competition policy

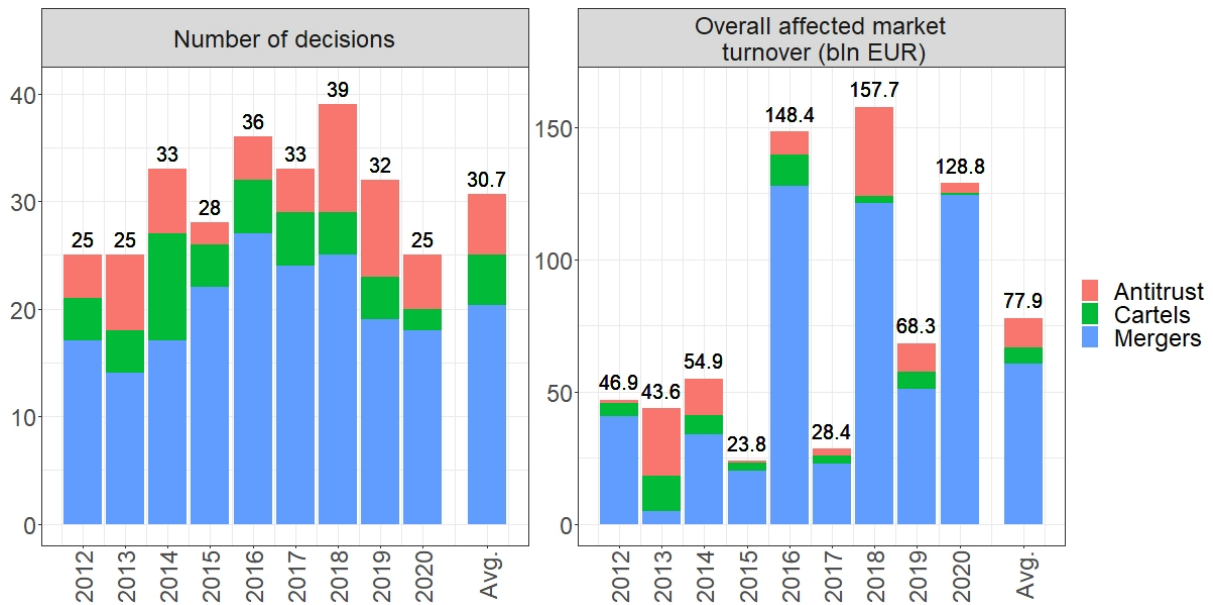
interventions and at establishing a link between competition policy interventions, mark-ups and concentration at the industry level. Section 8 concludes.

## **2. DESCRIPTIVE ANALYSIS OF COMPETITION POLICY INTERVENTIONS OVER THE PERIOD 2012-2020**

Our analysis of competition policy enforcement considers the decisions made by the European Commission between 2012 and 2020 in three types of cases: merger interventions, cartel prohibitions and, antitrust interventions other than those concerning cartels. Despite the end of the EU membership of the United Kingdom, past cases involving UK companies are covered by the present analysis, because those cases had by definition effects on trade between Member States (see Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU)) and therefore effects also in other EU Member States than the UK. Antitrust activity is included in the analysis for the first time this year, but the data used are still preliminary and will likely be subject to revision in next year's report. Previous editions of this report focused on merger and cartel cases exclusively.

During the period under study, the European Commission adopted 183 merger, 42 cartel and 51 antitrust decisions through which the Commission intervened in the market. Taken together, the markets directly affected by those interventions are worth a total of approximately 700 billion euro. How this volume of competition policy enforcement is distributed over time can be seen in Figure 2.1. The left-hand panel represents the number of decisions broken down by type. The right-hand panel displays the overall turnover in the markets affected by those decisions, also broken down by type. From one year to another, the number of decisions varies between a minimum of 25 (in 2012, 2013 and 2020) and a maximum of 39 (in 2018). As cases differ widely in terms of associated market turnover, the total size of the markets affected by decisions may change remarkably from one year to the next. In 2018, for instance, the total affected market size is more than five times the value for 2017 despite the difference in case count being relatively modest. The year 2020 ranks third in terms of overall affected market size after 2018 and 2016. Contrary to those years, however, 2020 is characterised by a relatively low number of decisions: more than four-fifths of the overall market size can be accounted for by four high-profile merger cases (i.e. Boeing/Embraer, Vodafone Italia/Tim/Inwit JV, PKN Orlen/Grupa Lotos and Google/Fitbit).

**Figure 2.1: European Commission decisions 2012-2020**



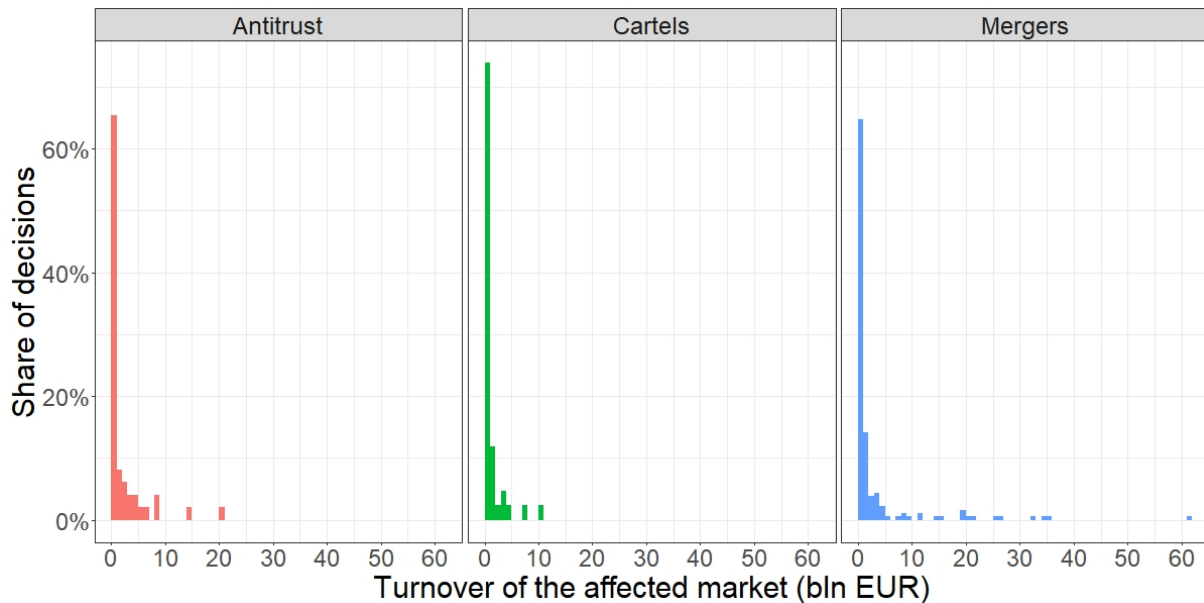
Source: DG-COMP data.

The bulk of the European Commission’s competition policy enforcement activity is represented by merger cases. In terms of raw case count, this is true in each and every year. On the whole, merger interventions account for approximately two thirds of the decisions taken. The remaining cases are split roughly evenly between cartel prohibitions and antitrust interventions. Most of the time, mergers are also leading in terms of the share of affected market turnover: in an average year, they represent about three quarters of the total. A striking exception to the pattern, however, is provided by the year 2013, in which antitrust and cartel cases accounted for 59% and 30% of the total affected turnover, respectively.

As measured by associated turnover, merger cases have a larger mean size (3.0 billion euro) than either antitrust (2.1 billion euro)<sup>1</sup> or cartel cases (1.3 billion euro). This results mostly from a handful of important merger interventions made in the years 2016, 2018 and 2020. As can be appreciated from Figure 2.2, such large decisions are relatively uncommon. The overwhelming majority of cases – whether concerning antitrust interventions, merger interventions or cartel prohibitions – target comparatively small markets. This also explains why for each competition policy instrument the median size of the affected markets is well below the mean size. The median affected market size is 0.5 billion euro<sup>1</sup> for antitrust cases, 0.6 billion euro for cartels and 0.5 billion euro for mergers.

<sup>1</sup> The figures reported on affected market turnover for antitrust interventions are still preliminary and will likely be subject to revision in next year’s report.

**Figure 2.2: Distribution of market turnover by competition policy instrument**



Source: Own computations based on DG-COMP data.

**Table 2.1: Average duration of the price effect by type and year**

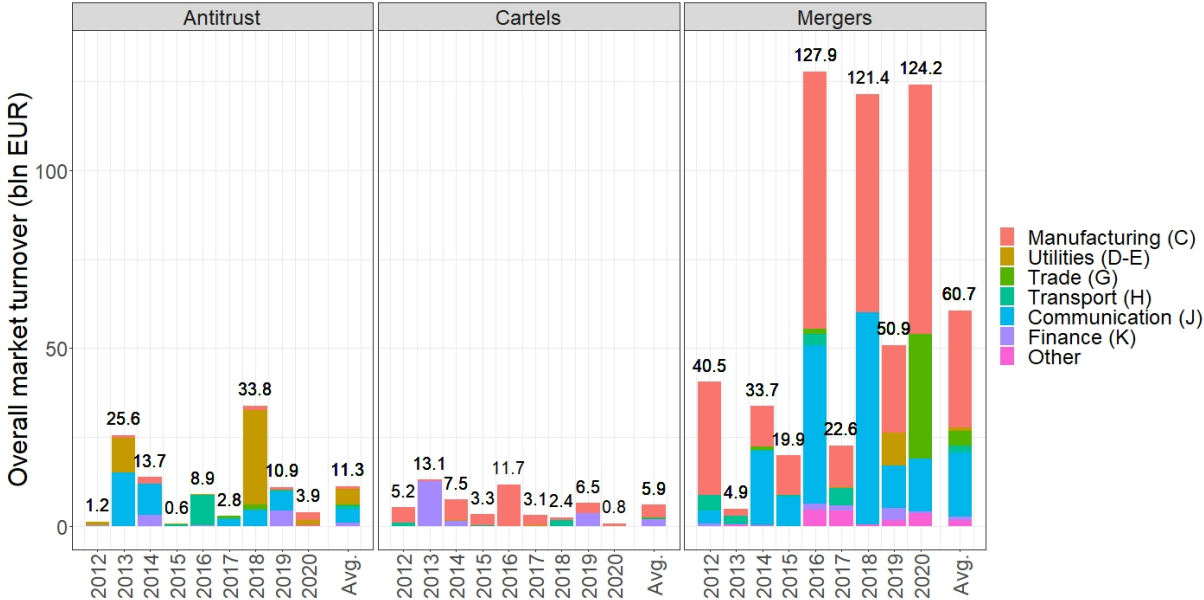
| Year                  | Antitrust  |                  | Cartel     |                  | Merger      |                  | All         |                  |
|-----------------------|------------|------------------|------------|------------------|-------------|------------------|-------------|------------------|
|                       | Case count | Average duration | Case count | Average duration | Case count  | Average duration | Case count  | Average duration |
| 2012                  | 4          | 3.0              | 4          | 2.0              | 17          | 3.3              | 25          | 3.0              |
| 2013                  | 7          | 3.0              | 4          | 2.0              | 14          | 2.4              | 25          | 2.5              |
| 2014                  | 6          | 3.0              | 10         | 2.4              | 17          | 2.5              | 33          | 2.6              |
| 2015                  | 2          | 3.0              | 4          | 3.0              | 22          | 2.5              | 28          | 2.6              |
| 2016                  | 4          | 3.0              | 5          | 4.2              | 27          | 3.9              | 36          | 3.8              |
| 2017                  | 4          | 3.0              | 5          | 3.8              | 24          | 3.2              | 33          | 3.2              |
| 2018                  | 10         | 3.0              | 4          | 4.5              | 25          | 3.4              | 39          | 3.4              |
| 2019                  | 9          | 3.0              | 4          | 3.3              | 19          | 3.4              | 32          | 3.3              |
| 2020                  | 5          | 3.0              | 2          | 3.0              | 18          | 3.4              | 25          | 3.3              |
| <b>Average</b>        | <b>5.7</b> | <b>3.0</b>       | <b>4.7</b> | <b>3.1</b>       | <b>20.3</b> | <b>3.2</b>       | <b>30.7</b> | <b>3.1</b>       |
| <b>Avg. (2012-15)</b> | 4.8        | 3.0              | 5.5        | 2.4              | 17.5        | 2.7              | 27.8        | 2.7              |
| <b>Avg. (2016-20)</b> | 6.4        | 3.0              | 4.0        | 3.9              | 22.6        | 3.5              | 33.0        | 3.4              |

For each case, DG COMP estimates the period of time during which the effects of the anticompetitive behaviour would have lasted had the European Commission not intervened. The length of that period is referred to as the duration of the price effect. The average case has an estimated duration of 3.1 years (Table 2.1). In this preliminary analysis, all antitrust interventions are assumed to be effective during a period of three years, which is in line with the OECD (2014) guidance on the calculation of consumer benefits. In next year's report, this assumption will be relaxed to take account of the case-specific information available, in line with current practice for the two other competition policy instruments. In spite of the case-by-

case variation in duration, cartel prohibitions and merger interventions do not appear to differ systematically in terms of average duration. There is however a tendency for more recent decisions to have a longer associated duration than those adopted in earlier years, with the average duration increasing from around 2½ years over the period 2012-2015 to 3½ years over the period 2016-2020. It is worth noting that, starting from 2016, DG COMP modified the methodology used to assess the duration of the price effect of an intervention, based on case-specific characteristics. Consequently, we cannot rule out the possibility that the observed trend towards longer durations is to some extent an artefact of that methodological change.

To a significant extent, the markets targeted by the European Commission’s cartel prohibitions and merger interventions are concentrated in the manufacturing sector (Figure 2.3). In the case of mergers, however, another large chunk of the overall affected turnover is accounted for by cases in the communication sector. Regarding cartels, on the other hand, a number of important decisions, especially in the year 2013, are found in the financial sector.

**Figure 2.3: Cartel, merger and antitrust cases by NACE Rev. 2 sector**



Source: own computations.

**3. DIRECT AND INDIRECT EFFECTS OF COMPETITION POLICY INTERVENTIONS**

**3.1. Direct effects of competition policy interventions**

A distinction can be made between the direct effects of competition policy interventions and their indirect deterrent effects. A second distinction can be made between the price effects of such interventions and the ‘non-price’ effects on innovation, product quality or diversity, and the like. The direct price effects, which exclude both the indirect deterrent effects and the non-price effects, are commonly measured by the consumer benefits or customer savings associated with such interventions. Based on the 2012-2020 dataset of the European Commission’s merger interventions and cartels prohibitions, DG COMP has calculated the customer savings from such interventions. This section describes the development over time of customer savings by sector and by instrument. Antitrust interventions other than cartel

prohibitions have not yet been taken into account as the dataset for such interventions is not final. Consequently, the totals reported below significantly underreport the true direct effects of the Commission’s interventions. Moreover, the direct price effects give only a partial view of the benefits of competition policy interventions as they do not include the deterrent and non-price effects of these interventions described in section 3.3.

The customer savings calculations can be considered as a bottom-up approach aimed at providing a conservative estimate of the direct consumer benefits from competition policy interventions by the European Commission. Customer savings from a given intervention equal the product of conservative estimates of (1) the price increase avoided, (2) the size of the affected market, and (3) the expected duration of the price effect in the absence of an intervention by the competition authority. Annual customer savings are the sum of the customer savings associated with all competition policy interventions in a given year. This approach is broadly in line with the guiding principles and methodologies to calculate the customer savings agreed within the OECD (2014).

Information on the three components of the customer savings are based on case-specific information to the extent possible and on conservative assumptions otherwise (see Table 3.1). For the avoided price increases associated with merger interventions and cartel prohibitions, ranges of the expected price effects have been adopted, reflecting the uncertainty about size of such effects reported in the economic literature. Data on the size of the affected market can normally be found in the case file, while information about the expected duration of the price effect is gathered by way of a questionnaire sent to the case teams responsible for the preparation of the relevant Commission decisions.

**Table 3.1: Assumptions used to calculate the customer savings from cartel prohibitions and merger interventions**

|  | <b>Merger cases</b>                                    | <b>Cartel cases</b>  |
|--|--|--|
| <b>Avoided price increase</b>                | Avoided price increase of 3-5%                         | Overcharge of 10-15%   |
| <b>Size of the affected market</b>           | Annual turnover of all firms in the affected market(s) | Annual value of sales by the companies under investigation in the affected market(s) |
| <b>Expected duration of the price effect</b> | 2/3/5 years  | 1/3/6 years  |

While we are able to estimate customer savings associated with each individual decision, the true value of the exercise lies in the aggregate assessment of developments over time or by sector. Table 3.2 compares the estimated customer savings from merger interventions and cartel prohibitions over the period 2012-2020. It appears that the total customer savings from cartel prohibitions are smaller than those of merger interventions. This divergence in customer savings between cartel prohibitions and merger interventions reflects differences in the number of intervention decisions taken over the 2012-2020 period, which varies from 42 for cartels to 183 for mergers.

Customer savings for an ‘average’ cartel prohibition range from 0.4 to 0.6 billion euro and for a merger intervention from 0.35 to 0.6 billion euro. It seems therefore that over the long run, customer savings per intervention case do not appear to differ greatly between these two competition policy instruments. However, one has to keep in mind that such averages hide enormous differences from one case to the next.

For the whole period under consideration, the estimated aggregate customer savings from cartel prohibitions and merger interventions by the European Commission ranged from 82 billion to 133 billion euro. Total customer savings were particularly high in 2016, 2018 and 2020, with annual amounts of well over 14 billion euro. In 2016, this was due to important merger interventions and cartel prohibitions, while in 2018 and 2020 merger interventions were the prime contributors to the high customer savings recorded in those years.

**Table 3.2: Customer savings (in bn EUR) from competition policy decisions since 2012**

| Year         | Cartel prohibitions | Merger interventions | Total               |
|--------------|---------------------|----------------------|---------------------|
| 2012         | 1.4 – 2.0           | 5.5 – 9.1            | 6.8 – 11.1          |
| 2013         | 1.4 – 2.1           | 0.4 – 0.6            | 1.8 – 2.8           |
| 2014         | 1.8 – 2.7           | 2.1 – 3.6            | 4.0 – 6.3           |
| 2015         | 1.0 – 1.5           | 1.7 – 2.9            | 2.7 – 4.4           |
| 2016         | 6.8 – 10.2          | 18.3 – 30.4          | 25.1 – 40.6         |
| 2017         | 1.4 – 2.1           | 2.4 – 4.1            | 3.9 – 6.2           |
| 2018         | 1.3 – 1.9           | 15.0 – 25.0          | 16.2 – 26.9         |
| 2019         | 1.5 – 2.3           | 5.7 – 9.4            | 7.2 – 11.7          |
| 2020         | 0.2 – 0.3           | 13.8 – 23.0          | 14.0 – 23.3         |
| <b>Total</b> | <b>16.8 – 25.2</b>  | <b>64.9 – 108.1</b>  | <b>81.7 – 133.3</b> |

Source: Own computations based on DG-COMP data. Ranges are provided to indicate the uncertainty associated with these customer savings calculations.

### 3.2. A comparison with other jurisdictions

Table 3.3 below presents data on the officially reported total customer savings in billions of euros from four jurisdictions, namely the EU (European Commission), the US (Department of Justice and Federal Trade Commission), Japan (Japan Fair Trade Commission) and the UK (Competition and Markets Authority). International agreement has been reached within the OECD (2014) on guiding principles for the calculation of customer savings. However, this table cannot be used to compare the performance of these competition authorities, because differences in customer savings are partly due to slightly dissimilar assumptions and calculation methods.

The different figures reported for the various competition authorities largely reflect differences in the size of the jurisdiction for which the authorities are responsible. Yet it remains striking that the customer savings attributable to the European Commission are significantly larger than those attributable to the US Department of Justice and the Federal Trade Commission combined. It should be clear however that the customer savings from interventions by US State authorities, or for that matter, EU National Competition Authorities (NCAs) have not been taken into account, even if there are customer benefits associated with such interventions as well. A recent survey of NCAs shows that at least 12 of them have taken the initiative to calculate the benefits of their interventions for consumers. Finally, if one wants to have an idea of the overall level of antitrust enforcement in a given geographic area, private enforcement would have to

be taken into account. In the US, for example, private enforcement through damages cases plays a very significant role not captured by the figures reported here.

Although the European Commission is experiencing a large variation over time in terms of total customer savings, significant annual fluctuations also appear in other jurisdictions. Nevertheless, the average customer savings figures for the European Commission are well above those of other non-EU jurisdictions over the period 2012–2020.

While this overview of total customer savings across different competition authorities allows getting an interesting impression of the order of magnitude of customer savings from competition policy interventions in the different jurisdictions, one has to be prudent when using it to evaluate or compare the performance of the different authorities.

**Table 3.3: Total customer savings (in bn EUR) in different jurisdictions**

| Year                  | EC                | US DOJ     | US FTC     | JFTC       | CMA        |
|-----------------------|-------------------|------------|------------|------------|------------|
| 2012                  | 6.8 – 11.1        | 1.3        | 0.7        | 1.6        | 0.2        |
| 2013                  | 1.8 – 2.8         | 7.1        | 0.8        | 1.2        | 0.2        |
| 2014                  | 4.0 – 6.3         | 0.9        | 1.1        | 0.8        | 0.1        |
| 2015                  | 2.7 – 4.4         | 3.3        | 3.1        | 0.3        | 0.1        |
| 2016                  | 25.1 – 40.6       | 3.2        | 3.3        | 7.6        | 0.3        |
| 2017                  | 3.9 - 6.2         | 1.6        | 3.3        | 2.2        | 1.5        |
| 2018                  | 16.2 – 26.9       | 0.8        | 3.1        | 0.6        | 1.5        |
| 2019                  | 7.2 – 11.7        | 3.5        | 3.3        | 4.3        | 1.5        |
| 2020                  | 14.0 – 23.3       | n.a.       | 2.4        | n.a.       | 1.5        |
| <b>Annual average</b> | <b>9.1 – 14.8</b> | <b>2.7</b> | <b>2.3</b> | <b>2.3</b> | <b>0.8</b> |

Sources: EC, own calculations presented in the current report; US DOJ, Antitrust Division - Congressional Submission FY 2021 Performance Budget; US FTC, Annual Performance Report for Fiscal Year 2020; JFTC, figures made available via exchange of emails; and CMA, CMA Impact Assessment 2019/2020.

The differences in customer savings may be associated with the fact that the scope of interventions covered varies between authorities. Part of the difference in customer savings levels may also be explained by different assumptions and methodologies (see Dierx and Ilzkovitz, 2020). Another factor to be taken into account is that both the administrative enforcement activities by the European Commission and the US authorities are in their respective geographic areas of responsibility complemented by ‘decentralised’ administrative enforcement at ‘NCA’ or ‘State’ level. In the same vein, the activities of the NCAs in Europe need to be seen as complements to the action of the European Commission.

**3.3. Indirect, deterrent effects from competition policy**

Going forward, we would like to explore whether it is possible to obtain a conservative lower bound estimate of the indirect deterrent effects of European Commission’s merger and antitrust interventions. Deterrent effects can be described as the harm that might have arisen in the absence of interventions by a competition authority but that does not arise because firms



have decided to change their behaviour. The most commonly used method to determine the importance of such deterrent effects relies on surveys that directly ask companies and legal advisors to estimate the number of cartels/mergers deterred for every cartel detected/merger intervention. However, many of these surveys are dated and have been conducted at the national level only. DG Competition therefore intends as part of its longer term work programme to launch a similar survey at the EU level as a basis for improving our estimates for the so-called deterrence ‘multipliers’. Doing so would have the additional benefit of strengthening the empirical foundation of the macroeconomic simulations of the impact of competition policy presented in the current report.

Moreover, customer savings only consider the price effects of competition policy interventions. Less is known about the effects of such interventions on other measures of market performance, including effects on innovation, product quality or diversity, and on the functioning of labour markets. With the development of the digital economy, innovation is rapidly becoming (one of) the principal determinants of a company’s competitive performance, as it may result in cost reductions or product quality improvements. By prohibiting killer acquisitions that eliminate promising R&D projects or tackling the abuse of dominant positions, which prevent innovative start-ups from successfully entering the market, competition policy interventions help foster innovation. However, innovation effects are difficult to measure and may only become visible in the longer term. Similarly, the presence within a labour catchment area of multiple companies requiring similar skills benefits workers with such skills. Merger prevention and the prohibition of coordination of hiring practices between such companies ensures that workers will earn a fair wage. Once more, the measurement of such effects is a true challenge, which explains why the current exercise focuses on the more easy to track price and mark-up effects of competition policy enforcement.

#### **4. MODELLING THE EFFECTS OF COMPETITION POLICY INTERVENTIONS**

This section first summarises the theoretical assumptions underlying the model simulations and then presents the two models used to assess the economic impact of competition policy interventions by the European Commission, i.e. the QUEST III model and the FIGARO input-output tables.

##### **4.1. Modelling assumptions for simulating the effects of competition interventions**

Competition policy interventions are imputed into the QUEST III model as mark-up shocks reflecting both the direct effects in affected markets and the deterrent effects in the corresponding subsectors. These effects are also reflected in the price shocks applied to the input-output model.

The direct effects of the competition policy interventions are often measured by the customer savings from such interventions (see Section 3). These direct effects provide only a partial view of the benefits of competition policy, as its deterrent effects are not taken into account. These deterrent effects consist in preventing and reducing in severity future anticompetitive behaviour of market participants. According to the economic literature and the results of surveys of market participants and their legal advisers, these deterrent effects are much larger than the direct effects. However, such deterrent effects cannot easily be measured since they cannot be directly observed.

The approach used here assumes that by detecting anticompetitive behaviour, the competition authority (i.e. the European Commission in this case) sends a signal that is diffused to and

between market participants and discourages them from infringing competition law. According to this approach, there is a positive (non-linear) relation between detection and deterrence, which depends on the diffusion of information about competition policy interventions. We also assume that the deterrent effects of competition policy interventions are primarily felt in the markets and sectors directly affected by these interventions. This assumption is based on the results 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.

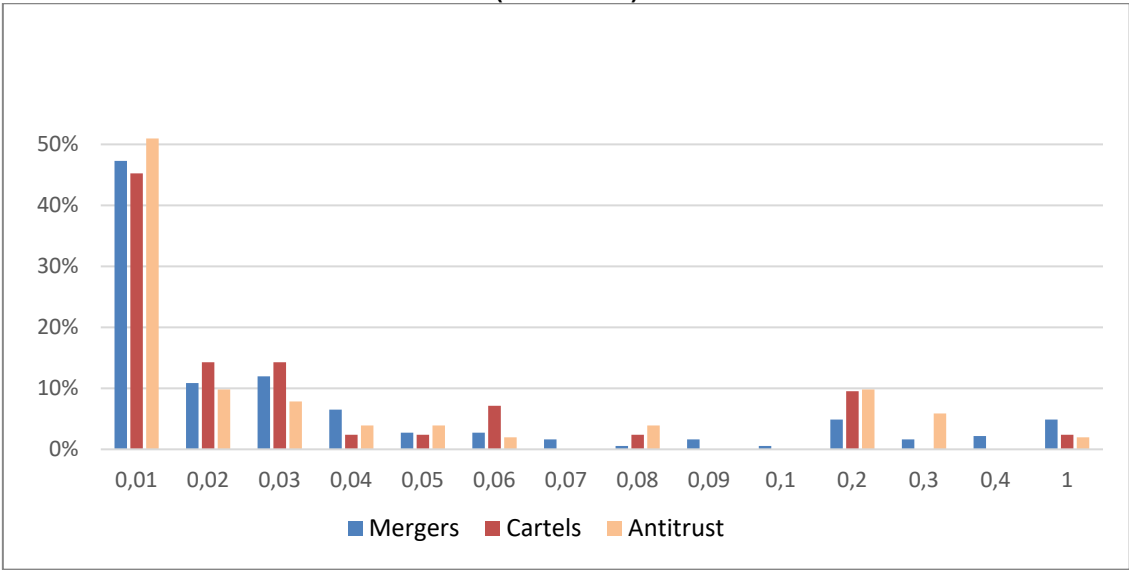
The model used to describe the diffusion of the signal sent by the competition authority is a logistic function<sup>2</sup> which may be represented by an S-shaped curve. In this model, the marginal effect of an increase in detection ( $\sigma$ ) on deterrence ( $\omega$ ) is proportional to the level of deterrence already present in the sector ( $\omega(\sigma)$ ):

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

with  $\sigma$  being the strength of the signal sent to market participants by a competition authority, and  $\omega$  the deterrent effects associated with this signal.  $\sigma$  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 this market belongs ( $\sigma = mkt/GO_4$ ).

Figure 4.1 describes the frequency distribution of the detection variable  $\sigma$  for each of the three competition policy instruments: merger interventions, cartel prohibitions and antitrust interventions. For all three 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 4.1: Frequency distribution of detection activity for merger, cartel and antitrust cases (2012-2020)**



<sup>2</sup> An alternative approach based on the Bass model is introduced in Section 7.2.

The strength of the signal  $\sigma$  resulting from the detection of competition policy infringements is amplified by interactions among market players (in particular through their legal counsels and the law firms that act as their advisers), which generate further deterrent effects. Defining  $mkt^D$  as the deterred market, the deterrent effects  $\omega(\sigma)$  can be expressed as the share of deterred markets in the part of the four-digit sector not directly affected by the intervention, i.e.,  $(\omega(\sigma) = mkt^D/(GO_4 - mkt))$ . The marginal effect of an increase in detection on deterrence  $(d\omega/d\sigma)$  initially increases until the share of deterred markets reaches a certain level and then it declines. When the share approaches unity, the second term  $(\{1 - \omega(\sigma)\})$  in Equation 4.1 approaches zero and there is no further increase in deterrence effects.

The deterrence multiplier can be defined as the ratio of the deterred markets over the detected market  $(mkt^D/mkt)$ . 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<sup>3</sup> average of the deterrence multipliers equals 10 for mergers, 20 for cartels, 25 for antitrust interventions under Article 101 and 10 for antitrust interventions under Article 102. These assumptions underlying the calibration of the logistic function and therefore the model simulations presented below are consistent with the results from company surveys on deterrence.<sup>4</sup>

#### 4.2. Application of a mark-up shock to the QUEST macro-model

The information on the avoided price increases associated with the European Commission's competition policy interventions is used to calibrate mark-up shocks, which are then applied to the QUEST III macroeconomic model.<sup>5</sup> More specifically, in QUEST III the aggregate change in mark-up due to merger interventions and cartel prohibitions,  $\Delta MUP_K$ , can be defined as follows:

$$\Delta MUP_K = \sum_{i \in \{I_K\}} \left[ \frac{\Delta P_i}{P_i} (1 + MUP_i) \right] \frac{GO_{2i}}{GO}$$

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 (4.2) shows that the aggregate mark-up shock depends on: (i) the price shocks in the sectors affected by the European Commission's competition policy interventions,  $\frac{\Delta P_i}{P_i}$ ; (ii) the gross mark-up level in the NACE two-digit sectors concerned,  $MUP_i$ ;<sup>6</sup> as well as (iii) the gross output of the sectors affected by the European Commission's competition policy interventions

<sup>3</sup> In the Bass approach introduced in Section 7.2, the weighted average of deterrence multipliers is used to calibrate the parameters of the Bass function. See Annex A.3 for more details.

<sup>4</sup> See Dierx et al. (2020) for a summary of these survey results.

<sup>5</sup> QUEST III belongs to the class of New-Keynesian Dynamic Stochastic General Equilibrium (DSGE) models widely used by international institutions and central banks. Competition policy acts as an instrument to increase competition amongst companies and thereby contributes to a decrease in the level of mark-ups. 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](https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/economic-research/macroeconomic-models_en)

<sup>6</sup> Mark-ups levels are calibrated according to the method proposed by Thum-Thysen and Canton (2015), which extends Roeger's (1995) mark-up calculation method by including the effects of product market reforms (see Annex A.1).

as a share of total gross output within the EU business economy,  $\frac{GO_{2i}}{GO}$  (see European Commission, 2021).

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:

$$\frac{\Delta P_i}{P_i} = \sum_{k \in M_i} \frac{\Delta P_k}{P_k} MS_{ik} + \sum_{k \in C_i} \frac{\Delta P_k}{P_k} MS_{ik} + \sum_{k \in A_i} \frac{\Delta P_k}{P_k} MS_{ik} \quad (4.3)$$

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 markets directly or indirectly affected by competition policy interventions  $k$  in industry  $i$ . A distinction is made between mark-up and price shocks reflecting only the direct effects of competition policy interventions and shocks including their deterrent effects as well. The weights  $MS_{ik}$  used to compute the direct price change at the two-digit sector level, are defined as the share of the affected turnover in the relevant market ( $mkt_{ik}$ ) over the gross output in the corresponding sector ( $GO_{2i}$ ):

$$MS_{ik} = \frac{mkt_{ik}}{GO_{2i}} \quad (4.4)$$

When deterrence is taken into account, the total weights  $MS_{ik}^T$  – including both the direct effects and the indirect deterrent effects of competition policy interventions – are defined as follows:

$$MS_{ik}^T = \frac{mkt_{ik}^T}{GO_{2i}}$$

where  $mkt_{ik}^T$  is the total market affected by competition policy intervention  $k$  in industry  $i$ . The total market affected includes both the markets directly affected by intervention  $k$  ( $mkt_{ik}$ ) and the markets affected indirectly through sectoral deterrence ( $mkt_{ik}^D$ ):

$$mkt_{ik}^T = mkt_{ik} + mkt_{ik}^D$$

Finally, we also take into account information about the duration of the price increases avoided because of the European Commission's competition policy interventions.<sup>7</sup> This implies that the mark-up 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. The results of the simulations carried out with the QUEST III macro-model are presented in Section 5.

### 4.3. Application of a price-shock to an EU-wide input-output model

A central premise of this report is that when the European Commission decides to sanction anticompetitive behaviour in a merger, cartel or antitrust case, prices in the relevant market will decrease (or will be prevented from increasing). The effects of the decision, however, are likely to propagate to other markets, as firms downstream in the supply chain can now source

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<sup>7</sup> See Box.1, European Commission, 2021.

their inputs more cheaply. It is reasonable to expect that, at least to some extent, the resulting cost savings will lead those firms to reduce the price of their own products. To analyse how the effects of competition policy enforcement are transmitted across markets, we use information on economic interdependencies retrieved from the input-output table of the European Union. This section briefly outlines the main features of our approach. The results are presented in Section 6.

The input-output table on which the analysis is based categorises production units into 64 branches of economic activities ('industries' for short), which are defined based on the NACE Rev. 2 statistical classification. In any given industry  $i$ , competition policy interventions lead to a certain 'total' price reduction. The total price reduction – which can conceivably be zero – consists of two components: (a) a 'within-industry' effect; and (b) a 'spill-over' effect.

The within-industry effect reflects the immediate repercussions of cartel prohibitions, antitrust and merger interventions on the markets they affect. In a manner entirely consistent with the analysis conducted with the QUEST macro-model of Section 4.2, the within-industry effect in industry  $i$  is computed according to Equation (4.2). It is worth noting, however, that in this case the relative price drop computed through Equation (4.2) represents only one component of the overall price change in industry (the other one being the spill-over effect). For this reason, we will not denote it by  $\Delta P_i/P_i$ . Instead, it will be referred to as  $WITHIN_i$ . As before, deterrent effects are incorporated in the analysis as described in Equations (4.4) and (4.5).

The spill-over effect, on the other hand, captures the ripple effects caused by the European Commission's competition policy interventions as the price drops they generate are transmitted downstream along the supply chain. Spill-overs are computed from the within-industry effects on the basis of a standard input-output price model. In this sense, the within-industry effects represent the exogenous shock in the analysis. When as a result of such a negative price shock an input becomes cheaper, it is presumed that producers will entirely pass on the ensuing cost savings to their customers in the form of lower output prices. In turn, those customers will also reduce the price of their products. The percent reduction in the price of industry  $i$ 's output due to spillover effects will be denoted  $SPILLOVER_i$ . Then the overall price reduction in industry  $i$  (including the deterrent effects) is given by  $TOTAL_i = WITHIN_i + SPILLOVER_i$ . It should be kept in mind that, like all input-output models, our analysis assumes a relatively simple cross-industry price transmission mechanisms. In this framework, for example, firms' use of inputs does not respond to changing prices. From this point of view, we cannot rule out the possibility that our results somewhat overstate the price-reducing impact of competition policy.

With regard to the time dimension, our analysis of competition policy enforcement is conducted on a year-by-year basis. In each year for which data are available (i.e., from 2012 to 2020), the exogenous within-industry price effects are calculated taking into account the antitrust, cartel and merger cases that are relevant in that year and then fed to the input-output model to obtain the corresponding spill-overs. In addition to the annual results, average annual impacts over the entire period under analysis are also computed.

A related issue concerns the handling of duration in the analysis. Duration refers to the fact that, according to the European Commission's calculations, the price reducing effects of antitrust interventions, cartel prohibitions and merger interventions typically last for more than one year. In this respect, we produce two independent sets of results. One ('with duration') – in the spirit of the QUEST simulations – does take into consideration the fact that decisions by the European Commission can produce their effects over several years. Thus, the merger, antitrust and cartel cases accounted for in the computation of, say, the 2018 within-industry effect include not only those cases for which a decision was reached in 2018 itself, but also those from earlier years that are deemed to be still producing their effects in 2018. However,

impact of decisions taken before 2012 are not taken into account. By contrast, our second set of results ('without duration') completely disregards all information about the duration of the price effect: decisions are only relevant in the year in which the decision is adopted. Taken together, the two sets of results give us some indication as to the sensitivity of our findings to the assumptions on case duration.

While our input-output analysis aims primarily at constructing industry-level price impact estimates, aggregating those results into a single economy-wide figure provides a useful summary measure of the 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).

As noted in the introduction, in this year's report the geographical scope of the analysis has been modified to take Brexit into account. This entailed, among other things, replacing the consolidated EU28 input-output table that had been used until last year with a new one in which the United Kingdom no longer contributes to intra-EU flows. The new EU27 input-output table we use here has been constructed on the basis of the results of the Figaro project. The Figaro tables, which became available for the first time in the spring of 2021, constitute the official input-output framework of the EU and are produced by Eurostat with the support of the JRC.<sup>8</sup> The auxiliary data underlying the  $GO_4$  variable have also been adjusted to reflect the switch to the EU27. As a part of this major revision of the project's data sources, the reference year of the model has also been updated. The model is now parametrised using information for 2018, the most recent year for which all the necessary data are available at the time of writing.

## 5. RESULTS OF THE MACRO-MODELLING ANALYSIS

In this section, we report on the main results of the simulation analysis with the QUEST III model. The logic of the simulations is as follows: we convert merger interventions, cartel prohibitions and antitrust interventions into a mark-up shock, which is the difference between the observed mark-up as impacted by the European Commission's competition policy interventions, and the counterfactual mark-up computed in a macroeconomic scenario without competition policy interventions.

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 exploiting assumptions on the avoided price increase, its duration and the importance of deterrent effects, we convert these values into mark-up shocks at the two-digit sector level. Subsequently, we aggregate these shocks into a single EU economy-wide mark-up shock (see European Commission, 2021).

Specifically, we compute a time-invariant, permanent mark-up shock<sup>9</sup> generated by the European Commission's competition policy interventions, and we use this shock to simulate the macroeconomic impact through QUEST.<sup>10</sup> The permanence of the mark-up shock reflects companies' expectations that in the foreseeable future the European Commission will continue

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<sup>8</sup> <https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/figaro>

<sup>9</sup> For more details on the computation of the permanent shock see Box.1, European Commission (2021).

<sup>10</sup> Annex A.4 considers the merits of introducing an additional shock to the QUEST III model, reflecting the impact of competition policy interventions on labour augmenting productivity. This shock would come on top of the mark-up shock applied in the main model simulations.

to enforce EU competition policy rules at the same average pace as the one observed over the period 2012-2020.

Table 5.1 summarises the assumptions underlying the permanent mark-up 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 customer savings calculations presented in Section 3 (see Table 3.1). As already mentioned in Section 4.1, the deterrent effects are calibrated by a logistic function in such a way that the arithmetic average of the deterrence multipliers equals 10 for mergers, 20 for cartels, 25 for antitrust interventions under Article 101 and 10 for antitrust interventions under Article 102 TFEU.

**Table 5.1: Baseline scenario under the logistic approach to deterrence**

|   | Mergers | Cartels | Antitrust Art. 101 | Antitrust Art. 102 |
|---|---------|---------|--------------------|--------------------|
| <b>Avoided price increase</b>                       | 3%      | 15%     | 5%                 | 5%                 |
| <b>Arithmetic average of deterrence multipliers</b> | 10      | 20      | 25                 | 10                 |

The simulation exercises presented below have been developed under the assumption that the economy is hit by a mark-up 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. Under the baseline scenario, the steady state (gross) mark-up in the business economy decreases from 13.56 percent to 12.79 percent. This decline by 0.77 percentage points<sup>11</sup> corresponds to a 0.68% variation relative to the steady state. To put the mark-up variation into perspective, this roughly corresponds to the effect of halving the gap vis-à-vis the average of the three best EU performers in terms of market functioning (see Varga and in 't Veld, 2014). Alternatively, one can assess the negative mark-up shock of 0.77 percentage points against the background of the worldwide increase in mark-ups reported by Díez *et al.* (2021). While the sector-level mark-up data used in the present model simulations are not comparable to the firm-level data used by Díez *et al.*, a back-of-the-envelope calculation suggests that without interventions by competition authorities the reported 7 percentage point increase in mark-ups (see Annex A.1 for more detail on the Díez *et al.* estimates) would have been larger by one fifth.

Table 5.2 illustrates the macroeconomic impact of competition policy enforcement under the baseline scenario. We observe that the 0.77 percentage point reduction in mark-up resulting from the European Commission’s competition policy interventions triggers an increase of real GDP equal to 0.37% and a 0.21% reduction in inflation as measured by the GDP deflator after five years.<sup>12</sup> All the main components of aggregate demand increase. More specifically, after 5 years we simulate substantial increases in consumption (0.32%) and investment (0.71%) in spite of the decline in profits associated with the negative mark-up shock.

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<sup>11</sup> See equation 4.2 for the relation between this decline in mark-up and the avoided price increase.  
<sup>12</sup> It is worth noting that the results under the baseline scenario are different from those obtained with the Bass model introduced in Section 7.2. The baseline scenario is based on the logistic approach to deterrence and assumes that the arithmetic averages of the deterrence multipliers are in line with the survey results, while in the Bass model approach the weighted averages of the deterrence multipliers correspond to the results of the company surveys on deterrence.

The difference between the five-year GDP impact of 0.37% reported here and the 0.27% reported in the report of last year (European Commission, 2021) can be explained by a number of factors: (1) in the present report, the EU-27 version of the QUEST III model is used for the model simulations, as opposed to the EU-28 version of QUEST III that was used last year; (2) new data describing the sector distribution of gross output have been used to reflect to Brexit transition from EU-28 to EU-27; (3) the impact of the Commission’s antitrust interventions is for the first time being taken into account (in the report of the previous year, only merger interventions and cartel prohibitions were considered); and (4) the model simulations reflect the Commission’s competition policy interventions of 2020 in addition to the interventions for the period 2012-2019, which had been the basis of the model simulations in last year’s report.

**Table 5.2: Macroeconomic impact of permanent mark-up shock to the steady state (in %)**

|                            | 1           | 5           | 10          | 50          |
|----------------------------|-------------|-------------|-------------|-------------|
| <b>GDP</b>                 | <b>0.21</b> | <b>0.37</b> | <b>0.49</b> | <b>0.70</b> |
| <i>GDP deflator</i>        | -0.16       | -0.21       | -0.29       | -0.46       |
| <i>Employment</i>          | 0.17        | 0.26        | 0.31        | 0.31        |
| <i>Labour productivity</i> | 0.04        | 0.1         | 0.18        | 0.39        |
| <i>Consumption</i>         | 0.22        | 0.32        | 0.43        | 0.63        |
| <i>Investment</i>          | 0.34        | 0.71        | 0.86        | 1.12        |
| <i>Profits</i>             | -5.52       | -7.48       | -7.07       | -6.18       |

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

To disentangle the impact of these different factors, Table 5.3 compares the GDP impact between different model scenarios. The 2020 update of the report on modelling the macroeconomic impact of competition policy considered the GDP impact for the EU-28 based on the information collected on merger interventions and cartel prohibitions for the period 2012-2019. It reported a GDP impact after five years of 0.27%. The introduction of the EU-27 version of QUEST and the reduction in sectoral gross output levels in the EU due to Brexit raised the five-year GDP impact by 0.03% to 0.30%. The addition of the antitrust interventions further raised the five-year GDP impact by 0.08% to 0.38%. Finally, the 2021 update with the information collected on the Commission’s competition policy interventions in 2020 brought about a small 0.01% reduction in the five-year GDP impact. The total impact of all these changes equaled  $0.03\% + 0.08\% - 0.01\% = 0.10\%$ .

**Table 5.3: Impact on GDP of a permanent mark-up shock to the steady state (in %)**

|   | 1    | 5    | 10   | 50   |
|---|------|------|------|------|
| <b>2012-2019 data on merger interventions and cartel prohibitions for EU-28 (2020 update)</b>             | 0.16 | 0.27 | 0.37 | 0.53 |
| <b>+ EU-27 version of QUEST + new gross output data</b>   | 0.18 | 0.30 | 0.41 | 0.58 |
| <b>+ 2012-2019 data on antitrust interventions</b>  | 0.22 | 0.38 | 0.51 | 0.73 |
| <b>+ 2020 data on merger interventions, cartel prohibitions and antitrust interventions (2021 update)</b> | 0.21 | 0.37 | 0.49 | 0.70 |

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

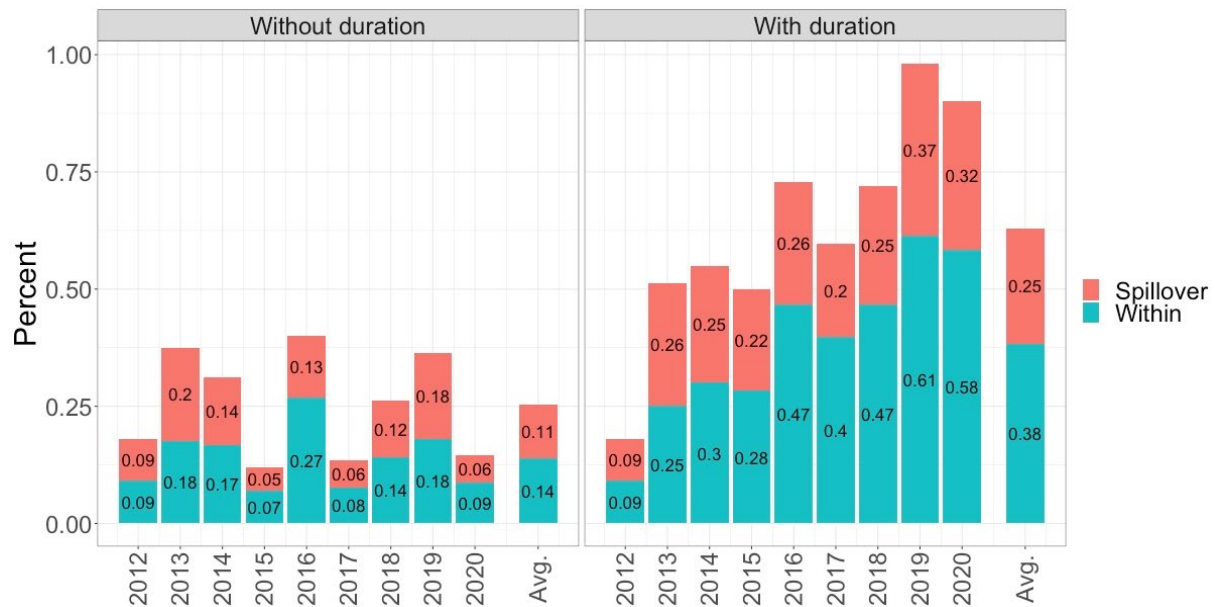


## 6. RESULTS OF THE INPUT-OUTPUT MODELLING ANALYSIS

As discussed in Section 4.3, one strand of our analysis uses an input-output framework to explore the impact of competition policy enforcement on prices in the European Union. The main findings are presented below. In each case, we report two separate sets of results: one takes the duration of the price effect into account and another does not. In all cases, the deterrent effects are accounted for. All price changes, although displayed in absolute value, are to be understood as price reductions. Figure 6.1 gives an overview of the repercussions of antitrust interventions, cartel prohibitions and merger interventions on the overall price level of the European Union.

First, consider the results without duration in the left-hand panel. In an average year, competition policy enforcement is found to lower prices by about 0.25%. Of that overall effect (TOTAL), little more than one half can be attributed to the within-sector impact of the European Commission’s competition policy interventions (WITHIN), with the remaining part resulting from propagation of this impact between sectors (SPILLOVER).<sup>13</sup> Over time, the results display substantial variation from one year to another. The pattern of the fluctuations over time reflects quite closely the dynamics of enforcement activity on the part of the European Commission (e.g., Figure 2.1). In addition to the size of the affected markets, the type of decisions made in a certain year also matters, as cartel prohibitions produce more pronounced price reductions than other types of cases. The year 2020 displays a fairly high volume of competition enforcement activity in terms of overall affected turnover but only a modest reduction in the price level. As noted in Section 2, although several high-profile merger decisions were made, cartels and antitrust cases were comparatively few and small in 2020.

**Figure 6.1: Impact of competition policy enforcement on the overall price level**



Sources: own calculations based on input-output price model; economy-wide effect is computed as a weighted average (on the basis of gross output) of the industry-level results

As is apparent from the right-hand panel of Figure 6.1, taking duration into account greatly increases all of our calculated price impacts: in an average year, the total price reduction associated with competition policy enforcement is equal to 0.63%, more than twice the

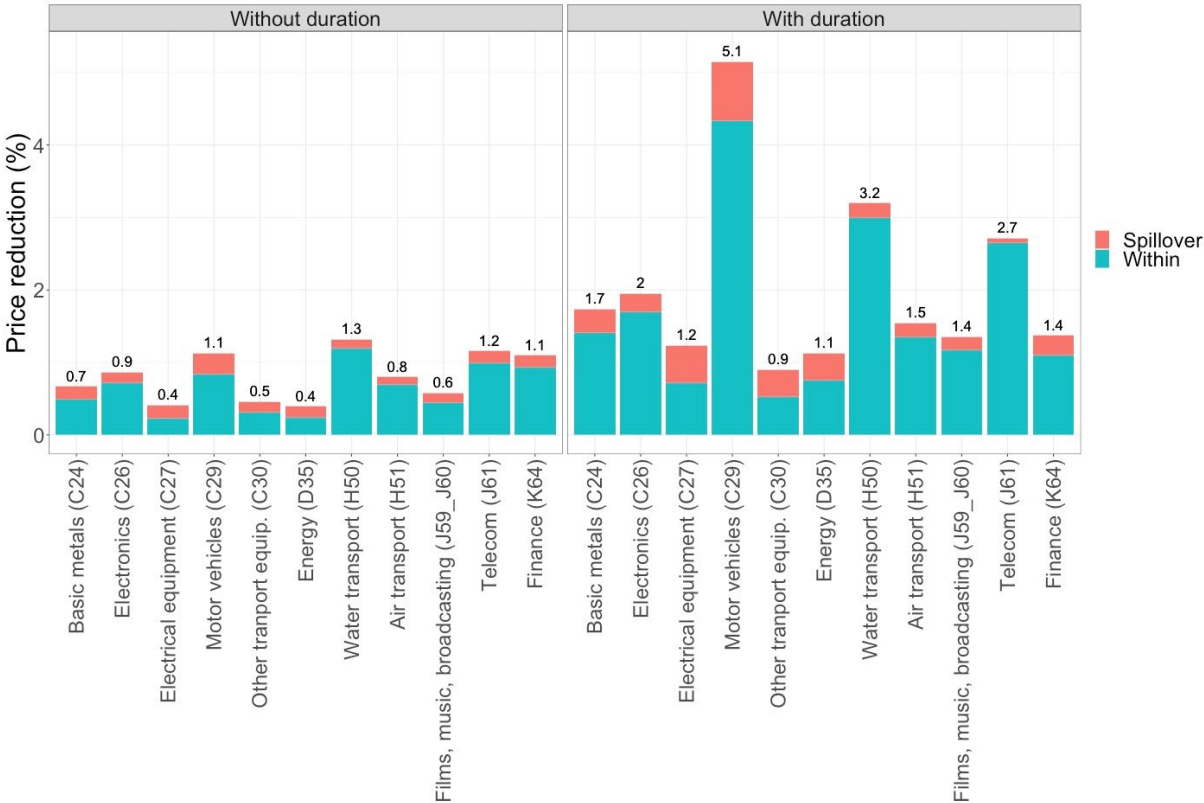
<sup>13</sup> Only the first-round linkages are taken into account because second-round effects are small.

corresponding result without duration. The reason is straightforward: with duration, a greater number of cases contribute to the exogenous shock in any given year. Without duration, the WITHIN effect for, say, 2020 only embodies the decisions made in 2020 itself. With duration, the 2020 WITHIN effect also incorporates the 2019 cases with an avoided price increase that lasts two or more years, the 2018 cases with a duration of three or more years, etc. Thus, when the duration of the price effect is factored in the analysis, the year 2020 goes from having one of the lowest to one of the highest total effects of the period under scrutiny. Albeit to a lesser extent, the same mechanism can be seen at work in 2015 and in 2017.

**Table 6.1: Relative significance of price spill-overs**

| Year        | Spill-over/Within |               | Spill-over/Total |               |
|-------------|-------------------|---------------|------------------|---------------|
|             | Without duration  | With duration | Without duration | With duration |
| 2012        | 1.07              | 1.07          | 0.49             | 0.49          |
| 2013        | 1.16              | 1.10          | 0.53             | 0.51          |
| 2014        | 0.93              | 0.90          | 0.46             | 0.45          |
| 2015        | 0.82              | 0.84          | 0.42             | 0.43          |
| 2016        | 0.53              | 0.60          | 0.33             | 0.36          |
| 2017        | 0.81              | 0.53          | 0.43             | 0.33          |
| 2018        | 0.92              | 0.57          | 0.46             | 0.35          |
| 2019        | 1.07              | 0.62          | 0.50             | 0.37          |
| 2020        | 0.74              | 0.56          | 0.41             | 0.35          |
| <b>Avg.</b> | <b>0.89</b>       | <b>0.76</b>   | <b>0.45</b>      | <b>0.41</b>   |

**Figure 6.2: Industry-level price changes, 2012-2020 average, selected industries**



In addition to raising all estimated price impacts, this carryover of cases from one year to the next tends to smooth the dynamics over time. Furthermore, with duration the impact of competition policy on the EU price level displays a certain tendency to increase over time. By and large, the observed increase in price impacts over time is due to the fact that more recent cases are often characterised by longer durations than older ones (see Table 2.1). Also, it is important to keep in mind that in early years of the series the results with duration are biased downwards by the fact that we do not have data on cases that took place before 2012.

Depending on the year, spill-over effects (Table 6.1) represent between one third and little more than a half of the total price impact. The SPILLOVER/TOTAL ratio (and correspondingly the SPILLOVER/WITHIN ratio) is primarily a function of the distribution of the antitrust, cartel and merger cases across industries. Industries with many important downstream links (i.e. those that sit higher up in supply chains) tend to produce stronger spill-over effects than industries with few downstream connections (i.e. those that sell a large share of their output to final users). 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. Thus, the SPILLOVER/TOTAL ratio tends to be higher (lower) in those years in which the European Commission's competition policy interventions are concentrated in high- (low-) spill-over industries. In 2020, spill-over ratios are at the lower end of the observed range, given that the most significant cases are found in retail trade, transport equipment and electronics, i.e. industries identified by Ilzkovitz *et al.* (2020) as having comparatively low spill-overs.

Figure 6.2 displays the results at the industry level and reports the grand averages over the entire period covered by the analysis. The bars represent the percent price change in the industries where the most significant impacts are observed, with a breakdown between within industry and spill-over effects. The largest price reductions are found in those industries (motor vehicles, water transport and telecoms services) in which the European Commission made its most significant decisions.

Finally, we have examined how our results are affected by the two methodological changes introduced in this year's report. The first one concerns the extension of the analysis to antitrust cases. As one would expect, without duration the largest impact of this extension on the economy wide price effects are found in those years in which antitrust cases were comparatively larger or more numerous (2013, 2014, 2018 and 2019). With duration, this impact naturally evens out over time. With or without duration, on average about one fifth of the estimated total effect can be attributed to antitrust cases. However, as the antitrust figures are still preliminary, their share in the estimated total will likely be subject to revision in next year's report.

The second methodological change introduced with this report relates to the geographical coverage of the analysis, which now focuses on post-Brexit EU27. As discussed in section 5, moving from a EU28 to a EU27 focus involved a major revision of all the data sources underlying our input-output modelling framework. We took advantage of this circumstance by updating the reference year of the model to 2018. The results produced by the newly parametrized model are remarkably close to those obtained from the previous version. Consider, for instance, the overall impact on the average price level displayed in Figure 6.1, which is 0.63%. Under the old model parametrization the corresponding would have been 0.67%. Year- and industry-specific results also remained fairly unaffected when we switched to the new data.

## 7. FURTHER DEVELOPMENTS IN DATA ANALYSIS AND MODELLING

This section discusses further developments in data analysis and modelling, including in particular: (i) the on-going research on the assessment of the evolution of mark-ups in the EU; (ii) improvements in the mathematical approach chosen to model deterrence; (iii) the possible correlation between mark-up levels and Commission interventions at the sector level.

### 7.1. Evolution of mark-ups since the early 2000s – a concise literature review

Assessing the intensity of competition in a specific market, or, more broadly, in a sector or country, is of primary interest for policymakers. There are multiple reasons for this. To name but a few, the intensity of competition affects output, investment, and prices in specific markets and at the macro-economic level, thereby affecting consumer welfare. It may also be linked to the incentives to innovate, thereby affecting productivity growth within firms as well as the strength of the resource reallocation channel across firms. A reduction in the intensity of competition can also lead to higher inflation, which could in turn imply a fall in real wages, contributing to lower participation rates, reduced employment, and thus also lower potential output.<sup>14</sup>

The evolution of market power since the early 2000s, typically measured through the ability of firms to charge a price in excess of the marginal cost of production (i.e. a mark-up), has been and continues to be a much-debated topic in the academic and policy circles alike.<sup>15</sup> As explained in more detail below, the intensity of the debate is linked to at least three aspects.

First, state-of-the-art methodologies used to assess the intensity of competition tend to be tailored to firm-level datasets focussing on well-defined product or service markets. When implemented on economy-wide datasets that do not provide detailed information on either product characteristics or production processes, results may be subject to identification issues or biases that impede drawing definitive and general conclusions. Methods based on economy-wide sector- or macro-level data allow drawing more general conclusions. Data typically come from harmonised national accounts and therefore tend to be of higher quality. However, they may suffer from an aggregation bias.<sup>16</sup> Drawing a single policy message from either firm-level or sector-/macro-level studies may therefore be problematic.

Second, the observed evolution of a particular indicator of market power, such as the mark-up, measured over a number of years, may not suffice to conclude on the evolution of the underlying intensity of competition. Indeed, an increase in the intensity of competition in a particular market may have an ambiguous effect on the aggregate mark-up, as on the one hand it is expected to reduce the level of mark-ups of all firms while on the other hand it may increase the weighted average mark-up by pushing the less productive firms – which have low mark-ups – towards exit and redistributing market share to the more productive firms, the latter charging relatively high mark-ups.<sup>17</sup> A measured increase in mark-up may signal efficiency gains with enhanced product quality in certain cases, while it may signal higher barriers to entry and reduced incentives to innovate in other cases. While the observed process of structural transformation may initially increase the intensity of competition, boosting innovation

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<sup>14</sup> See for example Eggertson *et al.* (2021) on how an increase in markups and a reduction in real interest rates may help to explain why several of the Kaldor growth facts no longer hold.

<sup>15</sup> See for example the debates at the 2017 Jackson Hole Symposium and the 2017 ECB Forum on Central Banking in Sintra. For a recent overview, see Syverson (2019).

<sup>16</sup> See Hall (2018) for a discussion on the argument.

<sup>17</sup> See discussion in Boone (2008). See the literature on the role of superstar firms reported by Autor *et al.* (2020) and Van Reenen (2018).

and productivity growth, subsequently it can contribute to entrenching market power through higher entry barriers.<sup>18</sup>

This point maps into the third aspect of complexity, namely that drawing policy implications requires not only reliably documenting the evolution of market power but also explaining the reasons behind a given change. Thus, several recent papers argue that the observed evolution of mark-ups is attributable to structural changes in the production process (e.g. returns to scale, magnitude of fixed and sunk costs, increased role of intangibles, innovation) and compatible with an increase in the intensity of competition, while others claim that the increased mark-ups signal excess rents and anticompetitive behaviour mapping into reduced business dynamism.<sup>19</sup> Both effects are not mutually exclusive: the structural change observed may indeed be the result of increased competition and at the same time pose a threat to future competition as early movers are protected by higher barriers to entry.

The main lessons of the literature, as regards changes in market power in Europe and beyond – as measured by the evolution of mark-ups since the early 2000s – are presented in annex A.2. The main conclusions of this literature review are the following:

- First, there is a lively methodological debate among the state-of-the-art approaches to mark-up estimation. We conclude that while critical for drawing policy implications, the assessment of competition intensity with help of structurally estimated mark-ups needs to be complemented by supporting indicators, such as profit rates, concentration ratios and measures of business dynamism.
- Second, the empirical evidence on the evolution of mark-ups shows some contrasting results pointing to: (1) increases in average mark-up levels (especially in the US); (2) a concentration of such increases in the upper tail of the productivity distribution ; (3) mark-up dynamics can differ across sectors (they are rising for example in the sectors most strongly affected by technological change but also in sectors in which regulatory barriers and investments in intangibles play an important role); (4) studies of profit rates, concentration rates and macroeconomic measures based on average costs have yet to provide conclusive evidence explaining the dynamics of market power in the EU and the US; (5) international trade and globalisation may affect market power and the distribution of value along the supply chain in different directions.
- Third, the analysis of market power needs to be combined with a careful assessment of sector and country specificities in view of drawing appropriate policy conclusions.<sup>20</sup> We underscore that the recent literature differs in its reading of the determinants of the evolution of market power. The benign view argues that technological change and globalisation have increased the cost of innovation – and the return to successful innovation – bringing about a change in market structure in combination with increased

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<sup>18</sup> See Berry *et al.* (2019) and Aghion *et al.* (2020).

<sup>19</sup> See discussion in Berry *et al.* (2019). Prominent examples of the first strand are Abraham *et al.* (2020), Autor *et al.* (2020), Bighelli *et al.* (2021) and Bajgar *et al.* (2021). Prominent examples of the second strand are Barkai (2017), Gutierrez and Philippon (2017, 2019). De Loecker *et al.* (2021) quantify the contribution of both channels and conclude that reallocation gains were dominated by deadweight loss in the US.

<sup>20</sup> Berry *et al.* (2019) argue that the uncertainties about the empirical evidence and the likelihood of heterogeneous developments across industries demand a focus of policy recommendations on “those beneficial under a wide range of conditions”. Policy recommendations may need to reach beyond antitrust enforcement and competition policy, and cover regulatory, trade, and tax policies as well.

incentives to innovate. This literature argues that policies need to tackle future obstacles to market contestability (for example through competition policy or flexible product market regulations) while preserving the incentives to innovate.<sup>21</sup> The less benign view argues that the intensity of competition has declined, in parallel with the process of technological change, with efficiency gains from reallocation and innovation having been overturned by deadweight losses and reduced incentives to innovate associated with increased market power. From a dynamic perspective, an increase in mark-ups associated with increased concentration, increased profitability and reduced churning could indicate larger entry barriers and a weakening of the competitive process. This literature argues that policies should focus on increasing the effective pass-through of cost reductions into prices, to curb excess rents and to reinforce productive investment.<sup>22</sup> These two views may be reconciled considering that the same factors that drive the ‘winner takes it all’ dynamics (globalisation, higher returns to scale, larger fixed costs, the rise of intangibles) may also act as powerful barriers to entry and expansion by potential competitors, which may require competition authorities to intervene.

## **7.2. The ‘Bass’ approach to modelling the deterrent effects of competition policy interventions**

### **(i) Introducing the Bass model**

The main objective of this section is to present an alternative model to describe the deterrent effects of competition policy. These deterrent effects consist in preventing or reducing in severity future anti-competitive behaviour both by the parties directly involved and by other firms. According to the literature<sup>23</sup>, the deterrent effects of a competition policy regime are influenced by: (i) the perceived probability for a company of being caught and convicted, which depends on the current capacity of detection of anticompetitive behaviour by the competition authority; and (ii) the reputation of the competition authority, which depends on its past enforcement record resulting from its detection and investigation activity and its capacity to stop and punish anticompetitive behaviour.

However, the positive relationship between detection and deterrence is not linear because a more effective enforcement may increase the deterrent impact of this enforcement, leading to fewer cases to be detected and then deterred. This means that the marginal effect of an increase in detection activity on deterrence is not constant: for very low detection activity, the marginal effect of an increase in detection is small but increasing, which corresponds to a convex relation between detection and deterrence, while for higher detection activity, the marginal effect of an increase in detection is larger but decreasing, which is reflected in a concave relationship. Therefore, as described in section 4.1, deterrent effects can be modelled as a process of diffusion of information on competition policy interventions using a logistic function.

In this section, we explore an alternative model, the Bass model (Bass (1969)), which provides a more robust theoretical framework to describe the diffusion of information related to competition policy interventions by integrating the role of both the competition authority and

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<sup>21</sup> See for example the discussion in Aghion *et al.* (2020).

<sup>22</sup> See for example, the evidence presented in Decker *et al.* (2017) as well as the discussion in Gutierrez and Philippon (2019).

<sup>23</sup> See for example, Becker (1968), Block *et al.* (1981), Bryant and Eckard (1981) and Werden *et al.* (2011).

market participants. On the one hand, the competition authority is the signalling authority external to the markets affected and it is assumed that the mere existence of a competition authority can have deterrent effects, described as the initial level of deterrence ( $\omega_0$ ) in the markets. On the other hand, market participants can contribute to the diffusion of the signal and thereby amplify its deterrent effects ( $\omega$ ). As in the logistic model used in this report, the strength of the signal ( $\sigma$ ) sent by the competition authority is approximated by the importance of the detected cases, measured by the size of the markets directly affected by the competition policy interventions in relation to the size of the sector to which these markets belong ( $mkt/GO_4$ ) and it is assumed that the deterrent effects of competition policy interventions are primarily felt in the markets and sectors directly affected by these interventions (see Figure 4.1).

### (ii) Definition of the Bass model and interpretation of the model parameters in the context of competition policy

The Bass model used here to describe the diffusion of information on competition policy interventions originates in the epidemiological literature describing the diffusion of a virus during a pandemic episode. In this model, the diffusion growth rate over time  $t$  is defined as:

$$\frac{d\omega}{dt} = (\alpha + \beta * \omega(t)) * \{1 - \omega(t)\} \quad (7.1)$$

with  $\omega$  being equal to the share of the population infected by the virus or informed about an event at time  $t$ . It is worth noticing that formula (7.1) collapses to (4.1) when  $\alpha = 0$ .

According to this model, the growth over time of diffusion of information in the population depends on:

- An external signal, which reaches a share  $\alpha$  of the population each period of time (external influence);
- The endogenous interaction between population members (internal influence), which depends on the level of information already present within the population ( $\omega(t)$ ) and the probability that contact will take place within the population ( $\beta$ );
- $\{1 - \omega(t)\}$ : the distance between the current level of information present in the population ( $\omega(t)$ ) and a ceiling of 1, reflecting the maximum share of the population to be informed about an event.

Let us apply this model to describe the deterrent effects associated with the diffusion of information about interventions by the competition authority in a given sector. If we define  $\sigma$  as the strength of the signal sent to market participants in that sector by such interventions, and  $\omega$  as the share of market participants in that sector being deterred, we have:

$$\frac{d\omega}{d\sigma} = (\alpha + \beta * \omega(\sigma)) * \{1 - \omega(\sigma)\} \quad (7.2)$$

In Equation 7.2, the change in deterrence associated with the diffusion of the signal  $\sigma$  depends on:

- The sensitivity of deterrence to the ‘external’ signal sent by the competition authority to market participants ( $\alpha$ );
- The ‘internal’ interaction between market participants, which depends on the share of market participants already deterred ( $\omega(\sigma)$ ) and the strength of their interactions with other market participants within the sector ( $\beta$ );
- $\{1 - \omega(\sigma)\}$ : the distance between the current level of deterrence in the sector ( $\omega(\sigma)$ ) and a ceiling of 1, reflecting that the deterrent effects can potentially reach the whole sector not directly affected by the external signal.

The solution of this differential equation is:

$$\omega(\sigma) = \frac{1 - \frac{\alpha(1-\omega_0)}{\alpha+\beta\omega_0} \exp(-(\alpha+\beta)\sigma)}{1 + \frac{\beta(1-\omega_0)}{\alpha+\beta\omega_0} \exp(-(\alpha+\beta)\sigma)} \quad (7.3)$$

From Equations 7.2 and 7.3, one can conclude that deterrence  $\omega(\sigma)$  is positively affected not only by an increase in sensitivity of deterrence to the external signal sent by the competition authority ( $\alpha$ ) and an increase in the strength of internal interactions between market participants ( $\beta$ ), but also by an increase in the initial level of deterrence in the sector concerned ( $\omega_0$ ). The parameter  $\omega_0$  can be interpreted as the deterrence associated with the reputation of the competition authority.

### (iii) Definition of a reference scenario and first results

To implement the Bass approach to modelling the deterrent effects of competition policy in our model simulations, we needed to define a reference scenario with appropriate values for the three parameters  $\alpha$ ,  $\beta$  and  $\omega_0$ . A two-step process was adopted.

First, we decided to find suitable values for  $\omega_0$  and the ratio ( $\beta/\alpha$ ). Under the reference scenario, the parameter  $\omega_0$  was set equal to 0.05 implying an initial level of deterrence of 5% (meaning that 5% of market participants in a given sector are deterred because of the mere existence of an EU-wide competition authority), which is a conservative assumption considering the good reputation of the European Commission. In future work, this parameter could be re-calibrated on the basis of the Commission's observed average annual intervention rate over the period 2012-2020 as the reputation of a competition authority is influenced by its past enforcement record. The ratio ( $\beta/\alpha$ ) reflects the importance of the internal influence of interactions between market participants relative to the external influence of the signal provided by the authority's intervention. A ratio of  $\beta/\alpha = 5$  with a relatively important internal influence gives rise to an S-shaped relationship between detection and deterrence which fits with the non-linear relation described in the literature. The sensitivity of the simulation results to different assumptions concerning the parameter values  $\omega_0$  and ( $\beta/\alpha$ ) is discussed in Annex A.3.

Second, we fixed  $\alpha$  to ensure that the case-weighted average of the deterrence multipliers<sup>24</sup> equalled 10 for merger interventions, 20 for cartel prohibitions, 25 for antitrust interventions under Article 101 and 10 for antitrust interventions under Article 102, which is broadly in line with the results of surveys reporting on the number of deterred cases per detected case.

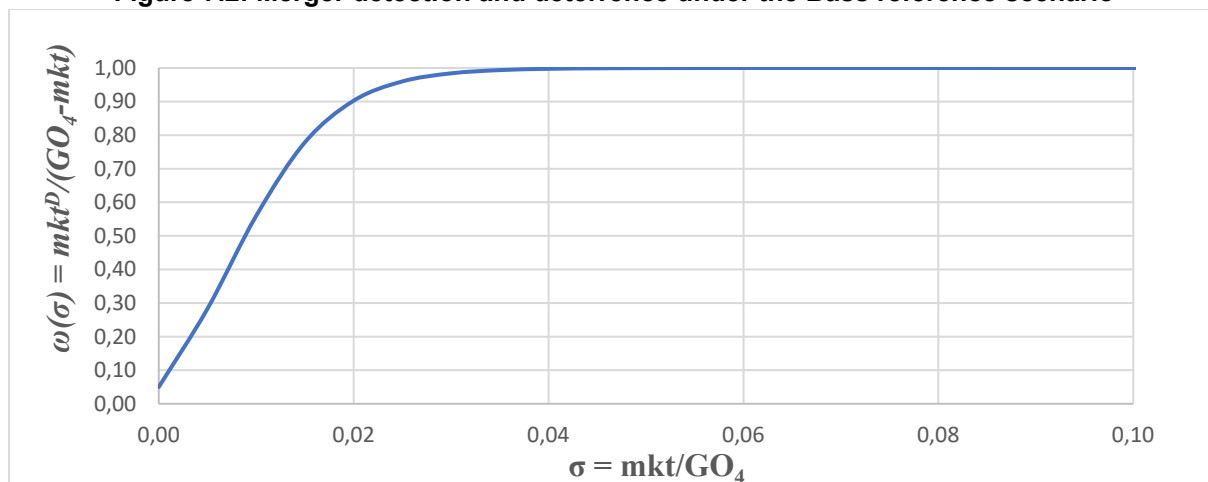
As an illustration, Figure 7.2 presents the relation between detection and deterrence in the area of merger control under the reference scenario with  $\omega_0 = 0.05$  and  $\beta/\alpha = 5$ . The figure makes clear that for interventions beyond a certain size (with a  $\sigma$ -value of 0.06), almost all anticompetitive mergers in the sector are deterred from notification. However, as shown in Figure 4.1, only 18% of all the merger interventions taken over 2012-2020 exceed this threshold. If we base the mark-up shock on the Bass reference scenario and apply such shock to the Quest III model, we obtain a real GDP increase of 0.49% after five years (see Annex A.4).

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<sup>24</sup> The deterrence multiplier is defined as the ratio of market players deterred over market players detected, which corresponds to  $mkt^D/mkt = \omega (1-\sigma) / \sigma$ .



**Figure 7.2: Merger detection and deterrence under the Bass reference scenario**



#### (iv) Concluding remarks

To sum up, the main advantage of this novel approach to modelling the deterrent effects of competition policy is that the relation between detection and deterrence is based on a more robust theoretical framework that relies on well-established models used to describe the diffusion of information about an event. This framework allows to better integrate the role of both the competition authority and market participants in the process of diffusion of information about competition policy interventions and to test the sensitivity of deterrence to the reputation of the competition authority and to the importance of interactions between market participants

Further work could contribute to improving this analytical framework. First, small cases in terms of the size of directly affected markets could have bigger deterrent effects due to their precedent values. For such cases, one would expect the impact of interactions between market participants ( $\beta/\alpha$ ) to be relatively high. Second, other competition policy interventions might be so important that their deterrent effects extend beyond the four-digit sector directly concerned into neighbouring sectors or an even larger part of the business economy. Third, the choice of the values of the parameters could be better calibrated on the basis of empirical evidence. Finally, one could try to better take into account the characteristics of the competition policy regime by defining more precisely the different components affecting the reputation of the competition authority (for example, its capacity of investigation and punishment).

### 7.3. Mark-ups, market concentration and competition policy interventions

For the purpose of the present study we have collected information on the number of merger interventions, cartel prohibitions and antitrust interventions in each industry  $i$  as well as the size of the markets directly or indirectly affected by such interventions relative to that of the industry concerned ( $\sum_{k \in M_i} MS_{ik}$ ,  $\sum_{k \in C_i} MS_{ik}$  and  $\sum_{k \in A_i} MS_{ik}$ ). In addition, we have obtained data on mark-ups and market concentration levels at the two-digit sector (or industry) level.

This section reports on the sectoral correlations between mark-ups and indicators of market concentration (as measured by the C4 ratio, which corresponds to the aggregate share of production of four largest companies within the industry) on the one hand, and the number of interventions by the European Commission and the size of the markets affected such interventions, on the other hand. A distinction is made between the Commission's three

competition policy instruments. 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 mark-ups. An environment with weak competitive pressures may indeed give rise to anticompetitive behaviour. However, the high level of data aggregation to the industry level may obscure relations that exist at the level of individual markets.

Over the period 2012-2020, the European Commission has intervened in 24 industries, which have been ranked by their mark-up and concentration levels and split accordingly into four groups of six industries (very low, low, high, very high). Table 7.1 seems to indicate that overall the European Commission intervenes most frequently in industries with very high mark-ups and very high levels of concentration. The relationship between the number of interventions, on the one hand, and mark-up and concentration levels, on the other hand, is most clear cut in the area of antitrust, where the Commission has most freedom in deciding whether to intervene. It is less evident for cartels, which are infringements by object, meaning that the Commission has the obligation to intervene whatever the circumstances of the case. For mergers as well, the relationship of the number of interventions with mark-up levels appears to be weaker than that with the levels of concentration. However, for all three instruments, the data clearly indicate that the Commission is more likely to intervene in the more concentrated markets and industries.

**Table 7.1: Frequency of interventions by the European Commission, 2012-2020**

|                   |  | Number of merger interventions | Number of cartel prohibitions | Number of antitrust interventions | Total number of interventions |
|-------------------|--|--------------------------------|-------------------------------|-----------------------------------|-------------------------------|
| Very low mark-up  |  | 27                             | 7                             | 1                                 | 35                            |
| Low mark-up       |  | 56                             | 19                            | 4                                 | 79                            |
| High mark-up      |  | 29                             | 8                             | 20                                | 57                            |
| Very high mark-up |  | 71                             | 8                             | 26                                | 105                           |
| <b>Total</b>      |  | <b>183</b>                     | <b>42</b>                     | <b>51</b>                         | <b>276</b>                    |

|                         |  | Number of merger interventions | Number of cartel prohibitions | Number of antitrust interventions | Total number of interventions |
|-------------------------|--|--------------------------------|-------------------------------|-----------------------------------|-------------------------------|
| Very low concentration  |  | 13                             | 1                             | 5                                 | 19                            |
| Low concentration       |  | 32                             | 7                             | 13                                | 52                            |
| High concentration      |  | 60                             | 20                            | 14                                | 94                            |
| Very high concentration |  | 78                             | 14                            | 19                                | 111                           |
| <b>Total</b>            |  | <b>183</b>                     | <b>42</b>                     | <b>51</b>                         | <b>276</b>                    |

The above analysis can be somewhat refined by analysing not just the number of interventions by the Commission, but also the relative size of the markets affected by such interventions. Table 7.2 shows the weighted Spearman rank correlations between the relative sizes of the markets affected by competition policy interventions, on the one hand, and industry mark-ups and concentration levels, on the other hand. All correlations are positive except the one relating the relative size of markets affected by cartel prohibitions and mark-ups. This indicates that except in the area of cartels, the decision to intervene is guided to some extent by mark-up and concentration levels. With cartels, the Commission will intervene no matter what is the level of mark-up in the sector concerned. Amongst the three competition policy instruments, the correlation with mark-up levels is strongest in the area of antitrust (0.69), indicating industries with high levels of mark-ups tend to draw the attention of antitrust enforcers. The correlation with the concentration ratio (C4) is stronger in the area of merger enforcement, reflecting the fact that high levels of market concentration tend to be a source of concern in merger reviews. If we combine the three competition policy instruments, there is a positive correlation between enforcement, on the one hand, and levels of mark-ups and concentration, on the other hand. However, the limited number of observations (24) makes it difficult to say something about the statistical significance of the above results. A more detailed analysis is provided in Annex A.3.

**Table 7.1: Spearman rank correlations of mark-ups and market concentration with the size of the markets affected relative to that of the industry concerned**

|   | Mark-up | Concentration (C4) |
|---|---------|--------------------|
| Relative size of markets affected by merger interventions             | 0.26    | 0.47               |
| Relative size of markets affected by cartel prohibitions              | -0.21   | 0.36               |
| Relative size of markets affected by antitrust interventions          | 0.69    | 0.29               |
| Relative size of markets affected by competition policy interventions | 0.39    | 0.50               |

**8. CONCLUSION**

This report provides an update of the macro-model simulations of the impact of the competition policy interventions by the European Commission. The novelties of this year’s report include the transition from EU28 to EU27, the inclusion of preliminary data on antitrust enforcement for the period 2012-2020, and the regular update with data for the year 2020 on merger interventions and cartel prohibitions. The year 2020 saw a relatively small total number of interventions, but the 25 interventions included four merger interventions with affected markets of substantial size. Taken together, 2020 was an ‘average’ year in terms of the macroeconomic impact of the Commission’s policies.

The report also includes a new section, which considers the direct and indirect effects of competition policy interventions. The direct effects are measured by the customer savings from merger interventions and cartel prohibitions, which are estimated to range between 9 and 15 billion euro annually. In addition, there are the indirect, deterrent effects of competition policy, which are generally considered to be even more important than its direct effects. This is the reason why the report devotes much attention to the modelling of the deterrent effects of competition policy.

In the simulations presented here, the relationship between detection of anticompetitive behaviour and deterrence is modelled by a logistic, S-shaped curve. The underlying assumption is that the marginal change in deterrence is proportional to the level of deterrence already achieved while maintaining an upper limit to the level of deterrence that can be achieved. As one of the special topics, the report proposes a generalisation of the logistic approach to deterrence, which is based on the Bass function commonly used to model the diffusion of information or the spread of a virus in an epidemic. This generalisation allows taking into account the reputation of the competition authority in deterring anticompetitive behaviour as well as making a distinction between the 'external' effects of the competition authority's intervention and the 'internal' effects (e.g., the interactions between law firms and legal counsel advising company executives). It is our intention to fully integrate the Bass function approach in next year's update of the report.

The QUEST III model simulation results presented in the current report show the effects of a 0.77 percentage point mark-up reduction associated with the Commission's competition policy interventions over the period 2012-2020. This 'permanent' mark-up shock leads to an increase in GDP of 0.37% after five years, as opposed to the figure of 0.27% reported last year. This 0.10% increase can be explained by Brexit and the associated reduction in gross output figures at the four-digit sector level, the inclusion of preliminary data on antitrust interventions and the update with the 2020 figures.

The input-output model simulation results permit investigating the cross-sector spill-overs of the price reductions associated with the Commission's competition policy interventions on an annual basis. The 2020 spill-overs were relatively low as the major interventions of the year were in sectors such as retail trade, transport equipment and electronics, which are close to the end of the supply chain and for which the spill-over effects tend to be relatively small.

In addition, the report covers several special topics: (1) the evolution of mark-ups since the early 2000s. Mark-up figures are tracked internationally to assess developments in the intensity of competition. There are increasingly clear indications of a widespread rise in mark-ups, in particular for companies in the upper tail of the productivity distribution and for industries having experienced rapid technological change or being subjected to regulatory entry barriers; (2) the correlation between mark-up and concentration levels, on the one hand, and relative size of the markets affected by the Commission's competition policy interventions, on the other. Broadly speaking, this analysis shows that the Commission's interventions tend to focus on industries with high mark-ups and concentration ratios; (3) the generalisation of the logistic approach used to model the deterrent effects, as discussed above; (4) the introduction of an additional shock to the QUEST III model, reflecting the impact of competition policy interventions on labour augmenting productivity.

In spite of the progress made, there remain a number of issues that merit further research. In particular, the application of definitive data on the Commission's antitrust interventions may change the outcomes of the model simulations. Also, the sensitivity of such outcomes to the parameters underlying the modelling of deterrent effects could be further investigated.

## REFERENCES

Abraham F., Boormans Y., Konings J. and Roeger W. (2020), "Price-Cost margins, fixed costs", *Working Papers 202010*, University of Liverpool, Department of Economics.

Aghion A., Bergeaud A., Boppart T., Klenow P. and Li H. (2020), "A theory of falling growth and rising rents", unpublished manuscript.

Autor D., Dorn D., Katz L.F., Patterson C. and Van Reenen J. (2020), "The fall of the labor share and the rise of superstar firms", *Quarterly Journal of Economics*, 135(2): 645-709.

Bajgar M., Criscuolo C. and Timmis J. (2021), "Intangibles and industry concentration: Supersize me", *OECD Science, Technology and Industry Working Papers*, No. 2021/12, OECD Publishing, Paris.

Barkai S. (2017), "Declining labor and capital shares", unpublished manuscript.

Bass F.M. (1969), "A new product growth model for consumer durables", *Management Science*, 15(5): 215-227.

Becker G.S. (1968), "Crime and punishment: An economic approach", *Journal of Political Economy*, 76(2): 169-217.

Berry S., Gaynor M. and Scott Morton F. (2019), "Do increasing markups matter? Lessons from empirical industrial organization", *Journal of Economic Perspectives*, 33(3): 44-68.

Bighelli T., Di Mauro F., Melitz M. and Mertens M. (2021), "European firm concentration and aggregate productivity", *IWH-CompNet Discussion Papers*, No. 3/2021.

Block M.K., Nold F.C. and Sidak J.G. (1981), "The deterrent effect of antitrust enforcement", *Journal of Political Economy*, 89(3): 429-445.

Boone J. 2008, "A New Way to Measure Competition", *The Economic Journal*, 118(531): 1245-1261.

Bryant P.G. and Eckard E.W. (1991). "The probability of getting caught", *The Review of Economics and Statistics*, 73(3): 531-536.

Decker R. A., Haltiwanger J., Jarmin R.J. and Miranda J. (2017), "Declining dynamism, allocative efficiency, and the productivity slowdown", *American Economic Review: Papers & Proceedings*, 107(5): 322-26.

De Loecker J., Eeckhout J. and Mongey S. (2021), "Quantifying market power and business dynamism in the macroeconomy", *University of Chicago, Becker Friedman Institute for Economics Working Paper*, No. 2021-54.

Dierx A. and Ilzkovitz F. (2020), "How to measure the direct effects of competition policy interventions?" in Ilzkovitz F. and Dierx A. (Eds.), *Ex post economic evaluation of competition policy: The EU experience*, Wolters Kluwer.

Dierx A., Ilzkovitz F., Katsoulacos Y. and Ulph D. (2020), “Deterrent effects of competition policy” in Ilzkovitz F. and Dierx A. (Eds.), *Ex post economic evaluation of competition policy: The EU experience*, Wolters Kluwer.

Díez F.J., Fan J. and Villegas-Sánchez C. (2021), “Global declining competition?”, *Journal of International Economics*, 132(C).

Eggertsson G.B., Robbins J.A. and Getz Wold E. (2021), “Kaldor and Piketty’s facts: The rise of monopoly power in the United States”, *Journal of Monetary Economics* (forthcoming).

European Commission, Directorate-General for Competition, Directorate-General for Economic and Financial Affairs, Joint Research Centre (2021), “Modelling the macroeconomic impact of competition policy: 2020 update and further development”, Publications Office, January.

Gutiérrez G. and Philippon T. (2017), “Declining competition and investment in the US”, *NBER Working Paper*, No. 23583.

Gutiérrez G. and Philippon T. (2019), “From good to bad concentration? U.S. industries over the past 30 years”, *NBER Macroeconomics*, Annual Volume 34.

Hall R.E. (2018), “New evidence on the markup of prices over marginal costs and the role of mega-firms in the US economy”, *NBER Working Paper*, No. 24574.

Ilzkovitz F., Cai M., Cardani R., Dierx A. and Pericoli F. (2020), “The macroeconomic and sectoral impact of EU competition policy” in Ilzkovitz F. and Dierx A. (Eds.), *Ex post economic evaluation of competition policy: The EU experience*, Wolters Kluwer.

OECD (2014), “Guide for helping competition authorities assess the expected impact of their activities”, <https://www.oecd.org/daf/competition/Guide-competition-impact-assessmentEN>

Syverson C. (2019), “Macroeconomics and market power: Context, implications, and open questions”, *Journal of Economic Perspectives*, 33(3): 23–43.

Van Reenen J. (2018), “Increasing differences between firms: Market power and the macro-economy”, *CEP Discussion Papers (CEPDP1576)*, Centre for Economic Performance, London School of Economics and Political Science.

Varga J. and in ’t Veld J. (2014), “The potential growth impact of structural reforms in the EU: A benchmarking exercise”, *European Economy, Economic Papers*, No. 541, December.

Werden G.J., Hammond S.D. and Barnett B.A. (2011), “Deterrence and detection of cartels: Using all the tools and sanctions”, *The Antitrust Bulletin*, 56(2): 207-234.

## A. TECHNICAL ANNEXES

### A1. EVOLUTION OF MARK-UPS SINCE THE EARLY 2000S – A CONCISE LITERATURE REVIEW<sup>25</sup>

In this section we review the literature on different state of the art measurement techniques of mark-ups. The method of estimation of calculation has an important impact on the empirical results. We then turn to reviewing the empirical evidence.

#### A1.1. Methodological approaches to mark-up estimation

A theoretically sound indicator of market power is the *mark-up*, defined as the ratio of price to marginal cost.<sup>26</sup> Yet, it is challenging to compute, as marginal costs are not directly observable. Prominent alternative indicators of market power are measures of concentration. The Herfindahl Hirschmann Index (HHI) and the concentration ratio help to characterise the distribution of market shares.<sup>27</sup> Yet, they suffer from the caveat of informing on relative revenues while not incorporating information on the associated costs. They also suffer from the caveat of evaluating concentration *ex post* while not informing on market contestability, i.e. the number of potential competitors.<sup>28</sup> Finally, the reported evolution may be sensitive to the definition of the scope of the market and may be ill-defined in the presence of multi-product firms.<sup>29</sup> Concentration measures may be best suited for narrowly defined products. Prominent complementary indicators that may signal changes in the underlying intensity of competition focus on the efficiency of resource allocation and business dynamism. An example of the former is the Boone elasticity, which captures the extent to which an increase in marginal costs is penalising for the firm in terms of its ability to generate profits.<sup>30</sup> Two examples of the latter are net entry indicators and cohort approaches that measure the speed with which young productive firms grow to overtake the market.

More macro-level approaches typically resort to indicators of profitability. Profitability is either captured through the profit rate, measured as the ratio of revenue over total variable costs, or through the profit share, measured as the share of total income not distributed to labour or capital. The profit rate or share is based on total costs while mark-ups are based on marginal costs. The main advantage of such indicators is their direct comparability across countries and industries, as well as over time, as they can be computed on macroeconomic data. Another attractive feature of this approach is the ability to implement it on firm-level as well as macro-level data. When implemented on macro-level data, the method of computation precludes

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<sup>25</sup> Prepared by Maria Garrone (DG ECFIN) and Anna Thum-Thysen (DG ECFIN).

<sup>26</sup> See Tirole (1988) for a textbook presentation. See Syverson (2019) for a recent overview.

<sup>27</sup> HHI is the sum of squared market shares, ideally computed over the full set of firms operating in a particular market. The index can be adjusted to account for partial coverage of the firm population. The index ranges from 0 (perfect competition) to 1 (monopoly) [if the market shares are expressed in percentages, the range is 0 to 10000]. The *n*-firm concentration ratio is given by the sum of market shares of the *n* biggest firms operating in a given market.

<sup>28</sup> See Stackelberg (1934) [2011 for the English translation] and Baumol et al. (1982) for seminal work on the relationship between concentration and market power. See Syverson (2019) for a recent discussion on how concentration-based measures of market power correlate differently with the underlying intensity of competition.

<sup>29</sup> See discussion in Werden and Froeb (2018) as regards product scope. See Rossi-Hansberg et al. (2018) on the sensitivity to geographical scope: the authors document increasing national concentration and decreasing local concentration in the US.

<sup>30</sup> See Boone (2008) and recent elaboration by Duygun et al. (2015).

distributional considerations. Further, such indicators correlate with the underlying aggregate mark-up under relatively strong assumptions. For example, when the average variable cost is used as a proxy of the mark-up, it is indeed expected to correlate with the marginal cost in the upward sloping portion of the average variable cost curve. Yet, this proxy of market power lacks a theoretical underpinning and is likely to be little informative as regards the level or the evolution of market power. Fundamentally, this approach would be providing an indication as regards the evolution of profitability in the sector, which may or may not be aligned with the evolution of mark-ups.<sup>31</sup>

A challenge in measuring mark-ups is posed by the lack of data on marginal costs. Several methodological approaches have been proposed to overcome this issue. In this section we focus on the *production* approach, and provide a concise overview of the most recent academic contributions in this area.<sup>32</sup> In so doing, we acknowledge that a lively methodological debate among state-of-the-art approaches to mark-up estimation, focussing mainly – but not exclusively - on the basis of firm financial accounts is very much ongoing.<sup>33</sup> Our main take-away is that these novel methodological advances, together with increased availability of firm-level data, reinforce our ability to assess the intensity of competition with help of structurally estimated mark-ups. Yet, the monitoring of this indicator needs to be complemented with supporting indicators and additional econometric work to shed light on the underlying *causes* of the observed mark-up evolution, in view of drawing policy implications.

The *production* approach implemented at the firm level has become the prevailing methodology for studying the evolution of market power in multiple industries (and countries) in one go, allowing to draw conclusions as regards the evolution of market power at the economy-wide and global levels. This approach requires two main ingredients. For the estimation, minimal data requirements encompass firm financial accounts, with information on revenues, costs, and assets, combined with additional information on output and input prices (deflators). For the theoretical underpinning, minimal requirements encompass the assumption of cost minimization of variable inputs in production, whereby the first order condition associated with this cost minimization yields a simple formula for the mark-up.

In this approach, the mark-up equals the ratio of the output elasticity for this variable input (a measure of productivity of the input factor) to the inverse of this input's share in total revenue (a measure of remuneration of the input factor) (see Hall 1988).<sup>34</sup> In a perfectly competitive

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<sup>31</sup> See seminal work by Bain (1941, 1951). See Syverson (2019) and Battiatì et al. (2021).

<sup>32</sup> A prominent strand of the industrial organization literature followed in the steps of Berry et al. (1995) who derived a demand side approach to structurally estimate marginal costs and obtain a theoretically sound measure of mark-ups. This method is extensively used to study costs, mark-ups, and conduct in narrowly defined product markets, as it enables the researcher to tailor and test assumptions on the nature of demand, cost and competitive behaviour to the specific features of the industry (see Berry et al. (2019) for an overview). Yet, its stringent data requirements, i.e. information on product characteristics and consumer attributes, on top of information on prices and market shares, precludes its use in studies aiming to evaluate economy-wide developments in market power. De Loecker and Scott (2016) document that both methods produce consistent results when the data requirements are met to estimate mark-ups with both approaches.

<sup>33</sup> See Basu (2019) for an overview of the main advantages and drawbacks of the three main methods used in the production approach.

<sup>34</sup> This derivation is due to Hall (1988) who applied it to industry-level data for the US. See Hall (2018) for a refinement of the original approach to allow for the estimation of time-varying markups on industry-level data. The application of Hall's approach to firm-level data for one country is attributable to De Loecker and Warzynski (2012). For the application to multiple countries, see De Loecker and Eeckhout (2018). See Basu (2019) for a discussion of how Hall's original derivation has been applied by different authors.



market, the share of expenditure on the input would coincide with the input's contribution to output. In the presence of market power, the share of expenditure is smaller than the output elasticity. This wedge is precisely the firm-level mark-up. While the share of expenditure on the input is directly observed in the data, the output elasticity is not. Hence, while not imposing any constraints on the features of the production function, this approach does require taking a stance on the production function and structurally estimating its parameters.<sup>35</sup>

The seminal paper by De Loecker and Warzynski (2012) was the first to implement the Hall (1988) derivation to estimate output elasticities for the input deemed *variable* and *consistently measured* across firms and over time, in view of computing the distribution of firm-level mark-ups. This estimation is based on a panel dataset of firm financial accounts either industry-specific -- assuming a Cobb-Douglas production function -- or firm-specific -- assuming a trans-log production function -- While the focus of the paper was on studying the response of firm-level mark-ups to entry into export markets, rather than documenting the evolution of market power over time, the De Loecker and Warzynski method gave rise to an important literature and has become – after multiple refinements in subsequent work – the most widespread approach to implementing the Hall (1988) derivation, in particular in view of assessing the extent and evolution of market power at the macro-level.<sup>36</sup>

An inherent feature of this approach to the estimation of mark-ups consists in selecting a variable intermediate input - or several inputs (such as materials, labour) - which relates with the quantity of output produced by the firm. The estimated level and evolution of mark-ups may be sensitive to the choice of the variable input for a number of reasons. Firstly, it could be argued that no input is perfectly variable, from both a conceptual viewpoint -- i.e. whether we look at intermediate inputs, labour, or capital, there are adjustment costs -- and a data viewpoint -- i.e. measures of production factors available in accounting data are too broad to be seen as fully variable. A connected issue is the extent to which a given type of expenditure is consistently measured in accounting data over time. As discussed in Basu (2019), there may be a trade-off involved: if the researcher opts for a more comprehensive definition of the expenditure category related to a specific intermediate input, it is more likely to be consistently measured over time. Yet, it is also more likely that a bigger share of inputs included in such an input bundle is quasi-fixed, rather than variable, entailing that the input bundle demonstrates a reduced responsiveness to shocks experienced by the firm and makes it more challenging to compute a consistent and precise estimate of the output elasticity used in the mark-up computation.<sup>37</sup>

Secondly, imperfect competition in factor markets, and more specifically different degrees of market power in intermediate inputs and labour markets, may affect the level and the evolution

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<sup>35</sup> See De Loecker (2021) and references therein as well as Syverson (2019). As argued in De Loecker (2021), the approach is flexible in that it does not impose specifying a particular demand system or model of conduct; and it allows working with different variable inputs.

<sup>36</sup> See De Loecker et al. (2020) for the US. See Akerberg et al. (2015) on the frontier approach to production function estimation. See Akerberg (2021) on the use of static inputs (rather than dynamic inputs) as control variables. See De Ridder et al. (2021) for an up-to-date guidance on the estimation of output elasticities in view of mark-up computation.

<sup>37</sup> The estimated evolution of markups appears somewhat sensitive to this trade-off, and there is a debate in the literature as to how best to make this choice. Traina (2018) finds that the increase in mark-ups is dampened when a more comprehensive definition of inputs is used while De Ridder et al. (2021) argue that output elasticities are unreliable when quasi-fixed inputs are used. See also Bond et al. (2020).

of estimated markups.<sup>38</sup> If market power evolves differently in the intermediate inputs' market and the labour market, the *evolution* of mark-ups may also differ. Mertens (2019) argues that labour markets have been subject to increasing monopsony power of employers and consequently suggests using materials rather than labour for a consistent estimation of mark-ups' evolution in final goods' markets.<sup>39</sup>

Several other issues with the identification of output elasticities and the consistent estimation of mark-ups using the firm-level approach by De Loecker and Warzynski (2012) continue to be debated. The first – and, as argued in Raval (2020) and De Ridder et al. (2021), likely major issue – is linked to the potential misspecification of the production function.<sup>40</sup>

Further issues of the De Loecker and Warzynski (2012) methodology pointed out by Bond et al. (2021) and Doraszelski et al. (2021) – namely measurement error, unobserved firm-level output and input prices, as well as the need to control for the unobserved mark-up in the estimation of the production function – appear to be of less critical empirical relevance. De Ridder et al. (2021) document the omission of such controls does not have strong bearing on the informational content of the estimated mark-ups. Another issue is related to the use of revenue and industry-level deflators in estimating the production function when the variables are expressed in monetary values, rather than employing direct information on prices and quantities, often not available in firm-level datasets. However, it is shown in De Ridder et al. (2021) that imperfectly deflated outputs and inputs do not have a strong bearing on the informational content of the estimated mark-ups, in terms of their dispersion or evolution. A possible intuition behind this result is that in homogeneous goods' markets, industry deflators do a pretty good job in recovering quantity variation, while in differentiated goods' markets, quality variation implies that quantities do not mirror the intrinsic properties of the product and, consequently, the use of revenue may be a more consistent unit of measurement than a quality-unadjusted quantity unit.<sup>41</sup>

An alternative approach to the estimation of mark-ups, also grounded in the original intuition of Hall (1988) and further elaboration of Hall's method by Roeger (1995), has been proposed in Abraham et al. (2020). An important way in which Hall (1988), Roeger (1995), Hall (2018), and Abraham et al. (2020) differ from the literature stemming from the seminal De Loecker and Warzynski (2012) paper is in the use of *time variation*, i.e. data in first differences, to estimate the parameters of interest. Specifically, in the Hall (1988) paper, the author recovers the marginal cost as the ratio of the change in expenditure on inputs, adjusted for changes in input prices, and the change in output, adjusted for productivity growth. The original implementation

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<sup>38</sup> As discussed in Basu (2019), if both input (factor) and output markets are subject to imperfect competition, the estimated mark-up will reflect a combination of these two wedges, potentially explaining differences in cross section in the magnitude of materials- vs. labour-based mark-ups.

<sup>39</sup> See also Bighelli et al. (2021). Rubens (2020) discusses how to separately identify market power in input and output markets.

<sup>40</sup> Notice that this issue goes to the heart of Hall (1988)'s original approach and is inherent to the assumptions on the structure of the production process assumed in the estimation – i.e. it is not, as explained in De Loecker (2021), specific to the De Loecker and Warzynski (2012) implementation of Hall (1988)'s intuition. Specifically, De Ridder et al. (2021) document that while the assumption of a Cobb-Douglas production function does not impede identifying the average mark-up, it strongly overestimates mark-up dispersion when the true underlying production function is trans-log. Similarly, Raval (2020) points out that a flexible production function estimated to compute the mark-up should also account for productivity dynamics, allowing for factor-biased productivity growth.

<sup>41</sup> Moreover, there could be potential sample representativeness issues for some countries in the De Loecker and Eeckhout (2021) study, as the Worldscope database used in this study contains only 80 firms for Belgium. Abrahams et al (2020) employ the De Loecker and Warzynski -based methodology for Belgium, using data from the National Bank of Belgium, and find mark-ups to be declining.

by Hall (1988) requires instruments, as changes in input expenditure are correlated with the unobserved productivity shock. Roeger (1995) shows how to address endogeneity without requiring instrumental variables. Specifically, Roeger shows that by subtracting the dual from the primal Solow residual, unobserved productivity shocks cancel out. A consistent estimation of the mark-up is obtained by decomposing the Solow residual in a technological component and a mark-up component. An application of Roeger (1995) based on firm-level data is Konings and Vandebussche (2005).

Abraham et al. (2020) build upon Roeger (1995) by explicitly modelling the fixed costs in the production function, and showing how estimation should be adjusted for wedges associated to the presence of fixed factors of production. The authors develop a difference-in-differences approach which enables them to estimate an industry-level or an economy-wide average price-cost margin in each year, while not requiring instruments (as the unobserved productivity shocks cancel out) or price deflators (as the approach is based on nominal variables). As discussed in Basu (2019) and explained in Abraham et al. (2020), there are also caveats in this alternative approach. First and foremost, reliance on time variation in the data to estimate the parameters of interest may be problematic in the presence of measurement error – in particular linked to variation in capacity utilization, as measurement error is exacerbated when estimation is carried out in first differences. Second, the approach does require estimating the rental rate of capital, as the nominal cost of capital is not directly observed. Third, the approach does not allow estimating the distribution of mark-ups while relying on specific functional form assumptions as regards the relationship between mark-ups, fixed factor shares, and firm size.

The implementation of this methodology can be seen as strongly complementary to the De Loecker and Warzynski approach as it helps to assess the robustness of the evolution of mark-ups in the economy, while explicitly modelling fixed production factors and allowing to evaluate the evolution of mark-ups jointly with the evolution of fixed costs (profits). Consequently, the results can be directly used to gauge whether the evolution of the aggregate mark-up is compatible with other macro facts (labour share; returns to scale; profit rates).

In the next section we illustrate the methodological debate by discussing the recent empirical evidence provided in the literature.

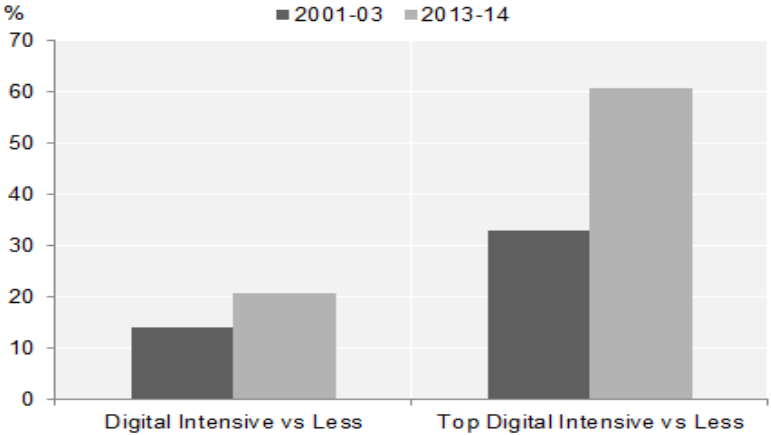
### **A1.2. Recent empirical evidence on the evolution of market power in Europe and beyond – with a focus on mark-ups**

The empirical findings by papers using the De Loecker and Warzynski (2012) methodology have generated much attention as they tend to show an increase in mark-ups in the last decades, which could be alarming for policy makers if this reflects softer competition, higher prices and reduced consumer welfare, reduced investment and other consequences outlined above. De Loecker and Eeckhout (2017) find that mark-ups have increased from 18% to 67% in the United States since 1950. This increase is found to stem from a change in mark-ups within rather than between industries and is driven by the top decile of the firm's mark-up distribution. The increase in mark-ups is due to reallocation forces toward higher revenue firms that fix higher mark-ups and the median mark-up has not increased. Building on this work, De Loecker and Eeckhout (2021) cover the evolution of mark-ups for the world economy. Using a database extracted from the Worldscope dataset containing 70,000 firms from 134 different countries, they report an increase in global aggregate mark-up from 1.1 to 1.6 between 1980 and 2016. Their dataset contain mainly publicly listed firms. The increase in mark-up especially occurs between 1980 and 2000 and has stagnated during a decade before starting to rise again. Their study shows that this increase is driven primarily by the United States and Europe. However, there are differences in the dynamics of trends between the two regions. According to the authors, while the increase in mark-ups is mostly due to reallocation forces towards high mark-ups firms in the US, the increase in mark-ups is mostly due to an increase in the level of

mark-ups itself in Europe. Similarly, using Worldscope data for 82 countries, Akcigit *et al.* (2021) report that ‘global’ mark-ups have increased by about one-third since 1980, with the increase being concentrated amongst the advanced economies. The increase in mark-ups amongst US, Canadian and euro area firms appears to be two times larger than the increase amongst Japanese and Korean firms. While mark-ups have increased across the board, the rise in mark-ups has been particularly sharp in the health care and technology industries.

Díez *et al.* (2021) also use the De Loecker and Warzynski (2012) approach to compute firm-level mark-ups. Their analysis, based on Orbis Historical database from Bureau van Dijk,<sup>42</sup> reports a more modest increase of mark-ups from 1.22 to 1.29 over the period 2000-2015. Like De Loecker and Eeckhout (2021), the increase in mark-ups is driven mostly by the top decile of the mark-up distribution. Furthermore, the authors also report a U-shape relation between firm’s size and mark-up – suggesting that few firms operating on niche market and very large firms are those driving higher mark-ups. The difference compared to the findings of De Loecker and Eeckhout (2021) is driven by the inclusion of privately held firms that have seen lower mark-ups increase and highlight the interest of taking into account a broader set of firms. They find that the rise of mark-ups trend exists especially for advanced economies, service sectors and sectors that use more intensively ICT technologies.

**Figure A1.1: Mark-up calculations in Calligaris et al. (2018)**



*Note: The graphs report the estimates of a pooled OLS regression explaining firm log mark-ups in the period, keeping into account firm’s capital intensity, age, and country-year of operation, as well as a dummy variable with value 1 if the industry of operation is digital intensive vs less intensive (specifications on the left in the graph), or if the industry of operation is among the top 25% of digital intensive industries vs. not (specifications on the right in the graph). The classification of sectors by digital intensity is sourced from Calvino et al. (2018). Estimates of mark-ups assuming a Cobb Douglas production function. Standard errors are clustered at the firm level. All coefficients are significant at the 1% confidence level. Source: Calligaris, Criscuolo, Marcolin (forthcoming) based on Calligaris, Criscuolo, Marcolin (2018) on Orbis® data.*

The observation that digital sectors are concerned when it comes to rising mark-ups is confirmed in Calligaris et al. (2018) who analyse the digital transformation and evolution of market power between 2001 and 2014 for 26 countries (including many EU countries but also the US, Japan, South Korea and other non-EU countries) and also using the De Loecker and Warzynski (2012) approach. The study finds that mark-ups have increased by 4% to 6% over

<sup>42</sup> The authors use the Orbis Historical database. The dataset contains more than 5 million firms from 19 countries and covers 40% of total reported output. The countries are Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Italy, Japan, Korea, Latvia, Portugal, Romania, Russia, Spain and the United States.

the period considered, with this increase mainly attributable to firms belonging to the top decile of the mark-up distribution. The authors interact the estimated mark-ups with a digital intensity taxonomy by sector and find that more-digitally intensive sectors are characterised by higher mark-ups than less-digitally intensive sectors. The mark-up gap between the more-digitally intensive and less-digitally intensive sectors has increased significantly over time (see Figure A1.1). As mentioned above, digitalisation may imply large upfront fixed sunk costs (e.g. customised software). However, the increase in mark-ups is not limited to the digital sectors alone, as other markets with large sunk costs (due to investments in R&D, brand development and other intangibles) have seen increased concentration and mark-up levels as well.

Using sector-level data (KLEMS) and an update of the Hall (1988) methodology including time trends, Hall (2018) finds mark-ups to rise – though more moderately than De Loecker and Eeckhout (2021). The mean mark-up grew from 1.12 in 1988 to 1.38 in 2015. He also finds some evidence that growth of superstar mega firms<sup>43</sup> is associated with rising market power.

Another group of studies that focus exclusively on Europe does not find the same upward trend as in the US. Weche and Wambach (2021) study the evolution of mark-ups in 17 EU member countries between 2007 and 2015 using the Orbis database with publicly traded and privately held companies based on the same methodology as De Loecker and Eeckhout (2021) and Díez et al. (2021). They report an increase in mark-ups, but to a lesser extent than in the United States. Contrary to the United States that had already returned to their pre-crisis level in 2012, the author report a sharp decline in mark-ups after the 2008 crisis and in 2015, the level of mark-ups did not reach the pre-crisis level, although the analysis reveals significant heterogeneity across EU countries.<sup>44</sup> Moreover, unlike the United States, they report an increase in mark-ups for the entire top half of the firms' distribution in Europe. Lopez-Garcia et al (2018) calculate mark-ups based on the Compnet firm-level database for euro area countries from 2000 to 2015 (with coverage differing across countries). They observe an increase in mark-ups, but find that results can be quite sensitive to different choice of variable input (labour or materials) or different forms of the production function (Cobb-Douglass or trans-log).

A crucial aspect when interpreting the evolution of mark-ups is the consideration of fixed cost in the analysis, if the presence of fixed or sunk costs stems from improved production technology or improved products and thereby possibly increase consumer welfare (see for example Guitierrez and Philippon (2017) or Traina (2018)). In the presence of increasing fixed costs, higher mark-ups are needed to maintain the profitability of the firms, without that being associated with an increase in market power. Technological changes, such as digitalization, transform the structure of cost and tend to reduce marginal costs. Moreover, an increase in intangible assets would increase fixed costs. For example, Bessen (2017) provides evidence that customized software widely used by large corporation, requires large up-front fixed sunk cost. Such a change in the structure of cost can be a source of the apparent pattern of rising mark-ups (if not corrected for fixed costs. Studies that take into account fixed costs more broadly than in the De Loecker and Warzynski (2021) methodology display another picture of the evolution of mark-ups. De Loecker et al (2020) argue however that firms with higher overhead costs (fixed costs as measured by SG&A costs) also have higher excess market power.

Regarding the EU, Abraham et al (2020) address the question of fixed cost in the mark-ups estimation (see above) and study the case of Belgium from 1985 to 2014. Their methodology is an extension of the work of Roeger (1995) and, using the properties of the primal and dual

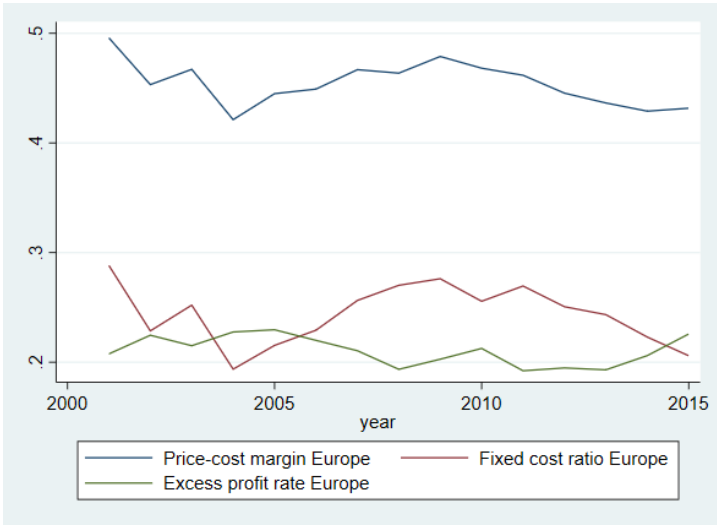
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<sup>43</sup> Firms with 10,000 or more employees.

<sup>44</sup> For Belgium, Czechia, Finland, Germany and Slovakia, the average post-2008 crisis markup is even higher than their pre-crisis level

Solow residual, they compute jointly price cost margin and fixed cost. According to their results, not taking into account which part of the mark-up should rather be attributed to fixed costs than to excess profit may lead to an overestimation of the excess profit and thus of market power. Their results suggest that price-cost margins and excess profit margin decrease in Belgium in their time span concluding on an increase in competition in Belgium. Their methodology can also be applied to EU level data at sector-level (EUKLEMS) as shown in Figure A1.2 which confirms the authors' findings for Belgium at EU level.

**Figure A1.2: Mark-up calculations in Abrahams et al (2020)**



Source :Abraham et al. (2020) based on EUKLEMS data.

**A1.3 Linking mark-up to other competition metrics**

Profit rates and other approaches to measure competition intensity may also be worth been looking at to have a clearer picture of how competition evolves. In a series of papers, Gutierrez and Philippon (2017, 2018, 2020) study the evolution of competition intensity using a broad range of indicators such as concentration and profit rate and studying the so called “superstar firms”. They find that competition decreased in the US since the 1990’ and that the superstar firms phenomenon is rather due to a lack of antitrust policy than a “winner take most” type of competition as reported by Autor *et al.* (2020). Evidence of a decline in competition in U.S. non-financial corporate sector is also confirmed by Barkai (2020). The author finds that over the period 1984 to 2014, the U.S. non-financial corporate sector experienced a large increase in pure profit share which offset the observed simultaneous large declines in the shares of labour and capital due to a decline in competition. While the forces of technological change and globalization might have played a role, further analysis of the causes is still needed. The “superstar firms” phenomena is particularly relevant for the digital sector. Firms exploiting digital platforms enable them to expand activity at very low marginal cost are benefitting most from the COVID related boost. Profits, sales and stock prices of major oligopolistic digital companies (“Big Tech” companies) have risen sharply (Döhring et al 2021).<sup>45</sup>

<sup>45</sup> Combined, the four companies Google, Amazon, Facebook and Apple reach a market capitalisation value of nearly \$5.5 trillion in November 2020 entailing nearly 40% growth up from \$4 trillion in December 2019 and a 50% growth on average since March 2020. Moreover, in the third quarter of

Moreover, based on two data sources, namely OECD MultiProd project and Orbis-Worldscope –Zephyr, Bajgar *et al.* (2019) report an increase in industry concentration by around 8 percentage point in the average North American industry between 2000 and 2014. Bajgar *et al.* (2021) report that rising concentration is strongly associated with intensive investment in intangibles, particularly innovative assets, software, and data. This relationship appears to be stronger in more globalised and digital-intensive industries. However, the authors note that industry concentration, i.e. extent to which economic activity is concentrated within a small number of large companies or business groups within an industry, by itself it is not fully informative on whether or not a market competition is changing. In this respect industry concentration is distinct from market concentration that instead focuses on economic activities in which price and quality are determined by the competitive environment, and in which antitrust authorities evaluate the impact of mergers and trade restraints (Werden and Froeb, 2018). Werden and Froeb (2018) stress how suitable data to analysis market concentration trends are not available for most of the US economy. Hence they focus on three industries where data are available, namely airlines, banking and wireless telephony. While, for the airline and banking concentration seem to decrease or not increase, evidence of a significant increase in market concentration was reported in Wireless telecoms.<sup>46</sup>

For Europe, while there is evidence congruent with the US studies indicating a reduced competitive environment, there is also evidence of no significant reduction in in the competitive environment, also depending on the competition metrics observed. Gutierrez and Philippon (2017, 2018, 2020) do not find evidence of decline of competition in Europe and report that European market have become more competitive than their US counterpart. They provide institutional differences and antitrust enforcement as an explanation for this difference in trend. Thum-Thysen and Canton (2015) indeed provide evidence of a declining stringency of product market regulations in Europe as well as a positive correlation between more stringent product market reforms and mark-up. Similarly, Cavalleri *et al.* (2019) find that in four largest euro area countries, namely Germany, France, Italy and Spain, concentration and mark-ups have been fairly stable over the years, despite some differences across sectors and countries. They also find that unlike the U.S. economic dynamism, there has been no obvious trend secular change in economic dynamism (i.e., the birth and death rate of new establishments and jobs) in the euro area. These findings seem at odds with other studies on different measures of competition. For example, Calvino *et al.* (2020) find pervasive declines in business dynamism in many countries, although such a decline tends to be less pronounced or evident in European countries such as Belgium, Spain, Finland and Sweden. Also, the already mentioned Bajgar *et al.* (2019) find that between 2001 and 2012 the average industry across 10 European economies<sup>47</sup> saw a 2-3-percentage-point increase in the share of the 10% largest companies in industry sales and industry concentration has increased in Europe<sup>48</sup> between 2000 and 2014 by 4 percentage points for the average industry, less than the 8 percentage points reported in the US. Similarly, Koltay and Lorincz (2021) find moderate increases (about 4-7%) in average industry concentration in the five largest European economies over the last two decades. This

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2020 they reported a quarterly net profit of \$38 billion (with Amazon's net profit growing 197% compared to the same time one year ago).

<sup>46</sup> The authors also emphasise that such increases in concentration, however, should not imply a failure of antitrust, as it might, for example, reflect the growth of the most innovative and efficient firms.

<sup>47</sup> This sample includes: Austria, Belgium, Germany, Denmark, Finland, France, Hungary, Norway and Portugal and Sweden.

<sup>48</sup> This metric for Europe is based on Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, the Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden and the UK.

increase was widespread – the share of the four largest firms increased in 498 out of the 685 industry/country pairs – but the change was typically small. More recently, Melitz et al. (2021) have recently investigated the relation between concentration, productivity and mark-ups in Europe between 2000 and 2015 based on the CompNet database. They find that concentration and productivity are positively correlated and that both measures are uncorrelated with mark-ups. Bajgar *et al.* (2021) and Akcigit *et al.* (2021), on the other hand, associate increases in industry concentration with a reduced churning amongst top firms and an increased entrenchment of market leaders, which may have negative competitive effects in the longer term.

Finally, there is a strand of literature that has documented how international trade and the participation in the Global Value Chain (GVC), via trade in both final product and input markets, can affect market power in different directions, depending on the position in the global value chain. Competition in the product market may exert a negative pro-competitive pressure on mark-ups. For example, Gradzewicz and Muck (2019) report a decline of mark-ups in Poland over the last 15 years. Such decline of mark-ups is not related to changes in a sectoral composition and firms demography, but it is most severe in exporting firms, suggesting a relationship between the fall of mark-ups and globalization and GVC emergence. On the other hand, increased input competition and international mergers may lead to increased mark-up. For instance, De Loecker et al (2016) analyse the relationship between increase in trade reforms and mark-ups in India. They find that an increase in import competition of intermediate inputs resulted in a lower cost of production, which was fully transmitted to price, raising mark-ups. Alviarez et al. (2019) analyse another mechanism, i.e. international consolidation of brands, affect mark-ups in the beer industry. They simulate the consequences of counterfactual national merger policy and quantify the potential saving to consumer from forcing brand divestitures as a conditions of merger approval. They find that the price index for U.S. beer would have been 4–7% higher without divestitures. On the other hand, consumers in Latin America would have saved 30% more by following similar pro-competition policies as the US and EU.

Less research exists on how the value is generated between the different agents of the value chain. There could be contrasting evolution of mark-ups in different segments of the value chain, in connection to globalisation (i.e. upstream knowledge-intensive conception and downstream branding vs. standardized manufacturing). The example of the iPod supply chain discussed by Dedrick et al (2010), the authors show how Apple captured a great deal of financial value from innovation in the global supply chains compared to the notebook makers and firms and workers assembling the products. They identify a number of elements that play a role in explaining these differences, such as industry evolution, complementary assets, appropriability, system integration, and bargaining power.

### **A1.3 Concluding remarks**

The evolution of mark-ups in the EU is subject to a lively debate. We conclude from an analysis of this debate, firstly, that while critical for drawing policy implications, the assessment of competition intensity with help of structurally estimated mark-ups needs to be complemented with supporting indicators (such as concentration indices, profit ratios or policy indicators such as product market reform indicators as provided by the OECD). Second, we delve into the empirical evidence on the evolution of mark-ups since the early 2000s in the US and the EU. We acknowledging some contrasting results, for instance, the comparison between De Loecker and Warzynski (2020) and Díez *et al.* (2021) discussed in the empirical section illustrates how different firms have different mark-up dynamics. In particular, the inclusion of privately held firms in analysis has seen lower increase in mark-ups and emphasised the interest of taking into account a broader set of firms. Moreover, the way fixed costs are taken



into account can influence the estimated results (see Abrahams et al 2020), as can the choice of variable input (see our discussion in the methodological section).

Nonetheless, we tentatively conclude from the literature that: (1) average mark-up levels have increased in advanced economies (and especially in the US); (2) such increases have been concentrated in the upper tail of the productivity distribution; (3) mark-up dynamics can differ across sectors (they can be rising for example in the sectors most strongly affected by technological change but also sectors in which regulatory barriers and investments in intangibles play an important role); (4) profit rates, concentration or macro-economic measures based on average costs have yet to provide conclusive evidence on the dynamics of market power in the EU; (5) international trade and globalisation may affect market power and the distribution of the value along the supply chain in different directions. However, on this last point, more literature is especially needed that examines the evolution of margins along a global value chain.

The IMF (2019) takes a next step, by investigating the growth implications of the increases in market power observed. It concludes that even though the overall macroeconomic implications have been modest so far, a further concentration of market power could weaken investment, deter innovation and reduce labour income shares.

Finally, we would like to underscore, in particular with a view to possible policy implications, that economy-wide studies of market power need to be combined with a careful assessment of sectoral and country specificities. Studies differ starkly in their reading of the determinants of the evolution of market power. The benign view argues that technological change and globalisation have increased the cost of innovation (and the return to successful innovation), bringing about a change in market structure together with increased incentives to innovate. While the observed process of structural transformation may initially increase the intensity of competition, subsequently it can contribute to entrenching market power through higher entry barriers. This literature therefore argues that policies need to tackle future obstacles to market contestability while preserving the incentives to innovate. The less benign view argues that the intensity of competition has declined, in parallel to the process of technological change, with efficiency gains from reallocation and innovation outweighed by deadweight loss, higher barriers to entry and reduced incentives to work associated with increased market power. This literature argues that policies should focus on ensuring more contestability increasing effective pass-through, to curb excess rents and reinforce productive investment. Both views are not necessarily contradictory: the structural change observed may indeed be the result of increased competition and at the same time pose a threat to future competition as the higher entry barriers contribute to a reduced churning amongst market leaders.

## References

- Abraham F., Boormans Y., Konings J. and Roeger W. (2020), "Price-Cost margins, fixed costs", *Working Papers* 202010, University of Liverpool, Department of Economics.
- Akerberg D.A. (2021), Comment on "Olley and Pakes-style production function estimators with firm fixed effects", *Oxford Bulletin of Economics and Statistics*, 83(3): 0305-9049
- Akerberg D. A., Caves K. and Frazer G. (2015), "Identification properties of recent production function estimators", *Econometrica*, 83(6): 2411-2451.
- Aghion A., Bergeaud A., Boppart T., Klenow P. and Li H. (2020), "A theory of falling growth and rising rents", unpublished manuscript.

Akcigit U., Chen W., Díez F.J., Duval R., Engler P., Fan J., Maggi C., Tavares M.M., Schwarz D., Shibata I. and Villegas-Sánchez C., “Rising corporate market power: Emerging policy issues”, *IMF Staff Discussion Note*, SDN/21/01, International Monetary Fund.

Alviarez, V., Head, K. and Mayer T. (2020), “Global giants and local stars: how changes in brand ownership affect competition”, *Sciences Po Economics Discussion Paper*, No. 2020-04

Autor D., Dorn D., Katz L.F., Patterson C. and Van Reenen J. (2020), “The fall of the labor share and the rise of superstar firms”, *Quarterly Journal of Economics*, 135(2): 645-709.

Bain J.S. (1951), “Relation of profit rate to industry concentration: American manufacturing, 1936–1940”, *The Quarterly Journal of Economics*, 65(3): 293-324.

Bain J.S. (1941), “The profit rate as a measure of market power”, *The Quarterly Journal of Economics*, 55(2): 271–293.

Bajgar M., Berlingieri G., Calligaris S., Criscuolo C. and Timmis J. (2019), “Industry Concentration in Europe and North America”, *OECD Productivity Working Papers*, 2019-18.

Bajgar M., Criscuolo C. and Timmis J. (2021), “Intangibles and industry concentration: Supersize me”, *OECD Science, Technology and Industry Working Papers*, No. 2021/12, OECD Publishing, Paris.

Barkai S. (2017), “Declining labor and capital shares”, unpublished manuscript.

Basu S. (2019), “Are price-cost markups rising in the United States? A discussion of the evidence”, *Journal of Economic Perspectives*, 33(1):3-22.

Battiatì C., Jona-Lasinio C., Marvasi E., and Sopranzetti S. (2021), “Market power and productivity trends in the European economies: A macroeconomic perspective”, *Working paper 1/2021 LUISS*.

Baumol W., Panzar J., and Willig R. (1982), *Contestable markets and the theory of industry structure*, Harcourt Brace Jovanovich, NY.

Berry S., Gaynor M., and Scott Morton F. (2019), “Do increasing markups matter? Lessons from empirical industrial organization”, *Journal of Economic Perspectives*, 33(3): 44-68.

Berry S., Levinsohn J., and Pakes A. (1995), “Automobile prices in market equilibrium”, *Econometrica*, 63(4): 841-90.

Bessen J. (2017), “Information technology and industry concentration”, *No. 17-41 Boston University School of Law, Law & Economics Paper Series*.

Bighelli T., Di Mauro F., Melitz M. and Mertens M. (2021), “European firm concentration and aggregate productivity”, *IWH-CompNet Discussion Papers*, No. 3/2021.

Bond S., Hashemi A., Kaplan G., and Zoch P. (2021), “Some unpleasant markups arithmetic: Production function elasticities and their estimation from production data.” *NBER working paper*, No. 27002.

Boone J. (2008), “A new way to measure competition”, *The Economic Journal*, 118(531): 1245-1261.

- Calligaris S., Criscuolo C., and Marcolin L. (2018), "Markups in the digital era", *OECD Science, Technology and Industry Working Papers*, 2018/10, OECD Publishing, Paris.
- Calvino F., Criscuolo C., and Verlhac R. (2020), "Declining business dynamism structural and policy determinants", *OECD Science, Technology and Innovation Policy Papers*, No. 94.
- Cavalleri M.C., Eliet A., McAdam P., Petroulakis F., Soares A. and Vansteenkiste I. (2019), "Concentration, market power and dynamism in the euro area", *ECB Working Paper Series*, No. 2253.
- Crouzet N. and Eberly J. (2021), "Intangibles, markups, and the measurement of productivity growth", *Journal of Monetary Economics* (forthcoming).
- Decker R. A., Haltiwanger J., Jarmin R. J., and Miranda J. (2017), "Declining dynamism, allocative efficiency, and the productivity slowdown", *American Economic Review: Papers & Proceedings*, 107 (5): 322-26.
- Dedrick J., Kraemer K., and Linden G. (2009), "Who profits from innovation in global value chains?: a study of the iPod and notebook PCs", *Industrial and Corporate Change*, 19 (1): 81–116.
- De Loecker J. and Eeckhout J. (2020), "Global market power", *NBER Working Paper*, No. 24768.
- De Loecker J., Goldberg P. K., Khandelwal A. K. and Pavcnik N. (2016), "Prices, markups, and trade reform", *Econometrica*, 84(2): 445-510.
- De Loecker J., Eeckhout J. and Unger G. (2020), "The rise of market power and the macroeconomic implications", *Quarterly Journal of Economics*, 135(2).
- De Loecker J. and Scott P.T. (2016), "Estimating market power. Evidence from the US brewing industry", *NBER Working Paper*, No. 22957.
- De Loecker J. (2021), "Comment on (Un)pleasant... by Bond et al (2020)", *The Journal of Monetary Economics*, Prepared for special issue.
- De Loecker J. and Warzinsky F. (2012), "Markups and firm-level export status", *American Economic Review*, 102(6): 2437-2471.
- De Loecker J., Eeckhout J. and Mongey S. (2021), "Quantifying market power and business dynamism in the macroeconomy", *University of Chicago, Becker Friedman Institute for Economics Working Paper*, No. 2021-54.
- De Ridder M., Brassi B. and Morzanti G. (2021), "The hitchhiker's guide to markup estimation", *Working Papers from IGER (Innocenzo Gasparini Institute for Economic Research)*, Bocconi University, No. 677.
- Díez F.J., Fan J. and Villegas-Sánchez C. (2021), "Global declining competition?", *Journal of International Economics*, 132(C).
- Döhring B., Hristov A., Maier C., Roeger W. and Thum-Thysen A. (2021), "COVID-19 acceleration in digitalisation, aggregate productivity growth and the functional income distribution", *International Economics and Economic Policy*, 18: 571–604
- Doraszelski U. and Jaumandreu J. (2021), "Reexamining the De Loecker & Warzinsky (2012) method for estimating markups", *CEPR Discussion Papers*, No.16027.

Duygun M., Shaban M., and Weyman-Jones T. (2015), "Measuring competition using the Boone relative profit difference indicator", *Economics Letters*, 132: 117-120.

Eggertsson G. B., Robbins J. A., and Getz Wold E. (2021), "Kaldor and Piketty's facts: The rise of monopoly power in the United States", *Journal of Monetary Economics* (forthcoming).

Goldberg P. and Hellerstein R. (2008), "A structural approach to explaining incomplete exchange-rate pass-through and pricing-to-market", *American Economic Review: Papers and Proceedings*, 98(2): 423-429.

Gradzewicz M. and Mućk J. (2019), "Globalization and the fall of markups", *NBP Working Papers*, No. 304.

Gutiérrez G. and Philippon T. (2017), "Declining competition and investment in the US", *NBER Working Paper*, No. 23583.

Gutiérrez G. and Philippon T. (2019), "From good to bad concentration? U.S. industries over the past 30 years", *NBER Macroeconomics Annual Volume 34*.

Gutiérrez G. and Philippon T. (2018), "How EU markets became more competitive than US markets: A study of institutional drift", *NBER Working Paper*, No. 24700.

Hall R. E. (2018), "New evidence on the markup of prices over marginal costs and the role of mega-firms in the US economy", *NBER Working Paper*, No. 24574.

Hall R. E. (1988), "The relation between price and marginal cost in US industry", *Journal of Political Economy*, 96(5): 921-47.

IMF (2019), "The rise of corporate market power and its macroeconomic effects", Chapter 2 in *World Economic Outlook: Growth slowdown, precarious recovery*, April.

Koltay G. and Lorincz S. (2021), "Industry concentration and competition", Competition Policy Brief, No 02/2021, European Commission.

Konings J. and Vandenbussche H. (2005), "Antidumping protection and markups of domestic firms", *Journal of International Economics*, 65(1): 151-165.

López-García P., Aglio D., Bräuer R., Haug P., Van der Kerke J. P., Mertens M. and Mattioli M. (2018), "CompNet 6th vintage of data: Novelties and main stylized facts", CompNet Documentation.

Mertens M. (2019), "Micro-mechanisms behind declining labour shares: Market power, production processes, and global competition", Halle Institute for Economic Research (IWH), unpublished manuscript.

Raval D. (2020), "Testing the production approach to markup estimation", unpublished manuscript.

Roeger W. (1995), "Can imperfect competition explain the difference between primal and dual productivity measures? Estimates for US manufacturing", *Journal of Political Economy*, 103(2): 316-330.

Rossi-Hansberg E., Sarte P.-D., and Trachter N. (2018), "Diverging trends in national and local concentration", NBER working paper, No. 25066.

Rubens M. (2020), "Ownership consolidation, monopsony power and efficiency: Evidence from the Chinese tobacco industry", University of Leuven, unpublished manuscript.

Stackelberg H. von (2011), *Market Structure and Equilibrium*, Springer, Heidelberg, NY.

Syverson C. (2019), "Macroeconomics and market power: Context, implications, and open questions", *Journal of Economic Perspectives*, 33(3): 23-43.

Thum-Thyssen A. and Canton E. (2015), "Estimation of service sector mark-ups determined by structural reform indicators", *European Economy, Economic Papers*, No. 547.

Tirole J. (1988), *The theory of industrial organization*, MIT Press.

Traina J. (2018), "Is aggregate market power increasing? Production trends using financial statements", unpublished manuscript.

Van Reenen J. (2018), "Increasing differences between firms: Market power and the macro-economy", CEP Discussion Papers (CEPDP1576). Centre for Economic Performance, London School of Economics and Political Science.

Varga J. and in't Veld J. (2014), "The potential growth impact of structural reforms in the EU. A benchmarking exercise", 541, *European Economy Economic Papers DG ECFIN*.

Weche J. P. and Wambach A. (2021), "The fall and rise of market power in Europe", *Jahrbücher für Nationalökonomie und Statistik*.

Werden G.J. and Froeb L.M. (2018), "Don't panic: A guide to claims of increasing concentration." *Unpublished manuscript*.

## **A2. CORRELATION BETWEEN MARK-UPS AND COMMISSION INTERVENTIONS AT THE SECTOR LEVEL<sup>49</sup>**

In this Annex, we study correlations between mark-ups, market concentration and Commission interventions. Commission interventions consist of merger interventions, cartel prohibitions and antitrust interventions under Articles 101 and 102 TFEU. They are defined and discussed in detail in Section 2. Apart from that we analyse the size of the markets directly or indirectly affected by such interventions relative to that of the industry concerned. They are defined in Section 4, Equation 4.4.

Mark-ups are defined as the ratio of price to marginal cost. The mark-up data is defined at the industry level (NACE rev2, two-digit, 24 sectors) aggregated at the European level and time invariant.

The data on market concentration is based on four countries: France, Germany, Italy and Spain. The source of the concentration data at the four-digit ISIC rev. 3.1 sector level is Euromonitor International, commissioned by DG COMP. The market concentration ratio (C4) is defined as the share of production of the four largest companies in the sector. In order to match these data with mark-ups and interventions, we have converted the four-digit ISIC rev. 3.1 sector data into two-digit NACE rev. 2 industry data. The observations are calculated as a weighted average of corresponding ISIC rev. 3.1 four-digit sectors, with weights equal to the total production in that sector.

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<sup>45</sup> Prepared by Mattia Cai (JRC) and Igor Fedotenkov (JRC).

In Table A2.1 we present data used in the analysis and Table A2.2 provides descriptions of the sectors. The highest mark-ups (MUPs) are observed in Mining and quarrying (around 50%). There are also high mark-ups in Telecommunications (30%), Energy, water supply and waste management (23.6%), Publishing, audio-visual and broadcasting activities (19.3%), and Financial and insurance activities (19.2%). The highest market concentration is in Telecommunications (70%), Coke and refined petroleum products (63.4%), Energy, water supply and waste management (45.4%); and in Chemicals and pharmaceuticals (42.5%).

The total number of interventions is particularly high in Chemicals and pharmaceuticals (40), Transport equipment (27), Computer and electrical equipment (23), and Transportation and storage (23).

Figure A2.1 visualises distributions of mark-ups and concentration. The distribution of mark-ups is more skewed than that of concentration. Nevertheless, as both measures by definition take values between zero and one, both distributions have light tails, and the usual measures of analysis, such as summary statistics and correlations can be applied.

**Table A2.1: Data used in this descriptive analysis.**

| Sector | MUPs  | C4    | Number of cases |        |           |       | Relative size of the markets affected by competition policy interventions |        |           |       |
|--------|-------|-------|-----------------|--------|-----------|-------|---|--------|-----------|-------|
|        |       |       | merger          | cartel | antitrust | total | merger  | cartel | antitrust | total |
| 10-12  | 0,095 | 0,325 | 10              | 3      | 0         | 13    | 0,063   | 0,001  | 0,000     | 0,065 |
| 13-15  | 0,081 | 0,204 | 0               | 0      | 0         | 0     | 0,000   | 0,000  | 0,000     | 0,000 |
| 16-18  | 0,094 | 0,168 | 6               | 1      | 0         | 7     | 0,045   | 0,002  | 0,000     | 0,048 |
| 19     | 0,058 | 0,634 | 0               | 0      | 0         | 0     | 0,000   | 0,000  | 0,000     | 0,000 |
| 20-21  | 0,172 | 0,425 | 35              | 1      | 4         | 40    | 0,063   | 0,001  | 0,004     | 0,067 |
| 22-23  | 0,105 | 0,196 | 7               | 3      | 0         | 10    | 0,018   | 0,001  | 0,000     | 0,020 |
| 24-25  | 0,090 | 0,215 | 11              | 3      | 1         | 15    | 0,076   | 0,002  | 0,000     | 0,079 |
| 26-27  | 0,141 | 0,271 | 13              | 7      | 3         | 23    | 0,081   | 0,015  | 0,008     | 0,104 |
| 28     | 0,123 | 0,334 | 6               | 1      | 0         | 7     | 0,010   | 0,003  | 0,000     | 0,013 |
| 29-30  | 0,097 | 0,528 | 16              | 11     | 0         | 27    | 0,043   | 0,017  | 0,000     | 0,060 |
| 31-33  | 0,098 | 0,282 | 8               | 1      | 0         | 9     | 0,005   | 0,002  | 0,000     | 0,007 |
| 58-60  | 0,193 | 0,395 | 8               | 0      | 3         | 11    | 0,129   | 0,000  | 0,015     | 0,145 |
| 61     | 0,300 | 0,700 | 17              | 0      | 2         | 19    | 0,340   | 0,000  | 0,042     | 0,382 |
| 62-63  | 0,168 | 0,172 | 3               | 0      | 5         | 8     | 0,001   | 0,000  | 0,030     | 0,030 |
| A      | 0,118 | 0,149 | 3               | 0      | 0         | 3     | 0,005   | 0,000  | 0,000     | 0,005 |
| B      | 0,501 | 0,174 | 2               | 0      | 0         | 2     | 0,030   | 0,000  | 0,000     | 0,030 |
| D-E    | 0,236 | 0,454 | 2               | 2      | 10        | 14    | 0,009   | 0,000  | 0,038     | 0,047 |
| F      | 0,081 | 0,068 | 0               | 0      | 0         | 0     | 0,000   | 0,000  | 0,000     | 0,000 |
| G      | 0,144 | 0,255 | 9               | 1      | 7         | 17    | 0,015   | 0,000  | 0,001     | 0,016 |
| H      | 0,128 | 0,324 | 16              | 3      | 4         | 23    | 0,011   | 0,002  | 0,006     | 0,019 |
| I      | 0,156 | 0,084 | 1               | 0      | 1         | 2     | 0,002   | 0,000  | 0,000     | 0,002 |
| K      | 0,192 | 0,383 | 7               | 5      | 7         | 19    | 0,005   | 0,012  | 0,005     | 0,023 |
| M-N    | 0,150 | 0,144 | 3               | 0      | 3         | 6     | 0,003   | 0,000  | 0,000     | 0,003 |
| R-S    | 0,146 | 0,126 | 0               | 0      | 1         | 1     | 0,000   | 0,000  | 0,000     | 0,000 |

**Table A2.2: Sector descriptions**

| Sector NACE rev2 | Description  |
|------------------|--|
| <b>10-12</b>     | Food products, beverages and tobacco   |
| <b>13-15</b>     | Textiles, wearing apparel, leather and related products  |
| <b>16-18</b>     | Wood and paper products; printing and reproduction of recorded media   |
| <b>19</b>        | Coke and refined petroleum products  |
| <b>20-21</b>     | Chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations                         |
| <b>22-23</b>     | Rubber and plastics products, and other non-metallic mineral products  |
| <b>24-25</b>     | Basic metals and fabricated metal products, except machinery and equipment   |
| <b>26-27</b>     | Computer, electronic and optical products, electrical equipment  |
| <b>28</b>        | Machinery and equipment n.e.c.   |
| <b>29-30</b>     | Transport equipment  |
| <b>31-33</b>     | Other manufacturing; repair and installation of machinery and equipment  |
| <b>58-60</b>     | Publishing, audio-visual and broadcasting activities   |
| <b>61</b>        | Telecommunications   |
| <b>62-63</b>     | IT and other information services  |
| <b>A</b>         | Agriculture, forestry and fishing  |
| <b>B</b>         | Mining and quarrying   |
| <b>D-E</b>       | Electricity, gas, steam and air conditioning supply, Water supply; sewage; waste management and remediation activities |
| <b>F</b>         | Construction   |
| <b>G</b>         | Wholesale and retail trade; repair of motor vehicles and motorcycles   |
| <b>H</b>         | Transportation and storage   |
| <b>I</b>         | Accommodation and food service activities  |
| <b>K</b>         | Financial and insurance activities   |
| <b>M-N</b>       | Professional, scientific, technical, administrative and support service activities                                     |
| <b>R-S</b>       | Arts, entertainment, recreation; other services and service activities, etc.   |

Figure A2.1: Distribution of mark-ups and concentration (C4)

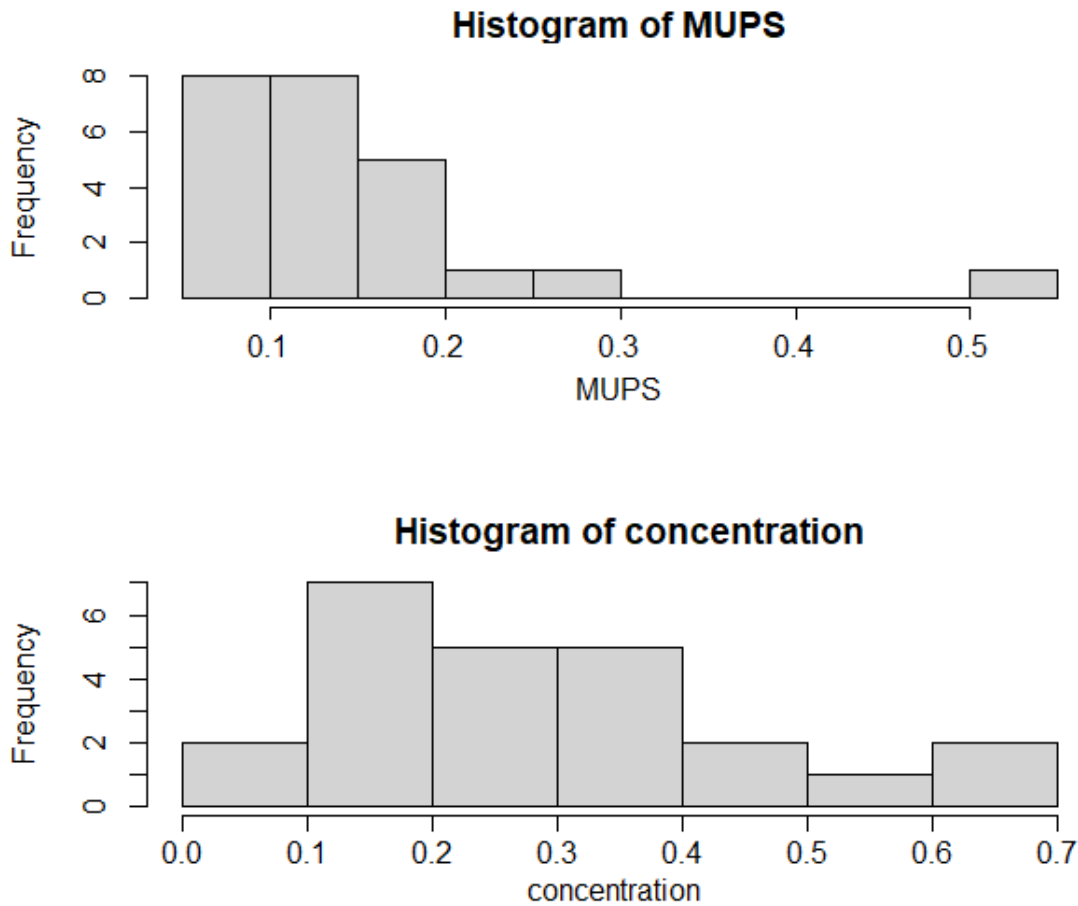


Table A2.3 presents correlations between mark-ups and market concentration with the number of competition policy interventions by instrument. As the results could be sensitive to outliers, Spearman rank correlations are presented, which is more robust to outliers.

**Table A2.3: Spearman rank correlations of mark-ups and market concentration with the number of competition policy interventions**

|   | Mark-up | Concentration (C4) |
|---|---------|--------------------|
| <b>Number of merger interventions</b>             | 0.17    | 0.53               |
| <b>Number of cartel prohibitions</b>              | -0.15   | 0.39               |
| <b>Number of antitrust interventions</b>          | 0.65    | 0.21               |
| <b>Number of competition policy interventions</b> | 0.32    | 0.59               |

It shall also be noted that mark-ups and market concentration are moderately correlated with each other (0.1057 – Pearson (ordinary) correlation, 0.1613 – Spearman rank correlation). In fact, a greater market concentration does not always imply higher mark-ups. In a sector with a large market concentration, firms may keep mark-ups low in order to deter new firms from entering to this sector, because new firms can erode the dominant position of the market leaders. At the same time, sometimes markets are geographically segmented, and firms operating in one country but different regions may not be direct competitors. Therefore, low

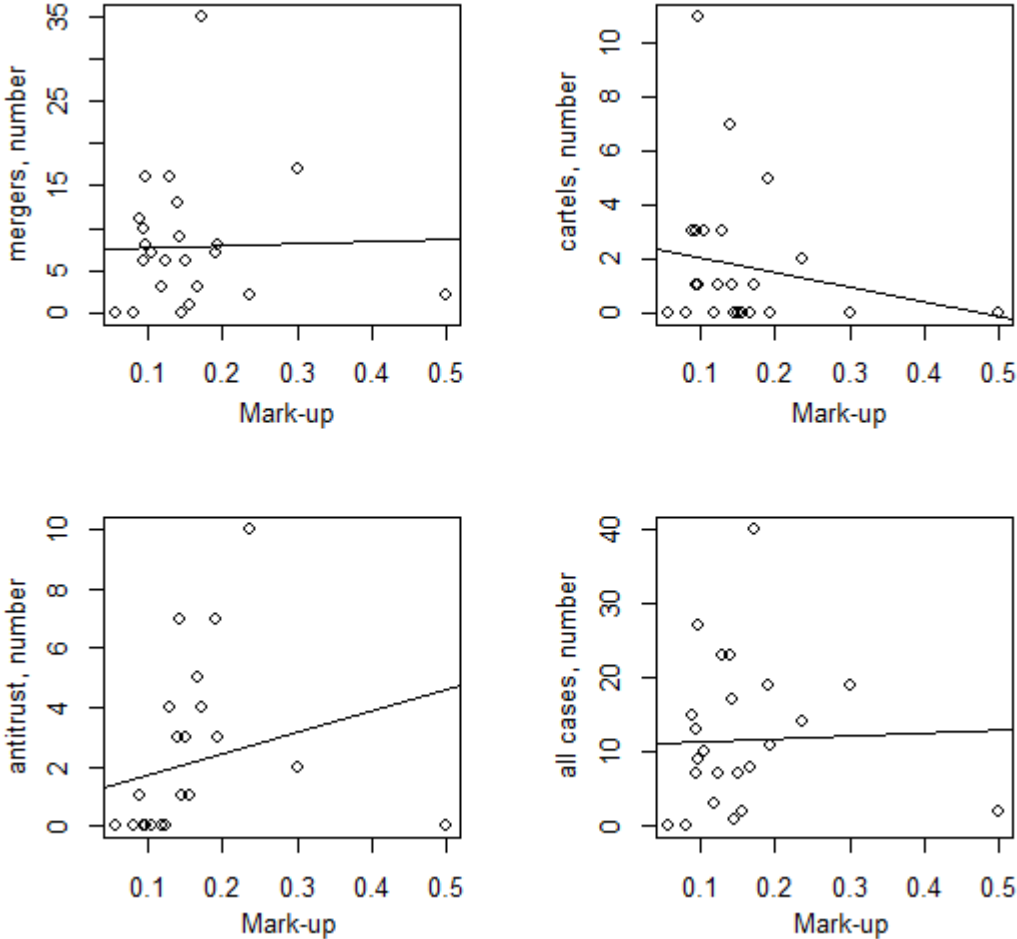


market concentration on the aggregate level, does not necessarily imply high competition and low mark-ups on the local level.

Correlation between the number of interventions and mark-up is the highest in the area of antitrust while the correlation between these variables and market concentration is the highest in mergers. It seems that the drivers of market interventions are different for these instruments. However, we cannot determine these drivers from our descriptive analysis.

Figure A2.2 depicts the sector-specific mark-ups in 2015 vis-à-vis the number of competition policy interventions by the European Commission over the period 2012-2020. The data are sector-specific (NACE rev2, two-digit, 24 sectors) and aggregated at the EU27 level. Ordinary least squares (OLS) regression lines visualise the correlations.

**Figure A2.2: Number of cases and mark-ups, scatterplots**



In cartels, we observe a negative correlation between the mark-ups and the number of cases. It is likely that low mark-ups stimulate cartel creation, which increases the number of cartel prohibitions.

At the same time, in the case of mergers and antitrust interventions the relationship is positive: sectors with greater mark-ups attract more policy interventions. The correlation between the total number of all cases (cartels, mergers and antitrust taken together) and mark-ups is positive.

In all cases there is an obvious outlier: mining and quarrying, a sector with unusually high mark-ups (50%) and very few interventions. In case of mergers also another outlier is visible: Chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations. In this sector mark-ups are relatively low, but there is a large number of interventions (35).

Figure A2.3 presents scatter plots of sector-specific mark-ups against the relative size of markets affected by EC interventions in 2012-2020. Correlations between mergers and sector shares affected by policy interventions are positive. The positive correlation is also observed, when antitrust and total cases are analysed. However, in case of cartels, we observe negative correlation again. Nevertheless, the correlation between all the cases and the mark-ups is positive.

**Figure A2.3: Relative size of markets affected and mark-ups, scatterplots**

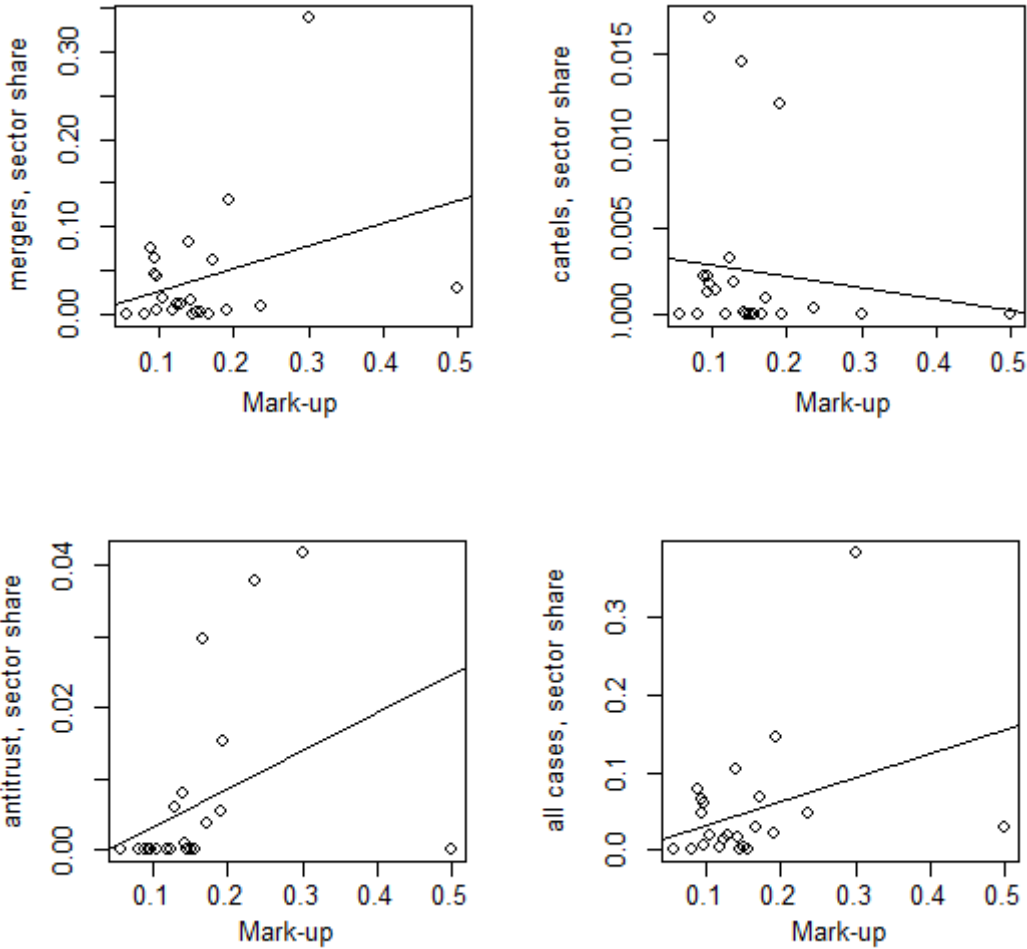


Figure A2.4 presents correlations between market concentration and the cases, and Figure A2.5 depicts a relationship between concentration and relative size of the markets affected by Commission interventions. In this case, all the observed correlations are positive: more cases are observed in the sectors with greater market concentration.

Therefore, we can conclude that more interventions are observed in sectors with high market concentration. Furthermore, apart from cartels, the cases are more often detected in the sectors with greater mark-ups.

Figure A.2.4: Number of cases and concentration (C4), scatterplots

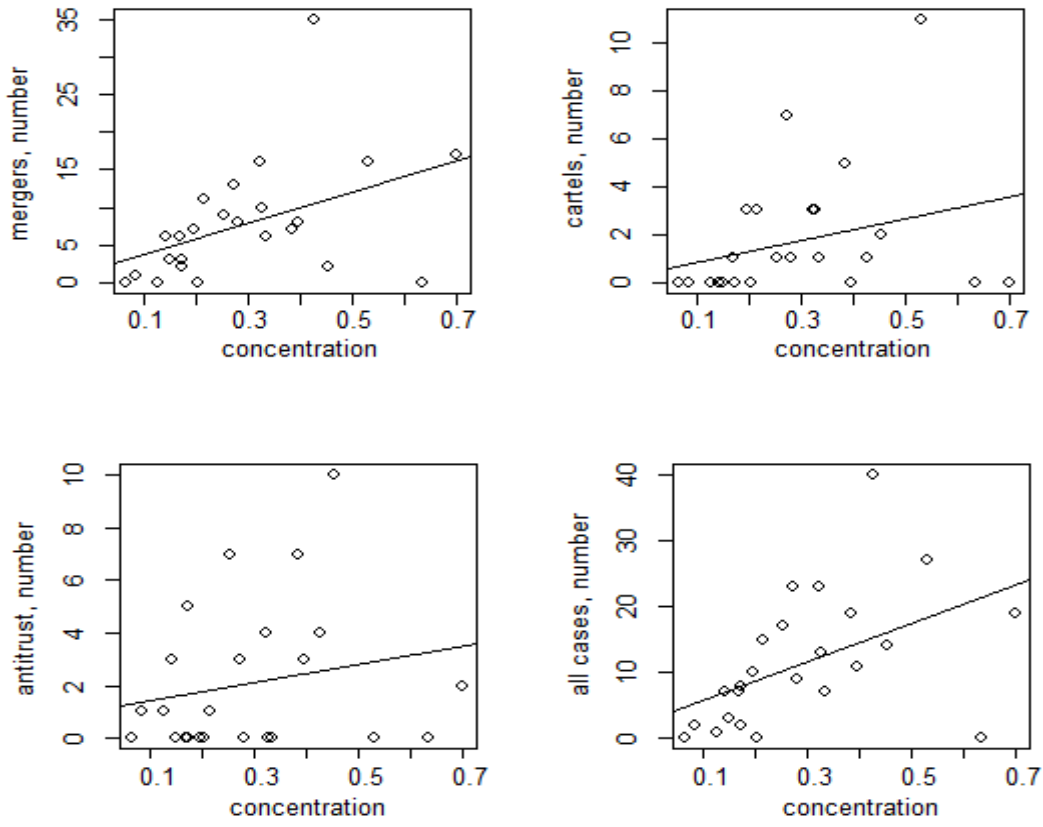
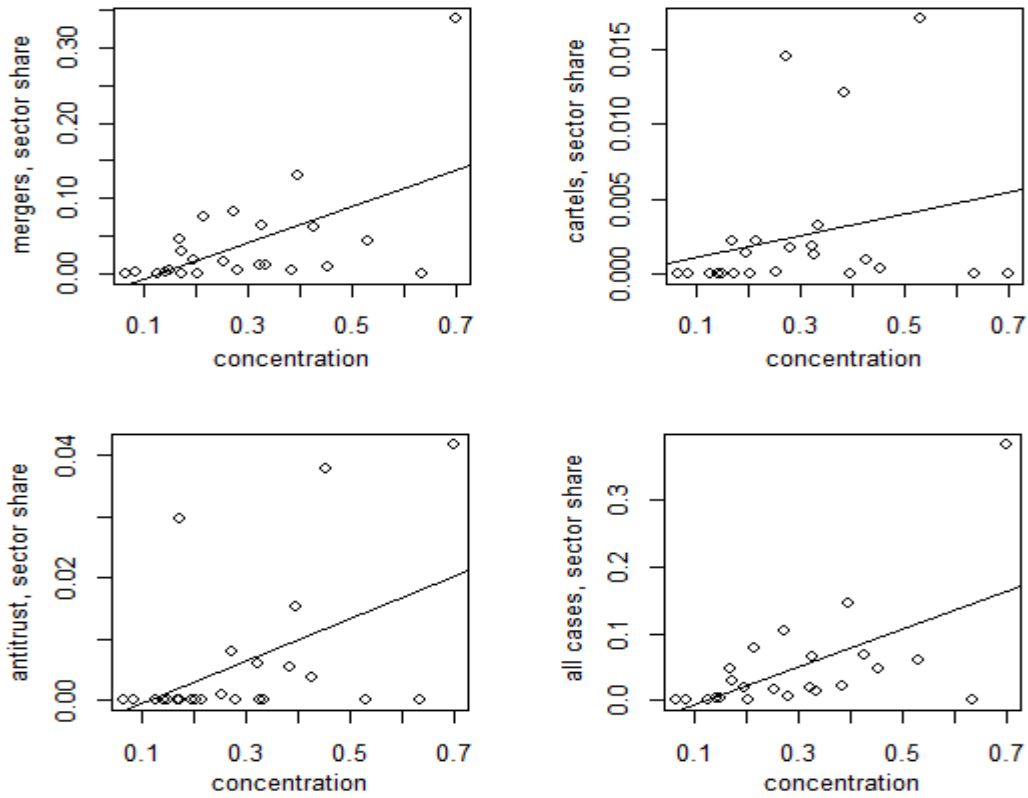


Figure A2.5: Relative size of markets affected and concentration (C4), scatterplots



### A3. THE ‘BASS’ APPROACH TO MODELLING DETERRENCE: MACROECONOMIC IMPACT AND EXPLORATION OF ALTERNATIVE SCENARIOS<sup>50</sup>

#### A3.1 Definition of the different scenarios

As introduced in Section 7.2, the Bass model represents an alternative way to describe the deterrent effects of competition policy interventions. In comparison with the logistic approach, the Bass model offers two advantages. First, it incorporates the impact of the reputation of the competition authority ( $\omega_0$ ) on deterrence. And second, it makes a distinction between the sensitivity of deterrence to the “external” signal sent by the competition authority (external influence or  $\alpha$ ) and the “internal” interactions between market participants (internal influence or  $\beta$ ).

This annex reports on the macroeconomic impact of competition policy interventions as estimated under the Bass reference scenario and analyses the sensitivity of these results to different assumptions concerning the reputation of the competition authority ( $\omega_0$ ) and to the relative importance of the internal influence over external influence, as measured by the ratio  $\beta/\alpha$ . These parameters can be set at different values while varying  $\alpha$  to ensure that the case-weighted averages of the deterrence multipliers (defined as the ratio of market players deterred over market players detected) are broadly in line with results from company surveys. More specifically, we adopt the assumption that under the reference scenario, the parameter  $\omega_0$  equals 0.05 implying an initial level of deterrence of 5% while the ratio  $\beta/\alpha$  equals 5 giving rise to an S-shaped relationship between detection and deterrence, which is similar to the S-shaped curve resulting from the logistic approach to deterrence.

Table A3.1 presents the assumptions in the underlying the alternative scenarios investigated. Under the reputation scenarios, we fix  $\beta/\alpha$  at its reference scenario value of 5 while varying  $\omega_0$  between the no-reputation value of 0 and the high reputation value of 0.10. Under the interactions scenarios, we fix  $\omega_0$  at its reference scenario value of 0.05 while varying the value of  $\beta/\alpha$  between the low-interaction value of 0.2 and the high-interaction value of 10.

**Table A3.1: Definition of the Bass reference scenario and other scenarios**

|  | Reference | No/Low | High |
|--|-----------|--------|------|
| $\omega_0$ = reputation of the competition authority | 0.05      | 0      | 0.10 |
| $\beta/\alpha$ = importance of interactions          | 5         | 0.2    | 10   |

#### A3.2. Macroeconomic impact of competition policy interventions under the reference scenario

Table A3.2 reports the macroeconomic impact of competition policy interventions over the period 2012-2020 using the reference scenario for the Bass approach.

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<sup>50</sup> Prepared by Adriaan Dierx (DG COMP), Fabienne Ilzkovitz (ULB), Beatrice Pataracchia (JRC) and Filippo Pericoli (JRC).

**Table A3.2: Macroeconomic impact of permanent mark-up shock (in %) – Bass model**

|                     | 1           | 5           | 10           | 50          |
|---------------------|-------------|-------------|--------------|-------------|
| <b>GDP</b>          | <b>0.28</b> | <b>0.49</b> | <b>0.647</b> | <b>0.93</b> |
| <i>GDP deflator</i> | -0.21       | -0.28       | -0.38        | -0.61       |
| <i>Employment</i>   | 0.22        | 0.35        | 0.41         | 0.41        |
| <i>Consumption</i>  | 0.29        | 0.42        | 0.57         | 0.82        |
| <i>Investment</i>   | 0.45        | 0.94        | 1.14         | 1.48        |
| <i>Profits</i>      | -7.34       | -9.89       | -9.35        | -8.19       |

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

We observe that the macroeconomic impact of competition policy interventions is larger in the Bass model (0.5% increase in GDP after 5 years) than in the logistic model (0.4%). This difference is mainly due to the fact that the calibration of the parameters of the two models is different. In the Bass model reference scenario, the parameters are calibrated in such a way that the case-weighted average of the deterrence multipliers equals 10 for merger interventions, 20 for cartel prohibitions, 25 for antitrust interventions under Article 101 TFEU and 10 for antitrust interventions under Article 102 TFEU. In the logistic model baseline scenario, an unweighted arithmetic average was used instead. The reasons for the move from the unweighted average to the weighted average are explained in the next sub-section.

### A3.3. Deterrence under different reputation scenarios

In Figure A3.1, we modify the reference scenario by varying the reputation effect of the competition authority ( $\omega_0$ ) from 0.00 (No reputation) to 0.05 (reference) and 0.1 (Reputation High) while keeping the ratio of internal over external influence  $\beta/\alpha$  constant at 5. A reduction in the reputation of the competition authority (from high to no reputation) shifts the deterrence curve downwards and leads to a decrease in the weighted average deterrence multipliers (corresponding to the ratio of the deterred markets over the detected markets) by 26%. However, the positive impact of the reputation of the competition authority on deterrence is larger for interventions affecting markets that are small relative to the size of the sector concerned. In other words, the small interventions of a competition authority having a good reputation would have much larger deterrent effects than the same interventions taken by a competition authority having a less good reputation, while the difference is less pronounced for interventions affecting large markets.

**Figure A.3.1: Detection and deterrence under the different reputation scenarios**

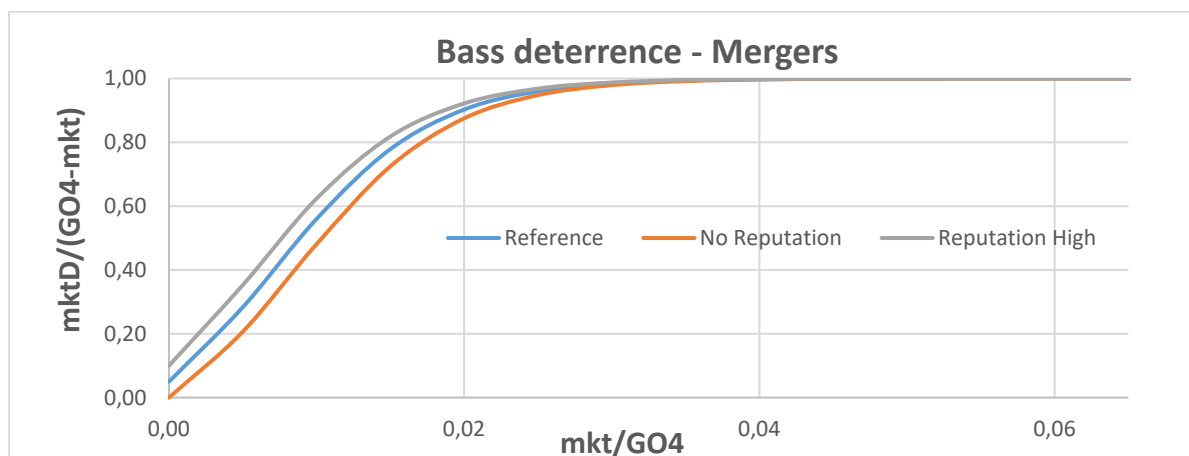
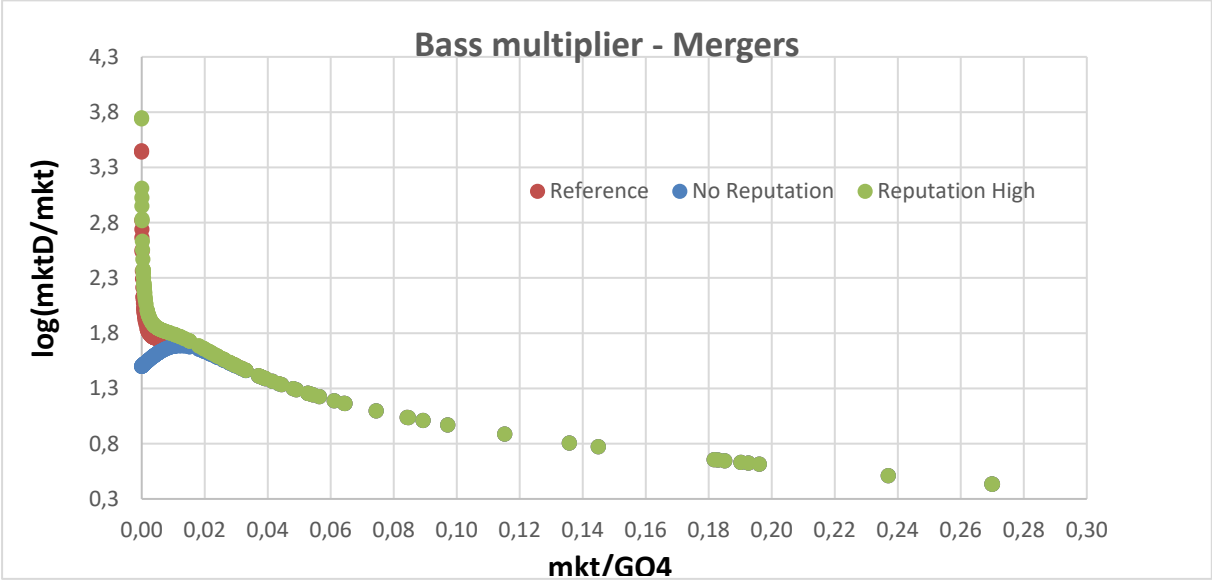


Figure A3.2 illustrates even better that the effects of a competition authority’s reputation are particularly important for ‘small’ interventions. It represents the values of the deterrence multipliers for the individual merger interventions made by the European Commission over the period 2012-2020 under the three reputation scenarios. The y-axis is put in log-scale as for very small interventions the deterrence ratio can reach very high values under the different scenarios.

The observation that with positive reputation ( $\omega_0$  different from zero), the deterrence multipliers of very small interventions can reach extremely high values has motivated the use of the case-weighted average multipliers (replacing the unweighted arithmetic average multipliers) as a target for the calibration of the Bass function to the surveys’ values. Moreover, the weighted average of the deterrence multipliers is mathematically equivalent to the ratio between the overall value of the deterred market over the overall value of the directly affected market.

The weighted average of the deterrence multipliers equals 10, which corresponds to 1 on the log-scale. Figure A3.2 clearly illustrates that the great majority of relatively ‘small’ merger interventions have deterrence multipliers above this average of 10 and that for these interventions, reputation has a strong positive effect on deterrence. By contrast, the more limited number of larger interventions have below-average deterrence multipliers and the deterrence multipliers of such larger interventions are hardly affected by the reputation of the competition authority. As the size of the intervention increases, there is a rapid convergence of the deterrence multipliers in the three scenarios. In the scenario that abstracts from reputation effects, the deterrence multiplier initially increases with size reflecting the idea that for an intervention to become fully effective it needs to affect a minimum share of the sector concerned.

**Figure A3.2: Deterrence multipliers under the different reputation scenarios**



**A3.4. Deterrence under alternative assumption on market participants’ interactions**

Figure A3.3 considers the effects of changes in the relative importance of internal versus external influence on the diffusion of the deterrent effects ( $\beta/\alpha$ ). This figure shows that a reduction in the level of interactions between market participants (from high to low interactions) shifts the deterrence curve downwards and leads to a decrease in the weighted average deterrence by 55%. Moreover, the maximum level of deterrence is reached more rapidly when interactions between market participants increase. This is a clear illustration of the importance

of interactions between legal counsels and law firms for effective enforcement and increased deterrence.

**Figure A3.3: Detection and deterrence under different interactions scenarios**

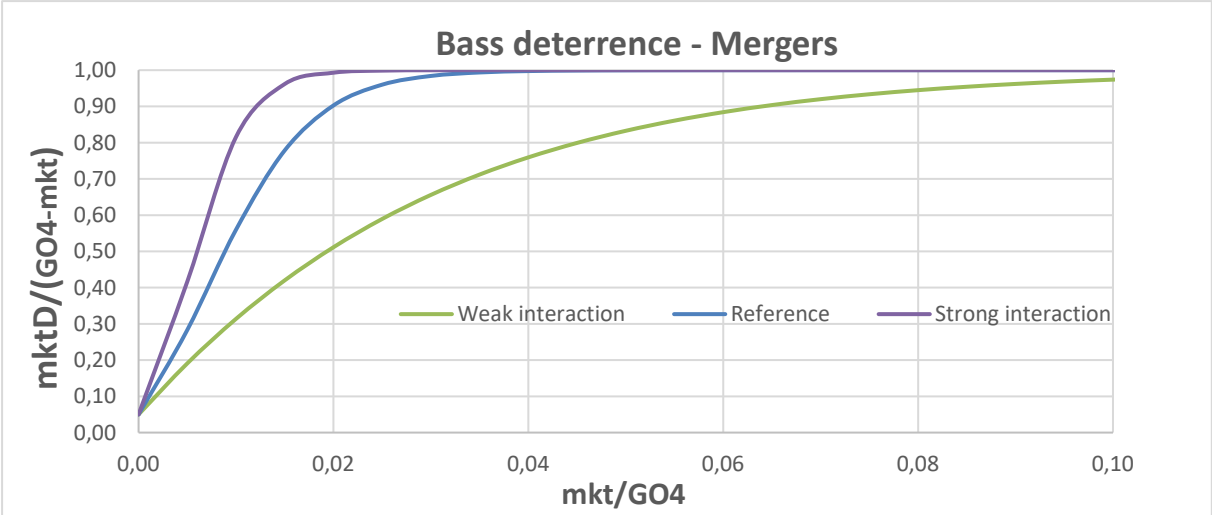
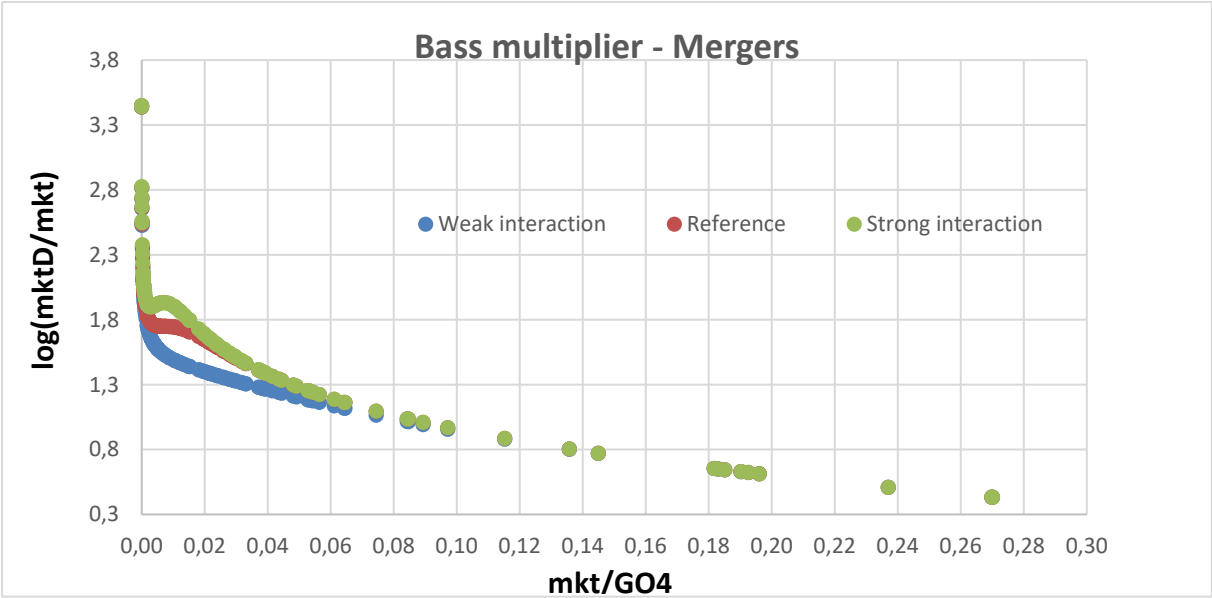


Figure A3.4 shows that the Bass deterrent multipliers are lower in the low interactions scenario than in the two other scenarios, at least for smaller interventions. As the interventions become larger, there is a convergence in the deterrent multipliers under the different interaction scenarios.

**Figure A3.4: Deterrence multipliers under the different diffusion scenarios**



## **A4. LINKING LABOUR AUGMENTING PRODUCTIVITY TO CHANGES IN MARK-UPS<sup>51</sup>**

### **A4.1. Introduction**

In the simulations on the macroeconomic impact of the European Commission's competition policies implemented over the years 2012-2020, there is no direct relation between the variation in mark-ups and productivity, because in the QUEST III model technology is assumed exogenous and firm dynamics is not modelled.

In this Annex, we discuss if it is appropriate to apply a productivity shock to the QUEST III model based on the existing empirical literature. Such shock would reflect the productivity effects of competition policy enforcement by means of three different channels: namely, a reallocation of scarce resources (allocative efficiency), an improvement in the utilisation of the production factors by firms (productive efficiency) and an incentive for firms to innovate (dynamic efficiency).

However, empirical studies show that the empirical evaluation of the link between competition and productivity may be complex and debated by the profession. Its sign may depend on several factors, such as the starting point on the hump-shape relationship at the sectoral level, on the importance of sunk costs, the size of the firms and the technology used by the firms.

Section A4.2 discusses the economic foundation behind the link between competition policy interventions and labour augmenting productivity while section A4.3 overviews the empirical literature assessing such link. Based on the empirical findings, section A4.4 discusses the calibration of the productivity shock, while section A4.5 reports the results of macroeconomic simulation incorporating the labour productivity shock in the baseline scenario. Finally, section A4.6 concludes.

### **A4.2. How can antitrust interventions spur productivity?**

Productivity is defined as the amount of output obtained using one unit of input factors. Theoretical models show that when firms have market power, they produce less at higher prices. Therefore, the reduced output resulting from market power generates a positive expected relationship between competition and productivity.

The existence of a positive correlation between competition and productivity is of vital importance, because it motivates competition policy, as pointed out by Backus (2020). Competition authority enforcement has a direct and an indirect impact on the competition conditions, as explained in Ilzkovitz and Dierx (2020). On the one hand, the direct effects are due to the removal of causes for concern and its anti-competitive effects. For example, in the case of merger control, such interventions prevent situations, which may affect negatively competition and increased prices. On the other hand, the indirect effects are due to the prevention of anti-competitive behaviour.

Both direct and indirect effects of competition policy enforcement are transmitted to the economy and can foster indirectly productivity growth by improving the efficiency of the market,<sup>52</sup> through three different channels: i) reallocation of resource, which affects the

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<sup>51</sup> Prepared by Roberta Cardani (JRC) and Marco Ratto (JRC).

<sup>52</sup> For a survey of the literature, refer to Ahn (2001), Syverson (2011), Nicodème et al. (2007), Competition, and Markets Authority (2015).



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.

Specifically, competition policy interventions increase the number of competitors or the threat of entry of new competitors, leading to more competitive markets. The competition allows for more productive firms to increase their market shares at the expense of the less productive ones through an *allocative efficiency* channel. The low productive firms may then exit the market to be replaced by higher productivity firms (“*between-firm*” effect). Consequently, the market power of the incumbent tends to reduce as they are forced to set prices closer to their marginal costs.

Additionally, the increase in competition can be associated with the *productive efficiency* (“*within-firms*” effect). Competition puts pressure on the managers to become more efficient, i.e. incentive them to better allocate inputs (labour and capital) in order to reduce under-utilisation. Examples of such practices are organisational changes that aim at efficiently structuring the workplace.<sup>53</sup>

The last mechanism through which competition might drive higher productivity is by encouraging innovation, the so-called *dynamic efficiency*: innovation enhances productivity through technological improvements of production processes or the creation of new products. However, the sign of the relationship between competition and innovation is debated. On the one hand, competition may reduce future profits generated by innovation (“Schumpeterian effect”) and the expected durability of innovation.<sup>54</sup> In this sense, competition may be detrimental to innovation. On the other hand, greater competition may increase incentives for incumbents to innovate in order to gain market shares and catch post-innovation rents (“escape competition effect”). Consequently, competition may foster innovation.

To reconcile these views, a non-linear relationship between innovation and competition has been considered: the link may be positive or negative depending on the initial state of competition and on the industry or firm’s distance to the technological frontier.<sup>55</sup>

All those channels result in higher productivity growth due to a more competitive market structure, all policies that lead to markets operating more competitively, such as competition authority’s interventions, will result in faster economic growth.

#### **A4.3. Empirical evidence of a relationship between competition and productivity**

Even if there exist strong theoretical arguments linking positively competition with productivity, its empirical assessment is still complex and debated. There is an extensive economic

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<sup>53</sup> See Ahn (2001), Bloom and Van Reenen (2007; 2010) for a survey on this topic.

<sup>54</sup> Papers showing that companies sheltered from competition are less likely to innovate and are, therefore, less productive are due to Porter (1990, 2001), Syverson (2004, 2011), Holmes, Levine, Schmitz (2012), Holmes and Schmitz (2010) and Bloom and van Reenen (2007, 2010).

<sup>55</sup> Empirical evidence on the dynamic channel is mixed. The inverted-U relationship has been documented by empirical work of Aghion (2005) based on industry-level US data, with innovation measured by the number of citation-weighted patents and competition by a Lerner index. Other empirical works include Polder and Veldhuizen (2012) based on Dutch National Accounts and micro-data and Bouis and Klein (2009) who find an inverted-U relationship between mark-ups and productivity using sectoral data for the EU from EUKLEMS. Polder and Veldhuizen (2012) raise several caveats for the estimation of the inverted-U relationship.

literature that analyses the relationship between competition and productivity across many product markets using different sources of data.<sup>56</sup>

A first strand of the literature finds such a relationship to be positive. For example, Nickell (1996) uses a panel dataset of 800 UK firms to analyse the impact of competition on productivity. He concludes that a 10% increase in price mark-ups implies a 1.1 to 1.67% loss in aggregate total factor productivity (TFP) growth, depending on which competition measure is taken into account (e.g. market share at the firm level or measures of concentration).

Weyerstrass and Jaenicke (2008) analyse the influence of mark-up on productivity over the period 1976-2004 at the aggregate level for the euro area. They estimate that a reduction of the mark-up by around 10% would raise average TFP growth in the euro area by 0.57 p.p. The effect ranges from 0.5 p.p. in Finland and the Netherlands to 0.75 p.p. in Italy. On the contrary, a reduction of the mark-up by 10% would raise the growth rate of trend labour productivity by 0.15 p.p. (within bounds of 0.13 p.p. in the Netherlands to 0.2 p.p. in Italy).

Using the World Bank Enterprise Survey database, Ospina and Schiffbauer (2010) identify the effects of competition on firm-level productivity in eastern European and central Asian countries. They find that having a 20% higher mark-up leads to a 1.2% lower TFP level and an 8% lower labour productivity level. Moreover, countries that deregulated during the period have experienced a more pronounced increase in competition. The contribution to productivity growth due to competition spurred by these reforms is around 12-15%.

More recently, Siedschlag et al. (2019) assess the effect of the Single Market in the EU and evaluate the responsiveness of competition and productivity to trade integration, using CompNet and WIOD data. They conclude that an increase in the Top-10 firms (Herfindahl-Hirschman, HHI) concentration index by one unit is associated with a decline in labour productivity by 21.7% (174.9%). Given that the average value of the Top-10 firm (HHI) index is 0.45 (0.053), this implies that an increase in 1% of the Top-10 firms (HHI) concentration index would decrease the labour productivity by 9.76% (9.27%). Moreover, they observe that market concentration indexes and productivity are negatively correlated in the majority of the sectors, except textile sector.

Finally, Ganglmair et al. (2020) study the role of firm's competition on their productivity in Germany. To this end, they estimate firm-level price-cost margins in the form of price mark-ups as a proxy for a firm's pricing power and the degree of competition that it is exposed to. They conclude that, when the lagged mark-up is considered, a 1% increase in price mark-ups lowers the productivity level by 1.3% (labour productivity) to 1.5% (TFP). These effects are stronger for the trade sector (with a 4 % decrease) than in manufacturing (with a 2% decrease). On the contrary, an increase in price mark-ups has a small but positive effect on firm-level productivity for firms in service-related sectors.<sup>57</sup> They also note that the larger firms or higher capital intensity firms have on average higher productivity.

Other contributions to the literature, however, have found a negative relationship between competition and productivity.

One reason can be identified with the "winner takes it all" competition effect. As shown by Autor et al. (2020), in the United States firms with lower marginal costs can charge higher mark-ups via reallocation over time of market share to more efficient firms. In this sense, rising concentration may be the result of the adoption of technologies that favour large and more

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<sup>56</sup> See, among others, Syverson, 2011, CMA, 2015 and Holmes and Schmitz, 2010 for reviews of evidence. In this section, we do not pinpoint the mechanisms through which competition affects productivity, because we are interested in the overall impact of market competition on productivity.

<sup>57</sup> The authors consider also the indirect effect of price mark-ups on productivity via innovation. However, here we are only interested in the overall effect, so we do not take into account that part of the analysis.

efficient firms, as suggested by the “superstar firm” hypothesis. Baquee and Fahri (2020) estimate that this phenomenon accounts for about half of aggregate US TFP growth between 1997 and 2015.

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

Similar conclusions are reached by Bighelli et al. (2020), who also find a strong association between concentration and aggregate productivity in Europe. According to their study, almost 50% of productivity growth over the period 2009-2016 results from the productivity-enhancing reallocation process between firms. Moreover, rising European firm concentration is driven by a reallocation of market shares towards more concentrated sectors and countries over the same period. Germany seems to account for most of the European concentration level.

Another reason may be related to the within-firm dimension. The pricing power of firms may stem from concentration or technology. For example, De Loecker and Eeckhout (2017) argue that higher mark-ups do not necessarily imply strong market power: in the case of high tech firms, for example, higher mark-ups are needed to cover fixed costs of investments.

The link between mark-ups and aggregate productivity is complex and it is difficult to find a recent estimate of the elasticity between competition and productivity for the European Union.

One reason appears to be the lack of adequate data, as the strength of competition and productivity are not observed directly. Thus, their estimations may give rise to some measurement and quality data issues (see Syverson, 2011).

The strength of competition may be proxied by different measures (such as mark-up estimation, concentration indexes or market shares), each of which suffers from some limitations, as well explained by Syverson (2019). For example, the definition of concentration indexes relates to revenues, it does not cover fix-costs and it does not take into account profits nor price-cost margins, which are instead well-suitable indicators of the strength of market power. Moreover, market structure and market concentration do not precisely reflect the nature of competition intensity, as pointed out by Correa and Ornaghi (2014), particularly when this comes from price influences. Therefore, mark-ups may be preferable.

The productivity quantify the ability of economy, industry or firm to transform inputs into output. Generally, at the aggregate and sectoral level productivity may be measured in terms of labour productivity (output per unit of labour) or of TFP (output per unit of combined inputs). On the contrary, at the firm level it is calculated by measuring the number of units produced relative to employee labour hours or by measuring a company's net sales relative to employee labour hours.

Especially at the establishment-level, several methodological issues emerge. For example, input choices and output seem to be correlated. In addition, recovering productivity from revenue data (known as TFPR) may be unsatisfactory, because the TFPR reflects variation in output prices along with the true productivity (Haltiwanger and Syverson, 2008). Prices at the firm-level are generally unavailable. To overcome this issue, De Loecker et al. (2016) use the price and quantity of output for the sample of single product firms to estimate the production function. However, their procedure is unable to recover product-specific productivity for multi-product firms. The main challenge is that input allocations across products are unknown for multi-product firms.

#### **A4.4. Quantification of the elasticity of labour-augmenting productivity to mark-up**

As showed above, the relationship between mark-ups and productivity depends on various factors and could be well described by a hump-shape in which it is very difficult to determine

the turning point. Our estimates of the top-up shock are based on the assumption that we are on the right-hand side of the hump shape.

Motivated by geographical coverage and temporal span reasons, we calibrate the elasticity of labour-augmenting productivity to mark-ups according to Weyerstrass and Jaenicke (2008). Even if they consider a small subset of EU countries, we believe that those are a representative sample of EU. In addition, we assume that there is a stable structural relationship over time, so that we can apply such elasticity to the whole sample. While their estimation of TFP productivity elasticity relies on additional assumptions on production, capital and labour markets that are unknown, while labour productivity is easier to map with the QUEST model assumptions. Therefore, in the following, we can prudentially assume that due to a 1% decrease in mark-up, labour productivity growth increases by 0.015 p.p.

However, we cannot apply directly this elasticity value,  $\eta$ , to the QUEST model, but we need to translate it into a labour-augmenting productivity shock, taking into account the specification of the production function used in our macro-model.

In QUEST model, the production function takes the form of Cobb-Douglas production function with constant return of scale, specified as follows:

|  |  |                |
|--|--|----------------|
|  | $Y = (AY \cdot L)^\alpha K^{1-\alpha}$ | <b>(A.4.1)</b> |
|--|--|----------------|

The production function links the total output obtained by firms to the factor inputs used in the production (in our case, capital, K, and labour, L).  $\alpha$  is the output elasticity of labour input, while AY is the labour augmenting productivity shock.

By definition, labour productivity is defined as output in terms of labour input, Y/L. This measure can be easily obtained dividing equation (A.4.1) by L:

|  |   |                |
|--|---|----------------|
|  | $\frac{Y}{L} = (AY)^\alpha \left(\frac{K}{L}\right)^{1-\alpha}$ | <b>(A.4.2)</b> |
|--|---|----------------|

Keeping an ex-ante capital intensity (K/L) constant, the empirical elasticity,  $\eta$ , can be translate into a shock to AY using the following formula:

|  |                                  |                |
|--|----------------------------------|----------------|
|  | $\frac{\eta}{\alpha} \Delta MUP$ | <b>(A.4.3)</b> |
|--|----------------------------------|----------------|

where the  $\Delta MUP$  represents the percentage variation in the mark-up level of 0.68%. The QUEST parameter  $\alpha$  is calibrated to be 0.65, as in Havik et al. (2014). This implies that the size of the labour productivity shock induced by the decrease in mark-up is about 0.016 p.p.

The shock has been modelled as a persistent shock to the labour-augmenting productivity growth with a persistency equal to 0.83. Such a value has been calculated as considering the average duration of the decisions: the effect of the labour augmenting productivity shock dies out after 3.1 years.

#### **A4.5 The macroeconomic simulations**

Table A4.1 reports the baseline scenario macroeconomic impact of a decrease in mark-up by 0.7 p.p. combined with a temporary shock to the labour productivity growth (resulting in a

permanent level increase of productivity by 0.016 p.p.). Considering also its persistency,<sup>58</sup> its long-run effect is equal to  $0.016/(1-0.83)=0.09$  p.p.

The transmission mechanism of labour-augmenting productivity growth is different from the one of a mark-up shock. Specifically, a positive shock to the production level affects negatively the marginal costs of production. Consequently, firms lower their prices, the GDP deflator is reduced, while real wages rise. The increase in real wages stimulates consumption, which leads firms to produce more. Expected higher returns increase private investment. In the short run, the productivity shock has a negative impact on employment due to the nominal and real rigidities. In the medium-long run, the effect is positive, in light of the increase in the supply capacity and higher aggregate demand.

Moreover, productivity shock has a greater impact on the macroeconomic variables than the mark-up shock. When the economy is hit by a negative mark-up shock, firms do not fully adjust their prices down to the new lower level of marginal costs, because of the presence of price stickiness. On the contrary, the productivity shock influences directly the production function, expanding their productive possibilities.

As expected, the inclusion of a labour productivity shock in addition to the mark-up shock produces a higher increase in GDP compared to our baseline simulation (Table 5.2): the impact of the competition policy interventions on GDP increases from 0.37 (in our baseline simulation) to 0.44 p.p. after five years.

**Table A4.1 Macroeconomic impact of MUP (-0.7 p.p.) shock and AR(1) productivity (+0.016 p.p.) shocks in the baseline scenario**

|                          | 1     | 5     | 10    | 50    |
|--------------------------|-------|-------|-------|-------|
| GDP                      | 0.25  | 0.44  | 0.58  | 0.81  |
| GDP deflator             | -0.15 | -0.22 | -0.30 | -0.50 |
| Agg. Employment          | 0.17  | 0.26  | 0.32  | 0.32  |
| Labour productivity      | 0.08  | 0.18  | 0.26  | 0.49  |
| Agg. Consumption         | 0.29  | 0.43  | 0.55  | 0.76  |
| Consumption Savers       | 0.27  | 0.34  | 0.46  | 0.67  |
| Consumption Liq. Constr. | 0.40  | 0.90  | 1.10  | 1.28  |
| Investment               | 0.36  | 0.76  | 0.93  | 1.20  |
| Wage income high skilled | 0.68  | 1.51  | 1.88  | 2.10  |
| Wage income low skilled  | 0.62  | 1.42  | 1.72  | 1.94  |
| Profits high skilled     | -5.53 | -7.47 | -7.04 | -6.08 |

*Note: Numbers are expressed as percentage deviation from the equilibrium un-shocked values. Columns report the impact after 1, 5, 10, and 50 years.*

The increased competition and increased productivity reduces inflation and lead to an increase in all main components of aggregate demand: after 5 years consumption and investment increase respectively by 0.43 p.p. and 0.76 p.p. (comparing to 0.32 p.p. and 0.71 p.p. in the baseline scenario).

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<sup>58</sup> Note that we calibrate the persistency such that  $0.1^{1/12.4} = 0.83$ , i.e. after 3.1 years the shock exerts almost 10% of the initial shock. The 12.4 periods represents the average duration of the cases (see Section 2).

#### **A4.6. Conclusions**

In this annex, we discuss if it is appropriate to apply a productivity shock to the QUEST III model based on the existing empirical literature. Theoretically, such shock would reflect the productivity effects of competition policy enforcement by means of three different channels: namely, a reallocation of scarce resources (allocative efficiency), an improvement in the utilisation of the production factors by firms (productive efficiency) and an incentive for firms to innovate (dynamic efficiency).

However, the empirical evaluation of such a link is complex and debated in the profession. Its sign may depend on several factors, such as the starting point on the hump-shaped relationship at the sectoral level, the importance of sunk costs, the size of the firms and the technology used by the firms. The most likely relationship seems to be well described by a hump-shaped curve, which turning point may be difficult to estimate (see Aghion et al. 2005).

Assuming to be on the right-hand side of the hump-shape, Weyerstrass and Jaenicke (2008) find that a 10% decrease in the mark-up would increase the labour productivity growth by 0.015 p.p. which can be translated in a long run shock by 0.11 p.p. to the labour augmenting productivity growth in QUEST. As a consequence, after five years the overall impact on GDP of competition policy interventions is equal to 0.44 p.p.

## References

- Aghion P., Bloom N., Blundell R., Griffith, R. and Howitt P. (2005), "Competition and innovation: An inverted-U relationship", *The Quarterly Journal of Economics*, 120(2): 701-728.
- Ahn S. (2001), "Firm dynamics and productivity growth: A review of theory and evidence", *OECD Economics Department Working Papers*, No. 317.
- Autor D., Dorn D., Katz L.F., Patterson C. and Van Reenen J. (2020), "The fall of the labor share and the rise of superstar firms", *Quarterly Journal of Economics*, 135(2): 645-709.
- Backus M. (2020), "Why is productivity correlated with competition?", *Econometrica*, 88(6): 724-743.
- Baqaee D. and Fahri E. (2020), "Productivity and misallocation in general equilibrium", *Quarterly Journal of Economics*, 135(1): 105-163,
- Bighelli T., Di Mauro F., Melitz M. and Mertens M. (2021), "European firm concentration and aggregate productivity", *IWH-CompNet Discussion Papers*, No. 3/2021.
- Bloom N. and van Reenen J. (2007), "Measuring and explaining management practices across firms and countries", *Quarterly Journal of Economics*, 118(4): 1169–1208.
- Bloom N. and van Reenen J. (2010), "Why do management practices differ across firms and countries?", *Journal of Economic Perspectives*, 24(1): 203-24.
- Bouis R. and Klein C. (2009), "Concurrence et gains de productivité : analyse sectorielle dans les pays de l'OCDE", *Économie & prévision*, 3(189): 125-131.
- Competition and Markets Authority (2015), "Productivity and competition: A summary of the evidence", Report CMA454.
- Correa J.A. and Ornaghi C. (2014), "Competition & innovation: Evidence from U.S. patent and productivity data", *The Journal of Industrial Economics*, 62(2): 258-285.
- Cruzet N. and Eberly J. (2019), "Understanding weak capital investment: The role of market concentration and intangibles", *NBER Working Paper*, No. 25869.
- De Loecker J. and Eeckhout J. (2017), "The rise of market power and macro-economic implications", *NBER Working Paper*, No. 23687.
- De Loecker J., Eeckhout J. and Mongey S. (2021), "Quantifying market power and business dynamism in the macroeconomy", *University of Chicago, Becker Friedman Institute for Economics Working Paper*, No. 2021-54.
- Ganglmair B., Hahn N., Hellwig M., Kann A., Peters B. and Tsanko I. (2020), "Price markups, innovation, and productivity: Evidence from Germany", *Produktivität für Inklusives Wachstum*, No. 08, Bertelsmann Stiftung, Gütersloh.
- Havik K., Mc Morrow K., Orlandi F., Planas C., Raciborski F., Roeger W., Rossi A., Thum-Thysen A. and Vandermeulen V. (2014), "The production function methodology for calculating potential growth rates and output gaps", *European Economy Economic Papers*, No. 535.

Holmes J.T., Levine D. and Schmitz J.A. (2012), "Monopoly and the incentive to innovate when adoption involves switchover disruptions", *American Economic Journal: Microeconomics*, *American Economic Association*, 4(3): 1-33.

Holmes J.T. and Schmitz J.A. (2010), "Competition and productivity: A review of evidence", *Annual Review of Economics*, 2(1): 619-642.

Ilzkovitz, F. and Dierx, A. (2020), *Ex post economic evaluation of competition policy: The EU experience*, Wolters Kluwer.

Nickell, S. (1996), "Competition and corporate performance", *Journal of Political Economy*, 104(4): 724-746.

Nicodème G. and Sauner-Leroy J. B. (2007), "Product market reforms and productivity: A review of the theoretical and empirical literature on the transmission channels", *Journal of Industry, Competition and Trade*, 7: 53–72.

Ospina S. and Schiffbauer M. (2010), "Competition and firm productivity: Evidence from firm-level data," *IMF Working Papers*, No. 10/67.

Polder M. and Veldhuizen K. (2012), "Innovation and competition in the Netherlands: Testing the inverted-U for industries and firms", *Journal of Industry, Competition and Trade*, 12(1): 67-91.

Porter M. (1990), *The competitive advantage of nations*, Macmillan.

Porter M. (2001), "Strategy and the Internet", *Harvard Business Review*, 79(3), 62-78.

Siedschlag I., Di Ubaldo M., Koecklin M.T. and Yan W. (2019), "The single market, trade, competition and productivity" in "The performance of the single Market for goods after 25 years", European Commission Report

Syverson C. (2004), "Market structure and productivity: A concrete example", *Journal of Political Economy*, 112(6): 1181-1222.

Syverson C. (2011), "What determines productivity?", *Journal of Economic Literature*, 49(2): 326-65.

Syverson C. (2019), "Macroeconomics and market power: Context, implications, and open questions", *Journal of Economic Perspectives*, 33(3): 23–43.

Thum-Thysen A. and Canton E. (2015), "Estimation of service sector mark-ups determined by structural reform indicators", *European Economy, Economic Papers*, No. 547.

Weyerstrass K. and Jaenicke J. (2008), "Spillovers from economic reform" in *Economic spillovers, structural reforms and policy coordination in the Euro area*, Van Aarle and Weyerstrass (Eds.), Springer.





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