

Digital ecosystems, Big Data and Algorithms

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EXECUTIVE SUMMARY

The digitalisation of the economy led to the emergence of new business models, based on multi-sided platforms, which have significantly shaped consumers' behaviour. In 2018, 94% of Portuguese Internet users have made at least one online purchase within a wide range of product categories (Nielsen, 2018).

Multi-sided platforms are characterised by the large volume and diversity of data they collect about their users (big data) and strong network effects (*i.e.*, the effect that a user of a product/service has on the value of the product/service for other users). Platforms can be integrated in digital ecosystems that supply a wide range of products and services, many of which do not require a monetary payment. These ecosystems aim at capturing users and their attention, so as to direct them to monetised markets of the ecosystem (*e.g.*, online advertising).

The analysis developed in the scope of the application of competition law must take these specificities into account, otherwise they may run the risk of failing to capture the essence of competition in these markets. It is particularly important to highlight that, in these markets, prone to high concentration levels, potential competition plays a key role. The incentives of incumbents to protect their ecosystem may trigger strategies aimed at promoting the persistence of market power, and limit contestability and potential competition.

An incumbent platform may “close the entry point” to the market through an aggressive strategy of acquiring small and potential rivals. These pre-emptive mergers may aim at expanding/strengthening the ecosystem by incorporating products/services or discontinuing/limiting the introduction of new products (*killer acquisitions*).

One of the challenges for competition policy in the digital era is avoiding the risk that pre-emptive mergers escape competition authorities' merger control for not meeting notification thresholds, namely when the turnover of the targeted firm is small. One of the issues that is being discussed is the need to adjust the notification criteria foreseen in legal frameworks of competition so as to capture these mergers, in particular those that harm competition. Recently, in June 19th, the Commissioner for Competition, Margrethe Vestager has stated that, in the European Commission (EC), it is important to investigate the adequacy of introducing additional notification criteria linked to the value of the merger, as was the case in Germany and Austria.

Incumbent platforms may also adopt exclusionary strategies, for example, by restricting their rivals' access to the data they need in order to carry out their activities. Access to data has been the object of legal and regulatory developments towards providing users with more control over their data, such as the General Regulation on Data Protection.

At the sectoral level, the Second Payment Service Directive (PSD2) stands as a pioneering example of regulation of access to data in the digital era. PSD2, transposed to Portugal in November 2018, imposes obligations on banks to, upon client consent, provide FinTech operators with access to client data in order to provide certain payment services. In this regard, the Autoridade da Concorrência (Portuguese Competition Authority, AdC) identified, in its October 2018 Issues Paper on Innovation and Competition in the Financial Sector (FinTech Issues Paper), a risk of foreclosure, by banks, of FinTech operators access to client data and issued several recommendations to mitigate this risk.

In fact, exclusionary strategies in the digital area may take specific forms, namely based on the exploitation of users' behavioural biases, for example, through default options (*e.g.*, applications) or the promotion of salience effects that divert consumers from certain products/services to others.

In digital markets, rather than competition being a click away, it may well be that exclusion is a click away. The first statement, that is frequently used to disregard competition concerns in

digital markets, abstracts from the market power that may arise from behavioural biases of consumers themselves. The recommendations set forth by the AdC in its FinTech Issues Paper are illustrative of how exclusion may arise in the digital era, when it raises awareness of the fact that the mere introduction of additional authentication steps (customer journey) for the client may chill incentives for using new products and services.

Big data has allowed the development of pricing, monitoring and ranking or recommendation algorithms. These may have positive effects through the reduction of transaction and search costs, and the promotion of product discovery and price comparison, but they may also facilitate reaching and sustaining both explicit and tacit collusive equilibria in the market. Pricing algorithms may also enable personalised pricing strategies that, while potentially entailing an output expansion, may also allow for an enhanced ability of firms to appropriate consumer surplus.

Algorithms used to monitor online prices of competitors are already a widely used tool by firms in Portugal. About 37% of a sample of firms active online in Portugal have reported to using software to automatically track the prices of competitors. These results are in line with those of the e-commerce sector inquiry of the EC.

Regarding pricing algorithms, the AdC has not found evidence of a widespread use of pricing algorithms (7.9%) amongst the sample of inquired firms. However, even if algorithms are not widely used at present, the analysis developed raises issues as to the impact that they may already have, in some market contexts and marketplaces, or may have in the future, as they become more widespread.

Pricing algorithms can be instrumental in collusive agreements between firms, and assist in the implementation of the terms of coordination, as cases investigated in the UK and the USA illustrate. In these cases, poster sellers on the Amazon marketplace overcame the difficulty in enforcing the collusive agreement by effectively matching the concerted prices through repricing software. Additionally, simple pricing algorithms may generate patterns of decision that can be deciphered by competitors, thereby promoting tacit collusion equilibria via the increase of market transparency and the implicit commitment to a given pricing strategy. Finally, algorithms based on sophisticated techniques of reinforcement learning may, by interacting with one another, converge to collusive equilibria.

The AdC warns that firms are responsible for the algorithms they use, and that the application of competition law, in Portugal, follows and incorporates the realities of the digital era. The use of these tools as a way to coordinate strategies in the market, such as in the example above or through the subcontracting of pricing algorithms to a common supplier, is not compatible with competition law.

Algorithms can be used by firms in ranking and recommendation of products online, in digital advertising as well as in search engines. The Special Eurobarometer on online platforms shows that, for 75% of the respondents in Portugal, the order in which search results are displayed affects their consumption behaviour – the highest value for the EU. This allows firms to divert consumers from certain products to others and exploit users' behavioural biases. This ability introduces the risk of bottlenecks in the market, which grant a competitive advantage to certain products at the expense of others. In particular, this ability allows firms to leverage market power between products and services, especially if algorithms are used in ecosystems or by vertically integrated vertical platforms (e.g., market place that also sells products).

1. BACKGROUND

1. **Innovation in digital technologies is associated with the growing digitalisation of the economy and the emergence of new goods and services.** According to the Digital Economy and Society Index (DESI), in 2019, Portugal ranked 19th among the 28 EU Member States¹ in terms of digital performance. Compared to the EU, Portugal was above average in the utilisation of digital public services and the integration of digital technologies in firms. It was below the EU average, however, in human capital (*i.e.*, digital skills of the population and employment in the information and communication technology sector) and in Internet use.
2. **Nonetheless, in 2018, 94% of the Portuguese with Internet access made at least one online purchase, considering a wide range of product categories, and there was an increase in the number of online retail purchases².** Even though Portugal (37%) has one of the lowest percentage of individuals making online purchases in the EU (60%), the proportion of individuals between 16 and 74 who used the Internet to acquire goods and services increased almost fourfold since 2018, one of the largest increases in the EU.
3. **As for the business sector, Portugal ranks at 11th in the EU in an indicator on the integration of digital technologies within firms** (one of the indicators used in the DESI), scoring higher than the EU average. The firms with an online presence are mostly large firms. Conversely, small and medium-sized enterprises, as well as micro-enterprises, have yet to catch up on this measure³.
4. **Recent technological innovations, computer processing power and data storage, associated with the digitalisation of the economy and the Internet of Things, have led to the emergence of big data.** Big data is characterised by the 4 V's: the volume of data, the velocity of which data is gathered, used and diffused; the variety of information; and the value that may be generated from data⁴.
5. **The volume of data generated has increased significantly in recent years and several forecasts predict that it should keep growing substantially in the future.** Cisco, for example, forecast a 25% yearly average growth in the volume of data gathered between 2014 and 2020⁵. IBM, in turn, predicts that in 2020, the volume of information generated will be 300 larger than that of 2005⁶.
6. **Information may be currently gathered and used up to real time. This allows firms to more quickly monitor and adjust to market events.** The velocity of gathering and using data may be crucial for firms whose information has an expiration date, after which it loses its value. This is the case, for example, in passenger transport platforms which coordinate passenger requests for rides, the available drivers/vehicles and the price of each trip, in real-time.
7. **This data is often gathered and used by digital platforms, as they carry out their activities, by directly observing users' behaviour.** This ability has significantly expanded the range of information about consumers that may be gathered by firms, beyond traditional methods such as focus groups or surveys. This data includes not

¹ Cfr. Digital Economy and Society Index (DESI), 2019 Country Report, Portugal. Available [here](#). The DESI is a composite index of 5 indicators. It is calculated by the EC since 2015 and aims to measure the progress made by Member States in terms of the digitalisation of the economy and society.

² Cfr. Nielsen Connected Commerce Report 2018.

³ *Idem* nota de rodapé 1.

⁴ Vide Stucke & Grunes (2016, pp. 15-28).

⁵ OECD (2016a)

⁶ IBM. (2013). "The Four V's of Big Data". Available [here](#).

only demographic information but also information on the patterns and history of consumers' purchases or on the customer journey.

8. **The new goods and services that have arisen in the context of big data may increase the efficiency of the market and consumer welfare.** Big data, for example, may allow firms to create searching and product recommendation algorithms that reduce transaction and search costs for both consumers and other firms. As such, big data may facilitate product discovery and price comparison, which may intensify competition in the market. Using big data, firms may also provide goods and services that are better adjusted to consumers' needs, if the information gathered on consumers is subsequently incorporated into final products. Additionally, once these goods and services are produced, big data may be used to direct them to the consumers who valued them the most.
9. **Digital platforms may use the data they gather about their users to increase the quality of the goods and services they provide in the market, as well as to inform their strategic decisions.** On the one hand, data may be used as an input in the development of the algorithms they provide, increasing the quality of their goods and services. On the other hand, data may inform or even automatize pricing decisions. In addition, firms may also monitor the strategic variables of their competitors.
10. **There are, however, several risks associated with big data, from the point of view of competition. Big data may confer a significant competitive advantage to some firms in the market,** by amplifying data-driven network effects, in a context of multi-sided platforms or digital ecosystems of goods and services. Big data may enhance network effects, which may entail market tipping, with potential winner-takes-all outcomes.
11. **The use of monitoring and pricing algorithms may allow firms to implement personalised pricing strategies, and make collusive equilibria, tacit and explicit, easier to achieve and sustain,** at the expense of consumer welfare. Moreover, the ability of platforms to use ranking and recommendation algorithms to divert consumers from some products to others may introduce bottlenecks in the market, at the expense of competition.
12. **The opportunities and the risks of big data refer not only to online markets, but also to several offline markets.** Besides e-commerce platforms, marketplaces or digital advertising, big data may play an important role in traditional markets (*e.g.*, insurance and healthcare sectors).
13. **Considering data as an input raises important challenges in the context of multi-sided platforms and digital ecosystems. These challenges have generated a great deal of interest in the competition community.** Several reports have been published, including by competition authorities, aimed at promoting competition in digital markets. Since the beginning of 2019, as an illustration, the European Commission (Cr  mer et al. Report), the British Government (Furman Report) and an expert panel for the Stigler Center (Stigler Report) have published reports on this topic. Moreover, other competition authorities, such as the German, Australian, French, Canadian and British competition authorities have also published reports on digital markets in recent years⁷.
14. **This AdC Issues Paper addresses the competition issues that may be raised with respect to big data, multi-sided platforms and digital ecosystems.** In particular, it

⁷ In particular, the report jointly published by the Autorit   de la Concurrence and the Bundeskartellamt, 2016; the report by the Canada Competition Bureau, 2017; the report by the CMA on pricing algorithms, 2018; and the sector inquiry on digital platforms by the Australian Competition & Consumer Commission, 2018; among others.

analyses the role of big data as a driver of network effects and often a key aspect in digital ecosystems of goods and services. It also addresses the relevance of data as an input for digital operators and its role in market foreclosure strategies and/or aggressive mergers.

15. **This document also analyses the role and nature of algorithms, as well as the implications of their use for competition.** In this context, it focuses on the impact that monitoring and pricing algorithms may have in the way firms interact in the market, namely in terms of market transparency and the sustainability of coordinated behaviour. Lastly, it highlights the role that ranking and recommendation algorithms may have in product discovery, but also the risk they may entail in the creation of bottlenecks, if associated with vertically integrated platforms or ecosystems.
16. **For this paper, the AdC gathered quantitative and qualitative information in order to assess the development of these technologies/tools in the Portuguese digital economy.** In particular, the AdC sent a questionnaire to 38 firms, to gather information on their use of monitoring and pricing algorithms. The questionnaire focuses on firms active in digital markets, namely in e-commerce.

2. BIG DATA, PLATFORMS AND DIGITAL ECOSYSTEMS

17. **Multi-sided platforms stand in between and coordinate the multiple sides of a market.** As a result, platforms are able to gather information about their user's characteristics and to monitor their behaviour while they use their services.
18. **The data gathered by multi-sided platforms may be used as an input in the production of goods and services,** as it may contribute to their quality, either directly or indirectly⁸. On the other hand, data may be used to assist firms' strategic decisions (*e.g.*, when implementing price discrimination). For this reason, data may play a key role in firms' profit maximization, allowing them to better adjust their strategic decisions to market conditions or to improve the quality of their products. Moreover, to the extent that data may allow for a more thorough characterisation of clients, it may be used to extract more surplus from consumers or be instrumental in strategies aimed at exploiting consumers' behavioural biases.
19. **The higher quality of goods and services is reflected on customer valuation.** Firms may increase quality by following a strategy of vertical differentiation if they use data to increase the valuation that all consumers place on their products (*e.g.*, a website may use their users' browsing history to optimize its interface). Conversely, (average) quality may be increased by horizontal differentiation if, for example, a firm focuses on niche markets. Investments in the capacity to gather, process and analyse data may, thus, be considered as investment in quality.
20. **The role of quality-increasing data is especially relevant in the context of multi-sided platforms active in digital markets.** These platforms are characterised by direct and indirect network effects between the different sides of the market, generated by gathering and analysing data on how the services provided on the platform are used. These network effects may create a tendency towards concentration in these markets, which may result in winner-takes-all outcomes.
21. Access to data may become an important factor to consider in competitive assessments, given the role that data may play as an input for digital platforms.

⁸ The contribution will be direct if the final product is information (*e.g.*, search engine), and it will be indirect if the final product is not information (*e.g.*, user feedback used to improve features on a social network).

22. This section describes the specificities of multi-sided platforms, as well as the role big data may play in these markets. Moreover, it presents some implications for competition.

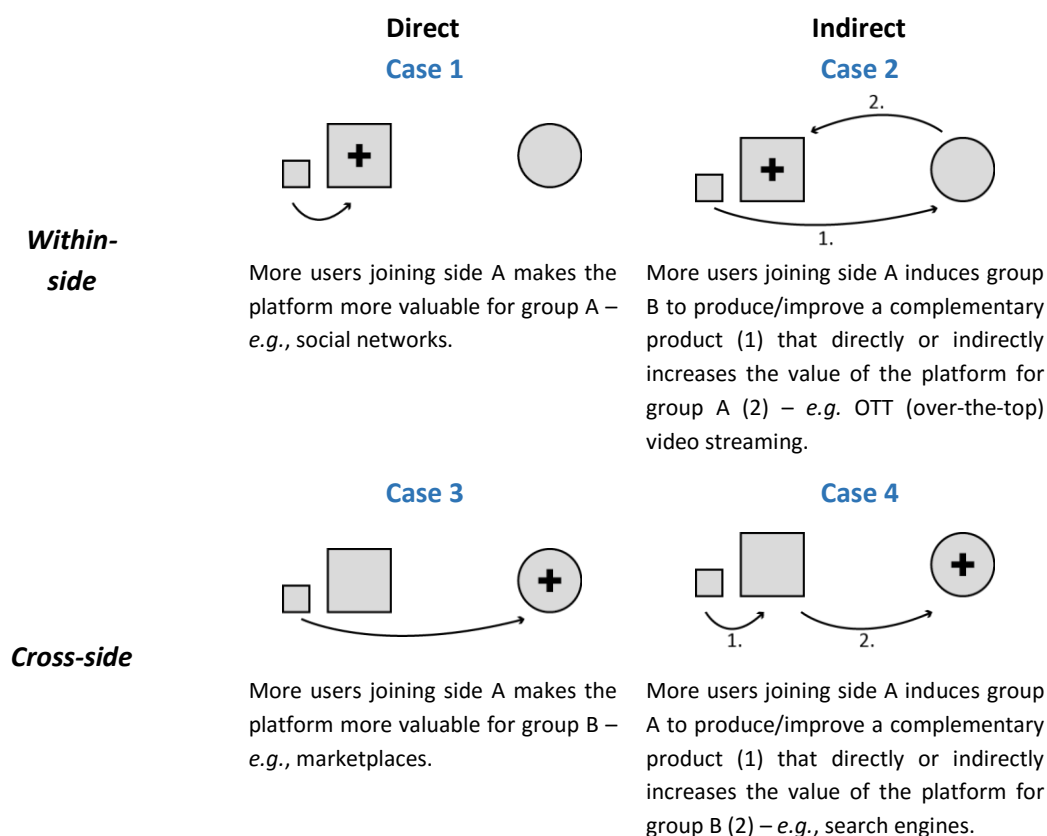
2.1. Network effects

23. **Multi-sided markets are characterised by network effects between different groups of market participants – the sides of the market.** Network effects between sides of the market present an opportunity for multi-sided platforms. The role of these platforms is to intermediate the different sides of the platform and, thus, to internalise the network effects between them.
24. **Network effects refer to the additional value of joining or using a multi-sided platform as a result of an increase in the number of users** or quantities consumed. Quantities consumed may be due to either to the acquisition of goods or services but also time spent on the platform *per user*. The value of a social network, for example, increases as more users join the platform and effectively use it.
25. The network effects in each multi-sided market may be categorised according to:
- The relationship between the side that generates them and the side that benefits from them. In this sense, they can be divided into **within-side network effects** and **cross-side network effects**;
 - The need (or not) to produce a complementary good/service to materialise the network effects in the market. In this case, network effects may be **direct network effects** or **indirect network effects**⁹.
26. **Within-side network effects refer to the additional value a platform has for users on one side of the market due to the presence of other users on the same side of the market.** This may be well illustrated by social network. In simple terms, social networks are characterised by two sides: users who share content in text, audio, video or audio-visual format; and advertisers, who want to exhibit their adverts to consumers next to the shared content. In this context, more users, namely friends or family members, increase the value of the social network to other users – a within-side network effect.
27. **Cross-side network effects refer to the additional value a platform has for users on one side of the market due to the presence of other users on a different side of the market.** In the case of a social network, more users make the platform more attractive to advertisers, generating a cross-side network effect.
28. **The presence of within-side or cross-side network effects in a platform may also generate indirect network effects.** In this context, more users on one side of the platform create incentives/means for another side of the platform to provide or improve a complementary product. In turn, this product is valued by at least one side of the market. If, however, such a complementary product is not necessary to materialise network effects, they will be direct.
29. Audio or video streaming platforms (*e.g.*, Spotify or Netflix) provide a good illustration of these indirect network effects. As a multi-sided platform, they are characterised by

⁹ Authors have adopted different definitions of direct and indirect network effects in the economic literature. The definition of indirect network effects adopted in this paper is close to the proposals by, for example, Katz & Shapiro (1985) or Clements & Ohashi (2005), according to which indirect network effects operate through the market for a complementary good. Therefore, an increase in the number users on one side provides greater incentives for another side to produce a complementary good or service, which, in turn, benefits at least one side of the market. Another definition often used in the economic literature (*e.g.*, Filistrucchi (2014), among others) considers that there are indirect network effects when “consumers’ willingness to pay for a product depends on the number of consumers (or the quantity bought) of another product”. This is the definition of cross-side network effects used in this paper.

cross-side network effects. On the one hand, more users make the platform more attractive for content producers. On the other hand, more content producers make the platform more attractive for users. The network effects generated by users, in turn, provide incentives for content producers to produce more content, which may increase the value of the platform for other users – an indirect network effect. This indirect network effect is also a within-side network effect, since these consumers value the platform more because other users, like them, joined the platform – case 2 in Figure 1.

Figure 1: Types of network effects in multi-sided platforms



Source: AdC.

30. The example of social networks, with users on one side and advertisers on the other, may illustrate these different types of network effects. A new user may generate, simultaneously, within-side direct network effects for other users (*e.g.*, friends) – case 1 in Figure 1 – and cross-side direct network effects for advertisers, as aforementioned – case 2 in Figure 1. Through these direct network effects, the user may also generate indirect network effects. The social network may monitor her behaviour and use the information it obtains to improve the features of its platform for other users – a within-side indirect network effect, shown as case 3 of Figure 1. Lastly, the information obtained by the social network about users may be used to improve the matching algorithms¹⁰ implemented on the advertiser side, which define which adverts to exhibit to users – a cross-side indirect network effect, represented in case 4 in Figure 1.
31. Network effects may be heterogeneous if users who join the platform generate different network effects to different users. The sources of this heterogeneity may

¹⁰ Vide Section 3.5 on selection algorithms.

include user preferences, location or social ties offline (*e.g.*, family). Hence, in a social network, network effects may be mostly generated by the presence of friends and/or family members in the platform, while network effects from users outside this social circle may be weaker. Similarly, for passenger transport through electronic platforms¹¹, the presence of many drivers in New York should not attract many passengers in Lisbon. In this case, network effects may be limited to each city.

32. **Besides positive network effects, in some scenarios, the network effects generated in platforms may also be negative.** This may be due to platform congestion, where many users compete for something that is scarce on the platform. In a social network, this may be the limited bandwidth of its infrastructure, but also the limited attention and income of users. Moreover, the presence of users with undesirable or abusive behaviour may also generate negative network effects. This may include, for example, users that promote piracy, verbal abuse or fraud. As for positive network effects, multi-sided platforms also internalise negative network effects. For this reason, they may adopt strategies to mitigate their impact. An example of such strategies are rules of conduct adopted in social networks, usually focused on preventing abusive behaviour between users¹².

2.2. Categories of multi-sided platforms

33. Multi-sided platforms may be categorised according to:
 - The way their sides interact with each other – **transaction platform** and **non-transaction platform**¹³;
 - The relative strength of the network effects generated by each side of the platform – **matching platform** or **audience-providing platform**¹⁴.
34. **Transaction platforms are characterised by their ability to charge usage fees to their users** (*e.g.*, commissions). For this to happen, the sides of the platform must interact directly and the interaction must be observed by the platform. However, the platform will be a non-transaction platform if the sides of the platform do not interact directly or the transaction is not observed.
35. **Marketplaces are an example of a transaction platform.** Since transactions are made through the marketplace, it may charge a commission to either its consumers and/or sellers for each transaction. On the other hand, in audio and video streaming platforms, there are no transactions between consumers and content producers. Hence, they are non-transaction platforms¹⁵. As for online classified ads, the platform may be a non-transaction platform if it is not able to observe the transaction that resulted from the online ad. Nonetheless, they may observe the transaction if, for example, they integrate the online classified ads service with a delivery service.
36. **On matching platforms, cross-side network effects are positive for both sides of the platform and are of similar magnitude.** For this reason, both sides of the platform benefit from increases in the number of users or quantities consumed in other sides of the platform. Marketplaces are an example of a matching platform. Buyers benefit from having access to more sellers, as that means more competition and greater

¹¹ In the Portuguese legislation, “*Transporte em Veículo Descaracterizado a partir de plataforma Eletrónica*” (electronic platform-based transport in unmarked vehicles), or TVDE.

¹² Vide Boudreau & Hagiu (2009).

¹³ Filistrucchi et al. (2014).

¹⁴ Bundeskartellamt (2016).

¹⁵ Note that, even though there may not be a usage fee, there might be an access fee (*e.g.*, Netflix).

product variety. Sellers, in turn, prefer platforms with a large number of buyers, as they provide them access to larger markets.

37. **Audience-providing platforms are characterised by differences in the relative strength of the cross-side network effects generated by the sides of the platform.** As such, one side of the market benefits more than the others from increases in the number of users or quantities consumed on other sides of the market.
38. Multi-sided platforms whose main source of revenue is advertising, such as online media, social networks or other platforms where users can share content, are examples of audience-providing platforms.
39. **In audience-providing platforms, the sides of the market that generate less cross-side network effects tend to subsidise the sides that generate more cross-side network effects.** That will have an impact on usage and access fees for the side generating more network effects. These fees may be lower than the cost of providing the goods and services to that side of the market, and even be zero (the so-called zero-pricing strategies)¹⁶.
40. **Audience-providing platforms may also be associated with attention markets¹⁷.** In these markets, platforms provide content to consumers and compete for their attention (e.g., Facebook or YouTube). This content may be produced by the platform itself or by content producers on one side of the market, independent from the platform. Once the platform captures consumers' attention, it may exhibit adverts from an advertising side of the market, *i.e.*, they sell consumers' attention to advertisers.
41. **Given that multi-sided platforms have, by definition, multiple sides, it may be difficult to exclusively classify them as transaction or non-transaction platforms; and matching or audience-providing platforms.** A video-sharing platform, for example, may include viewers, content producers and advertisers. In this case, it may act as a matching platform between viewers and content producers and, at the same time, adopt an audience-providing role between viewers and advertisers. Moreover, viewers are usually subsidised, as they do not compensate content producers but still value what they produce. In this scenario, the viewers are subsidised because their attention may be seen as a product that is sold in another side of the platform – *i.e.*, it is monetised –, where advertisers are willing to pay to have access to viewers' attention. Content producers are, hence, compensated by advertisers according to their ability to attract viewers, meaning this transaction may be observable.
42. For this reason, while the classification of multi-sided platforms described above does not allow for an exclusive or mutually exclusive classification of platforms, it allows one to identify the different roles a platform may play in the market. These roles shape how platforms gather data, what algorithms they use, the type and strength of network effects and the strategic behaviour of firms.
43. **Platforms may also be associated with ecosystems of goods and services that generate consumption synergies¹⁸.** Due to consumption synergies, the provision of goods and services in ecosystems may be subsidised or even provided without a monetary payment (zero-pricing). There is a large array of good and services that may

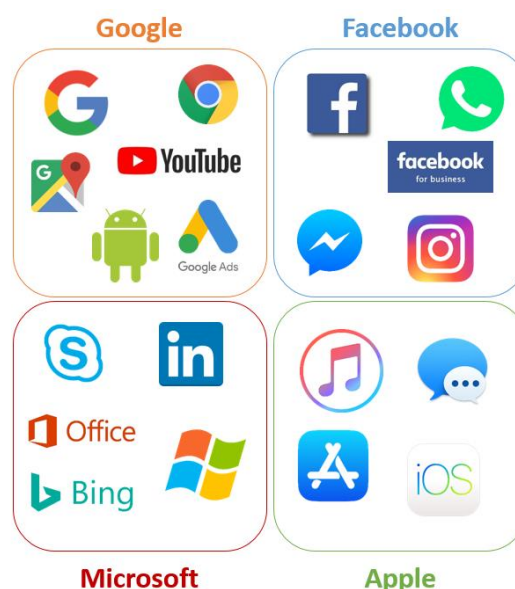
¹⁶ If platforms monitor their users' behaviour, it may be difficult to assess whether there is effectively a subsidisation between the sides of the platform, even under a zero-pricing strategy, since there is at the same time a non-monetary transaction involving data.

¹⁷ *Vide "attention markets"* em Anderson & Jullien (2015), Evans (2017) or Prat & Valletti (2019).

¹⁸ Bourreau & de Streel (2019, pp. 12).

be provided in ecosystems (v. Figure 2 for examples of ecosystems), including search engines, social networks and features for sharing content (e.g., text, photos, video or audio), instantaneous messaging services, e-mail services, comment and reaction systems, e-commerce platforms, marketplaces, translation services, web analysis tools, cloud storage services, payment services, crowdfunding services, games, productivity software (e.g., word processors), map search and visualisation services, news aggregators, digital advertising, among others. These services may also benefit from economies of scope¹⁹.

Figure 2: Examples of ecosystems of goods and services



Nota: The set of goods and services shown for each ecosystems is not exhaustive.

Source: AdC.

44. **Consumption synergies may result from complementarities in the consumption of these goods and services, such that products consumed jointly have a higher individual valuation than when consumed separately.** As a result, a social network, for example, may include at the same time a system for users' comments and reactions, an instantaneous messaging service, a marketplace and a payment and crowdfunding service²⁰.
45. **In addition, consumption synergies may result from indirect network effects.** In this context, an increase in the number of users or quantities consumed of a product increases the valuation of other products in the ecosystem, even if they are separately consumed by users. Therefore, the data obtained from a product, for example, may be used to increase the quality of other products in the ecosystem, even if these products are offered to different users (e.g., offered to different sides of the platform). This is the case, for example, in ecosystems that combine web analytics with matching algorithms for digital advertising. Web analytics allow platforms to monitor users' behaviour via tags and this data may be used to improve matching algorithms²¹.

¹⁹ Vide paragraph 78 in section 2.4.2 on barriers to entry and expansion.

²⁰ Note, for example, Amazon's expansion to financial services (e.g., Amazon Pay) or the recent announcements regarding Facebook's entry into payment services.

²¹ Vide Sections 2.3.2 and 3.5 which detail, respectively, the kind of data that may be obtained through cookies or tags (associated with web analytics) and the algorithms used for digital advertising.

2.3. Data gathered about users in multi-sided platforms

46. **Multi-sided platforms may acquire, gather, process or analyse information about the characteristics of their users**, on any side of the market, and monitor their behaviour on the platform.
47. **Gathering, processing and analysing data may be characterised by significant scale effects, generated both on the demand and the supply sides**. On the one hand, these activities may require investments in infrastructure and specialised human capital. On the other hand, the data on an individual *per se* may not provide much information to the platform. A single data point may not be enough to extract patterns or relationships between variables. Instead, extracting this information may require a large and varied sample of individuals. As such, the value of data already obtained may increase as the firm gathers more data, at least initially, *i.e.*, there might be scale effects to data gathering.
48. **These activities of gathering, processing and analysing data may be outsourced to third parties**. Google Analytics, for instance, allows platforms to monitor their users and provides web analytics and audience analysis services to third parties²².
49. **The information gathered about users' characteristics and behaviour may be subsequently used to aid firms' decisions on strategic variables** (*e.g.*, implementation of direct price discrimination²³) or to improve the quality of services provided to users (*e.g.*, product discovery through recommendation systems²⁴).
50. **In order to extract information from data, platforms must be able to identify their individual users/consumers** (or groups of users/consumers). Moreover, platforms may use the data they gather to characterise their users, namely, their interest and willingness to pay for goods and services. This information may be used in the implementation of differentiated strategies towards individual users or small groups of users (*e.g.*, product recommendation, direct price discrimination).

2.3.1. User identification

51. **A firm operating in a digital context, in its usual commercial activity, needs to identify its customers** so as to, for example, deliver physical goods, process payments or manage access to the content it provides.
52. **Besides these commercial aims, firms may identify users in order to monitor their activity across time** and build a history of their behaviour. In this sense, with identification, firms try to pin the behaviour they observe on their platforms to a particular individual or group of individuals.
53. **In order to identify individual users or categorise them into groups, firms may adopt strategies that induce users to self-identify or resort to cues that identify them**²⁵.
54. **The most common strategy to induce users to self-identify is to require registered accounts** to use a website, platform or application. The registration forms often request information that allows firms to identify individual users in most cases, such as their username, their name, address or e-mail.
55. **There are, however, other techniques to identify users, such as cookies, the users' IP**

²² Audiences are groups of users based on a combination of common characteristics, which a given firm finds relevant. See, for example, [an article from Google Analytics about its Audiences report](#).

²³ *Vide* Section 3.3.2 on direct price discrimination.

²⁴ *Vide* Section 3.5.1 on the different types of selection algorithms.

²⁵ According to the terminology used in Cr  mer et al. (2019, pp. 24-29), data may be volunteered or observed.

addresses or fingerprinting (v. Box 1). These techniques to identify users may be used jointly. For example, alphanumeric keys stored in cookies may be generated using information about a user's account or data obtained through fingerprinting or through hash functions²⁶.

Box 1. Techniques to identify users

Using cookies is a common strategy to identify users. Cookies are text files saved in a user's device that may be later accessed by a website, platform or application to identify that user. Hence, for example, when a user visits a new page, the website may generate an alphanumeric key. This key is saved both on the website's servers and on the user's device. If the user visits the page again, the website matches its key with the one saved on the user's device, thus identifying the user.

Firms may also use users' IP²⁷ addresses or estimate their location to identify them. Location estimates may be based on users' IP addresses but also GPS services.

Firms may also resort to fingerprinting techniques. These techniques gather information about the user's device, browser, screen resolution, language, installed fonts, among others. Some of the most sophisticated fingerprinting techniques will make the user's browser render images which are specific to the graphics card model or browser – canvas fingerprinting. Fingerprinting is only useful in identifying users if firms can observe several rare characteristics in their users. As the number of rare characteristics increases (e.g., odd resolution, many custom fonts or outdated browser or operating system), it becomes increasingly likely that a single user possesses them. As a result, it becomes easier to identify individual users.

56. **User identification may be done by third parties present in multiple channels at the same time.** That is, when a user browses pages A and B, for example, she may be monitored by the same third-party.

2.3.2. User characterisation

57. **User characterisation refers to firms' efforts to infer their users' interest or willingness to pay for goods and services, as well as to identify consumer types** (e.g., whether the consumer is sophisticated and aware of outside options, or less informed and loyal). The data required to characterise users is specific to the context of each platform. The data gathered by a social network is different from the data gathered by a video streaming platform. While a social network may focus on the number of times content is shared by the users' friends or family members²⁸, a video streaming platform may instead focus on how long viewers watch the content they provide.
58. **Some of the information used to identify users may also be useful to characterise them, i.e., to assess their willingness to pay.** Firms may ask for their users' age, gender or location in user accounts. In addition, fingerprinting combines data about users' devices that may be used to infer willingness to pay – e.g., the device's brand or operating system, whether it is a computer or a smartphone or the user's location.

²⁶ Hash functions are functions that allow one to reduce a given set of data of arbitrary size to data of fixed and pre-set size (e.g., usually in alphanumeric keys). They are often used as they make data lookups more efficient. Alphanumeric keys are not necessarily unique, but there is a very low probability that a hash function generates the same alphanumeric key for two different sets of data. As such, an alphanumeric key (e.g. "1O69XNmFxVI7MVDZlzm9Y") may sum up a lot of information about a user, such as the device being used, operating system, browser, screen resolution, location, time of access, among others. The resulting alphanumeric key is also called a fingerprint. Vide Chapter 5 in Ferguson et al. (2010).

²⁷ Internal Protocol address – IP address.

²⁸ V. "Collaborative filtering" in section 3.5.1 on the different types of selection algorithms.

59. **Nonetheless, user characterisation may require that firms monitor users' behaviour** when they browse their webpages or use their applications. Namely, the information firms may gather includes²⁹:
- The number of the times a user visits each page;
 - How long a user stays in each page;
 - How a user enters a website and how she leaves (e.g., the destination page);
 - The position and movement of the mouse pointer;
 - The frequency and location of clicks, as well as what has been clicked. This also includes taps, if a touch screen is used;
 - The position of the scrollbar;
 - Search entries, as well as search configurations adopted by a user;
 - In a marketplace or e-commerce platform, a user's purchase history and previous discounts;
 - Any interaction between or within sides of a multi-sided platform, which may include users' messages, comments, reactions (e.g., "likes"), as well as contact lists (e.g., list of "friends").
60. Platforms may infer some user characteristics from gathered data³⁰. Namely, it may be possible to infer a user's age, gender or interests³¹. This may be done through the creation of focal groups, who are monitored more closely (e.g., tracking browsing behaviour outside the platform) and may be compensated either monetarily or with goods and services (e.g., Virtual Private Networks – VPNs). This information may also be used to monitor competing platforms³².
61. **User monitoring may be done by third parties present in multiple channels at the same time, through tags or pixels.** These are small pieces of code added to each page that monitor specific events, such as the ones listed above (e.g., clicks, number of times a user visits a page).
62. **These third party providers of tags may be able to have a comprehensive and detailed view of users' browsing behaviour,** as they concentrate information from multiple channels³³. These third parties may use this information in other services of an ecosystem, such as search engines or algorithms that select which digital adverts to exhibit³⁴.

²⁹ Vide the website <https://clickclickclick.click>, which illustrates interactively the type of information that may be gathered about users about their browsing behaviour online.

³⁰ According to the terminology used in the Cr  mer et al. (2019, pp. 24-29), data may be inferred.

³¹ These inferences may be done using, for example, collaborative filtering algorithms. V. "Collaborative filtering" in section 3.5.1. on the different types of selection algorithms.

³² See, for example, Facebook's VPN, Onavo, which was allegedly [used by Facebook to assess the impact of a new Instagram feature, Stories, on Snachpat](#). In addition, using Onavo, [Facebook was able to monitor, between 2009 and 2013, the number of messages sent by users on WhatsApp in comparison with Facebook](#).

³³ According to W3Techs, a firm dedicated to monitoring the Internet and the tools used online to build and run websites, [about 66% of websites implement known traffic analysis tools](#). Among these, [about 86% use Google Analytics](#). In addition, according to BuildWith, another firm with the same aim, the [proportion of websites that use traffic analysis tools is greater for websites with more traffic](#). For example, BuiltWith estimates that, among the top 1 million websites by traffic, about 69% of websites use Google Analytics. [Among the top 100 thousand websites by traffic, however, this proportion increases to 86%; and it increases further to 89% among the top 10 thousand sites by traffic](#).

³⁴ Vide Section 3.5.1 about the different types of selection algorithms.

63. **The utilisation of tags provided by third parties is often associated with online traffic analysis services (e.g., Google Analytics), often free of charge.** In this context, the website administrators place tags on their pages, granting their users' browsing data to the third-party tags provider. Using this information, these third parties provide traffic analysis tools as well, which allow website administrators to better understand how users browse their pages. These services present, for example, browsing flowcharts describing how users move from one page to another in the website. They may also indicate at which times of the day or week is the website most used, or bouncing rates (*i.e.*, users who visit only one page on the website before leaving).
64. **These tags provided by third parties may also be associated with audience-providing multi-sided platforms, namely with digital advertising³⁵** (*e.g.*, sale of advertising spots in a social network or digital advertising analytics). A digital advertising platform may, for example, create a cookie in the user's browser when she is shown an advert. Additionally, the administrator of the page that sells the advertised product may add a tag developed by the digital advertising platform. This tag monitors whether the product is bought by the user who was shown the advert (*i.e.*, whether she has the aforementioned cookie). As such, if a user ends up buying a product after being shown an advert, the sale may be associated with the advert, even if the user has not clicked on it. Using this association, it is possible to estimate a return on investment of the digital advert.

2.4. Implications for competition

2.4.1. Specificities in relevant market definition for digital platforms

65. **The definition of relevant markets for multi-sided platforms presents some challenges³⁶.** From a methodological viewpoint, the intrinsic characteristics of multi-sided markets increase the complexity of applying the tools used to define relevant one-sided markets.
66. **When defining relevant markets for multi-sided platforms, it is important to take network effects into account, to better frame the competitive environment in which firms interact.** Network effects, when internalised by firms, may shape firms' pricing, quality and investment decisions, as well as how they react to entrants³⁷. For example, a search engine pondering whether to add an access fee to its service must weigh, on the one hand, the increased profit margin; and, on the other hand, the revenue it would forego on the advertiser side as users search less (as well as other indirect effects, such as the lower volume of data it is able to gather). This approach reflects the role of cross-side network effects between users and advertisers, which firms internalise in their strategic decisions.
67. **Incorporating network effects in the definition of relevant markets introduces additional informational requirements.** The quantitative implementation of the SSNIP test (Small but Significant Non-transitory Increase in Price) may require additional information to estimate cross-elasticities of demand for the different sides of the platform. In addition, each side may have a different demand-side substitutability. This

³⁵ See the [Bundeskartellamt vs. Facebook \(B6-22/16\)](#) case, which addresses Facebook's ability to gather data about both its users and individuals who do not use Facebook, through tags, as well as Facebook's ability to merge information obtained inside and outside its platform.

³⁶ Even though these challenges have become more pertinent in the context of the digital economy, the specificities in relevant market definition for multi-sided markets is a topic already discussed by the AdC. See, on this point, the chapter about the topic in *Linhas de Orientação para Análise Económica de Operações de Concentração Horizontais*, by the AdC.

³⁷ Vide Rysman (2009).

may be the case in social networks and search engines, which may be substitutable for advertisers but not for consumers³⁸.

68. **The possibility of setting multiple prices, given the multi-sidedness of the market, poses additional challenges as to the exact application of the SSNIP test.** In particular, the question will be on which sides the price and profit variation applies, considering the relative prices between the sides of the platform³⁹.
69. **Additionally, the possibility of non-monetary transactions, as well as zero-pricing strategies, may also weaken the adequacy of market definition tools focused on price, such as the SSNIP test.** On the sides of the platform where firm adopt a zero-pricing strategy, they do not compete in prices, and thus the relevance of assessing the impact of price changes will be limited. In this case, the compensation may be done, for example, through data transfers or users' attention that is monetised by the platform on other sides (*e.g.*, advertisers).
70. **In the context of non-price competition**, one may consider using other Hypothetical Monopolist Tests (HMT), such as the SSNDQ test (Small but Significant Non-transitory Decrease in Quality)⁴⁰, which defines relevant markets by focusing on quality instead of price^{41,42}.
71. **However, the implementation of tests focused on quality have their own difficulties.** In fact, this requires a quality benchmark in a competitive market, as is the case for tests focused on price. In addition, measuring the quality of a product requires a specific operationalisation for each market, which, in the case of multi-sided platforms, may be specific to each side of the market. Moreover, due to the multidimensional nature of quality, it may be difficult to identify what is exactly changing when quality varies. Lastly, the difficulty of defining quality as a continuous variable means that quality shocks are discrete and non-comparable⁴³. Despite these limitations, the SSNDQ test provides competition authorities with a conceptual framework for defining relevant markets, in the same way that the SSNIP test does.
72. **The challenges posed by defining relevant markets in the context of digital platforms have been under discussion.** To the extent that the aforementioned limitations impair the usefulness and informational value of certain quantitative tools, as well as the ability to implement them, it may be more advisable to resort to a more qualitative approach in market definition, based on the viewpoints of stakeholders⁴⁴ and focused on how the different groups of users in the platform interact (*e.g.*, sellers, consumers or advertisers).
73. **Additionally, in merger control, it may be more useful to directly assess the effects of the merger on competition.** These considerations, that gain traction in the context of digital platforms, are reflected in the AdC's Horizontal Merger Guidelines of 2013, namely within the discussion of the specificities of multisided markets. These guidelines outline the general principles that govern the analysis undertaken by the AdC in that context. It specifically refers to how the specificities related to multi-sided

³⁸ Filistrucchi et al. (2014).

³⁹ *Ibid.*

⁴⁰ Hartman et al. (1993).

⁴¹ *Vide* OECD (2018b) e Hartman et al. (1993).

⁴² A version of this test was applied in the case Quhoo 360 v Tencent, in China, according to Evans & Zhang (2014).

⁴³ *Vide* OECD (2018b).

⁴⁴ See, for example, the approach followed by the EC when analysing the Google/DoubleClick (COMP/M.4731) or Facebook/Whatsapp (COMP/M.7217) mergers.

platforms and network effects should be framed, both in the definition of relevant markets and in the competitive assessment.

2.4.2. Barriers to entry and expansion

74. **Multi-sided markets based on big data are particularly bound to be characterised by significant, activity-specific barriers to entry and expansion**, such as economies of scale and scope, network effects and switching costs. These barriers reduce the competitive discipline faced by incumbent platforms and may contribute to high market concentration and winner-takes-all outcomes.
75. **Additionally, these specific entry and expansion barriers may be amplified by the incumbents' strategies** to protect or strengthen their position in the market.⁴⁵ The tendency towards winner-takes-all outcomes affects the incentives that drive incumbents' strategic behaviour, such as their reaction to actual or potential entry/expansion by competitors. The goal of this type of strategy may be protecting or reinforcing the incumbent platform or ecosystem, in particular by eliminating the competitive discipline exerted by new entrants and market disruptors.

Economies of scale and scope

76. **The cost structure in multi-sided markets is conducive to significant economies of scale and scope.** Activities such as data gathering, storage, processing and analysis, as well as software development, exhibit economies of scale and may require considerable investments in both specific infrastructure, such as data centres⁴⁶, and human capital⁴⁷.
77. **On the other hand, cloud computing services may reduce the importance of economies of scale**, as they mitigate, at least to some extent, the disadvantages that entrants and small competitors may have *vis-à-vis* incumbents, in terms of computing capacity. For example, Microsoft and Amazon are among the major cloud computing suppliers, hired by companies like Netflix and Uber.
78. **Product development by digital platforms may also give rise to economies of scope**, since digital products are traditionally developed through a combination of hardware and software inputs. These inputs may be used and shared by a broad range of other products and services (the so-called modular design)⁴⁸. Hence the possibility of collecting large volumes of consumer data, for example, may shape the incentives of digital platforms to develop new products. This can be illustrated, for example, by the knowledge Google accumulates on artificial intelligence, which may be shared between its different services⁴⁹.

Network effects

79. **Multi-sided markets are characterised by network effects, which may create a positive relationship between platform size and product quality.** The products may be provided by the platform itself or by the sides of the platform (*vide* section 2.1 on the different types of network effects).
80. **The positive relationship between platform size and product quality can provide a competitive advantage to the largest platform on the market, which may affect how**

⁴⁵ Section 2.4.3 (on market power and contestability) discusses these strategies in more detail.

⁴⁶ Google, for example, [claims to have invested approximately 10.5 billion Euro in data centres in the US until April 2018](#), and approximately [3.2 billion Euro in Europe](#).

⁴⁷ Bourreau & de Streel (2019, pp. 8-9).

⁴⁸ Bourreau & de Streel (2019, pp. 10).

⁴⁹ *Ibid.*

the market operates, create a tendency towards concentration and lead to winner-takes-all outcomes. In these cases, the market is characterised by a dominant firm, possibly alongside smaller firms seeking to gain scale. The strong network effects may drive outcomes in which it is unlikely that the market self-corrects, leading to persistent dominance and market power⁵⁰.

81. **Network effects can arise, *inter alia*, in the context of ecosystems, by generating consumption synergies⁵¹, which reinforce the tendency towards concentration in the market.** In this context, a product with a large number of users attracts users to other products on the same ecosystem. As a consequence, the platform can leverage an existing competitive advantage in one of the products of its ecosystems to other products of the same ecosystem.
82. **Sharing data between products and services belonging to the same ecosystem is an example of how consumption synergies, generated by indirect network effects, can increase the value of a platform.** By monitoring consumer behaviour, platforms are able to extract information that may be subsequently used to improve algorithms used on other sides of the market, namely related to user characterisation. The greater the volume and variety of the data gathered, the higher the quality of these algorithms. This is particularly relevant for the algorithms in digital advertising that select which adverts to exhibit to consumers. If platforms can better characterise their users, they create higher value matches between products and consumers. Hence, the advertiser side has a higher willingness to pay to join or use the platform.

Switching costs and consumer behavioural biases

83. **The existence of switching costs between platforms or products of an ecosystem grant a competitive advantage to the larger platform in the market,** by generating a lock-in effect⁵². Therefore, they strengthen existing tendencies towards concentration in the market. Switching costs may be, for example, transaction costs, learning costs, search costs or psychological costs⁵³.
84. Users may face costs during the process of switching from one platform (or products of an ecosystem) to another – **transaction costs**. In digital markets, these may be, for example, account registrations or the process of installing new applications.
85. Using all the features available on platforms or products of an ecosystem may entail **learning costs** for users. These may include, for example, the users' adaptation to new layouts or applications, or the process of discovery of new features in a given platform or product.
86. When a user searches for alternative platforms, he may face **search costs**. These include the time and effort associated with looking for information that aids her decision, both when the user is undecided about alternatives but also when she knows little about alternative platforms, or does not even know they exist.
87. Lastly, there may be **psychological costs** associated with switching platforms, which may bias consumers towards default options – **consumer inertia**. In this context, consumers do not start looking for alternative platforms, even though they would have preferred them.

⁵⁰ *Vide* the Stigler Report (2019, pp. 59-60).

⁵¹ *Vide* paragraph 45 which defines consumption synergies driven by indirect network effects.

⁵² *Vide* Arthur (1989).

⁵³ *Vide* Office of Fair Trading (2003, pp. 10-14).

88. **In fact, there are a set of consumer biases that may create barriers to entry and expansion in the market.** There may be, for example, salience effects, in which consumers excessively value information that is more salient⁵⁴. Additionally, consumer behaviour may contribute to maintain the *status quo* in the market, and create a barrier to change. Moreover, consumers may also be impatient and have little self-control over their decisions⁵⁵. These consumer biases may be strategically strengthened and exploited by incumbent platforms (*e.g.*, via default options).
89. These consumer biases, in the context of ecosystems of goods and services, may amplify the effects of leveraging network effects between products in an ecosystem.
90. It should be noted that, despite the ease of installing new apps on smartphones or of visiting a new e-commerce platform, psychological costs and consumer biases may be the main barrier to change for consumers. Consumer inertia, and the incumbents' strategies to strengthen them, alongside network effects, have been presented as a countervailing argument⁵⁶ to the point that competition is "one click away"⁵⁷.
91. For this reason, consumer behaviour may, in itself, strengthen the market power of incumbent platforms or ecosystems.
92. In addition, psychological costs may result from user loyalty to specific brands.

Platform incompatibility

93. **The incompatibility between platforms or between goods and services of an ecosystem entails additional costs or prevents users of a platform from accessing users in other platforms.** Hence, a user in platform A has limited access, or has no access, to the network effects generated in other platforms.
94. **In the context of ecosystems of goods and services, a user that switches from a product in the ecosystem to a competing product outside the ecosystem may lose access to some features of the product,** which may entail a loss in quality. When a user switches from an Android device to an iPhone (iOS) device, and vice-versa, for example, she may lose access to some applications that are not available in the other operating system. In addition, the user may find it difficult to transfer data between the same application in both operating systems (*e.g.*, WhatsApp⁵⁸).
95. **Incompatibility between platforms may lead to a concentration of network effects in the larger platform by promoting single-homing⁵⁹, strengthening their competitive advantage over its competitors.** As such, the existence of incompatibilities between platforms strengthens the tendency towards concentration in the market.

2.4.3. Market power and contestability

Market tipping

96. **Digital platforms operate in markets characterised by high barriers to entry and expansion. When a platform becomes large enough, it benefits from strong network**

⁵⁴ Vide section 2.4.3, which, among other effects, details how salience effects may direct consumers towards products they would not otherwise have chosen, and how this may be exploited by platforms.

⁵⁵ Stigler Report (2019, pp. 35).

⁵⁶ *E.g.*, Stigler Report (2019, pp. 75)

⁵⁷ Vide "competition is one click away", a reply frequently adopted [by several Google representatives](#), when its market power is under discussion.

⁵⁸ See, for example, [this guide that lists some methods to transfer data from the WhatsApp application on an Android device to an iPhone device](#).

⁵⁹ A user, on one side of the market, is multi-homing if she is present in more than a platform. If the user is only on a single platform, she is said to be single-homing.

effects, direct and/or indirect, between the different sides of the platform, namely those driven by large volumes of data about its users. Network effects, alongside economies of scale and scope and strengthened by consumers' behavioural biases, such as consumer inertia, create a tendency towards self-reinforcing growth. As a consequence, the market may tip⁶⁰ and generate a winner-takes-all outcome.

97. **These effects may grant significant market power to the dominant platform, namely the ability to adopt strategies that foster the persistence of its position in the market.** These strategies hinge on promoting single-homing, which may be done, for example, by creating an ecosystem of goods and services around a monetised side of the market (e.g., an advertising side in an audience-providing platform). Platforms' market power may be reflected in higher access or utilisation fees on the monetised side(s) of the market, even if the platform subsidises other sides of the market⁶¹.
98. **In winner-takes-all markets, competition takes place in terms of competition for the market,** instead of competition *in the market*⁶². Competition for the market comes as a result of the threat posed by disruptive entrants^{63,64}, which may reach a critical mass and thus benefit from large enough network effects to substitute the incumbent. Initially, the entrant may adopt a differentiation strategy^{65,66}, focusing on niches of the incumbent's market. If the entrant becomes larger as a result of this strategy, differences in quality due to network effects will be reduced.
99. **However, the extent of competition for the market is reduced by barriers to entry and expansion that limit contestability.** It will be difficult for a smaller platform to surmount the barriers resulting from the network effects of the incumbent platform, even if the smaller platform has a higher quality, given that it requires a coordinated switch by consumers to reach its critical mass⁶⁷. This difficulty of switching makes the substitution of the incumbent by disruptive entrants unlikely – lock-in effect⁶⁸. In addition, there are further difficulties if the market is saturated, i.e., when there is little room to expand the market.
100. **In a context of winner-takes-all outcomes and competition for the market, contestability takes a leading role** as the only mechanism, in the absence of competition *in the market*, that may introduce some competitive discipline on platforms. For this reason, in a multi-sided market, the presence of small platforms is key to ensure contestability.

⁶⁰ Vide Arthur (1989).

⁶¹ Vide "competitive bottlenecks" in Armstrong (2006).

⁶² Vide Economides (2006, pp. 108-109).

⁶³ Vide Christensen et al. (2015).

⁶⁴ For example, among [Google](#), [Microsoft](#), [Facebook](#), [Apple](#) and [Amazon](#), the first three explicitly mention, in their 10-K forms for the U.S. Securities and Exchange Commission (U.S. SEC) of 2017, that the risk of disruptive innovation is one of the main sources of competition in the markets where they operate. The 10-K form is submitted annually by some firms to the U.S. SEC and provides an exhaustive summary of the financial performance of these firms.

⁶⁵ The entrants' differentiation strategy may be vertical or horizontal. There would be vertical differentiation if the users on at least one side of the platform would prefer the entrant's platform to the incumbent's, if they had similar sizes. In the case of horizontal differentiation, there may be tipping even if a large share of users is indifferent to the differentiating feature of the entrant. In such cases, one ought to look at the marginal user. For example, if a new platform grants its users more privacy and, for this reason, is able to attract new users, it may reach its critical mass even with a product directed towards a fraction of all users. The remaining users, in turn, would switch platforms due to the network effects generated by the first group. For indifferent consumers, switching platforms will be an increase in quality, as non-indifferent users who left eliminated positive network effects on the incumbent platform (assuming single-homing).

⁶⁶ Vide Crémer et al. (2019, pp. 42).

⁶⁷ Vide Caillaud & Jullien (2003).

⁶⁸ Vide Arthur (1989).

Single-homing vs. Multi-homing

101. **Entrenched incumbents may adopt a set of exclusionary strategies to strengthen their market power, thus reducing market contestability.** Incumbents may employ this type of strategies to defend their market position in a context of winner-takes-all outcomes. This strategic behaviour may mitigate or eliminate the threat of entry/expansion by competitors.
102. **Incumbents may, in particular, adopt strategies that reduce single-homing in the market** (sometimes called *divide-and-conquer strategies*). By ensuring network effects are not exclusive to a single platform, multi-homing reduces the tendency towards concentration in these markets and allows for the coexistence of platforms. Strategies towards the promotion of single-homing may be implemented through the creation of ecosystems of goods and services, specific strategies for attention markets, user subsidisation strategies, the creation or exploitation of switching costs and platform incompatibilities, bundling and tying strategies, most-favoured nation (MFN) clauses or exclusivity clauses.
103. **In multi-sided markets, single-homing may grant significant market power to the platforms where users concentrate.** Due to single-homing, these platforms are able to charge higher access and usage fees to other sides of the market.
104. **These strategies to strengthen market power, based on weakening the ability of new firms to enter or expand may, in certain circumstances, amount to practices that restrict competition.** Box 2 summarises some of the cases where this type of strategies were fined by the EC for breaching EU antitrust rules.

Box 2. Cases of abuse of dominant position by Google

In March 2019, the EC has fined Google €1.49 billion for abusing its dominant position in the online search advertising intermediation market, by imposing, between 2006 and 2016, restrictive clauses in contracts with third-party websites so as to limit the ability of competitors such as Microsoft and Yahoo to place their search adverts on these websites. These clauses forbade third-party websites from placing search adverts from Google's competitors on their search results pages. Later, Google reserved to itself the most visible and clicked on parts of these websites' search results pages for Google adverts and imposed clauses that granted Google the ability to control how these third-party websites exhibited competing search adverts.

In July 2018, the EC fined Google €4.34 billion for abusing its dominant position in general internet search services, licensable smart mobile operating systems and app stores for the Android mobile operating system markets, by imposing, since 2011, restrictions on Android device manufacturers and mobile network operators to ensure that traffic on Android devices goes to the Google search engine. Google (i) has required manufacturers to pre-install the "Google Search" app and browser app "Chrome" on their Android devices, as a condition for licensing Google's app store "Play Store"; (ii) made payments to certain large device manufacturers and mobile network operators on condition that they exclusively pre-installed "Google Search" on their Android devices; and (iii) has prevented manufacturers wishing to pre-install Google apps on their devices from developing or selling smart mobile devices running on versions of Android not approved by Google.

In June 2017, the EC fined Google €2.42 billion for abusing its dominant position in general internet search markets, by giving, since 2008, its own comparison shopping service an illegal advantage, by giving prominent placement in its search results only to it, whilst demoting rival comparison shopping services. The EC concluded that Google's conduct has the potential to foreclose competing comparison shopping services, which may lead to higher fees for merchants, higher prices for consumers, and less innovation, and, also, is likely to reduce the consumers' ability to access the most relevant comparison shopping services.

Source: <http://ec.europa.eu/competition/>

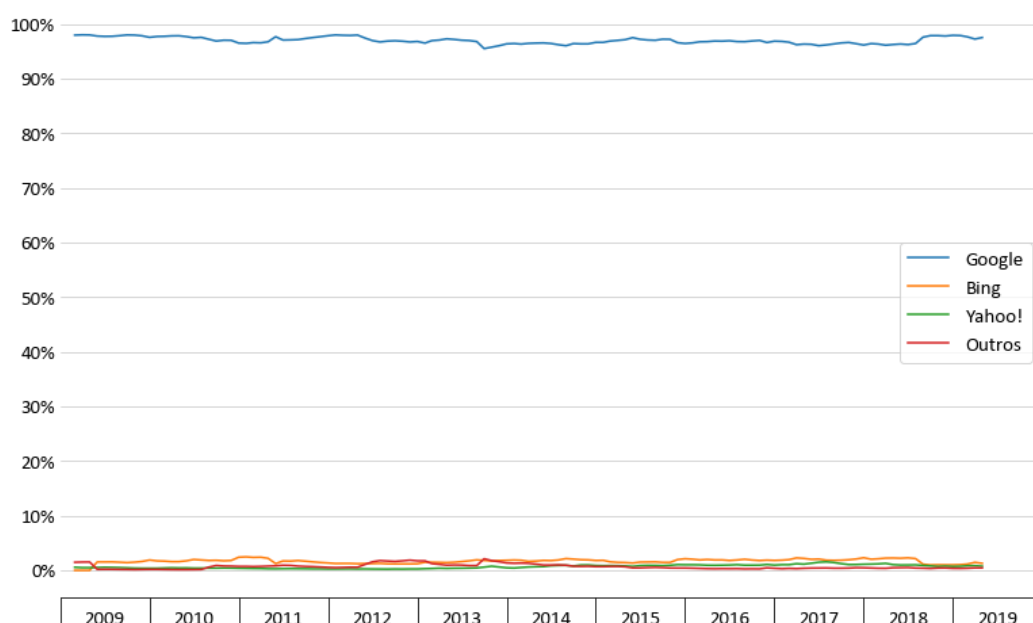
Ecosystems

105. **Ecosystems of goods and services are designed to maximize the number of active users on the platform and minimise the probability that users abandon the ecosystem**⁶⁹. Accumulating users, in turn, may increase the value of the platform, as well as its market power. The business model of audience-providing platforms, for example, is based on the ad revenues from the advertiser side. If a platform is able to attract a large number of users with the goods and services available on its ecosystem it may be able to direct a larger number of potential consumers to the adverts created by the advertiser side. In this respect, in the case of search engines, Google holds a significant and persistent position in Portugal (*vide* Figure 3), similar to the trend and prevalence verified in the rest of Europe⁷⁰.

⁶⁹ *Vide* section on attention markets *infra*.

⁷⁰ Source: [StatCounter](https://www.statcounter.com)

Figure 3: Share of usage of search engines, in Portugal, based on page views



Source: [StatCounter](#), data processed by AdC.

106. **Additionally, by monitoring a larger number of users, the platform is able to improve the quality of its targeted advertising, by focusing on consumers with greater willingness to pay.** That is, the ecosystem generates cross-side network effects from the user side to the advertiser side, increasing the latter's willingness to pay to either join or use the platform. Lastly, an audience-providing platform whose users single-home may, for example, charge higher fees to the advertiser side.
107. **A platform may adopt a set of strategies to expand its ecosystem.** These include most importantly the introduction of goods and services in the ecosystem that benefit from consumption synergies or economies of scope with existing goods/services in the ecosystem. Moreover, firms may, for example, integrate user accounts between platforms, such as mandatory, automated or facilitated login/registration in other webpages outside the ecosystem. These features are available in news pages, price comparison services (*e.g.*, Kuantokusta), *marketplaces* (*e.g.*, Airbnb) and other general interest websites (*e.g.*, IMDB). This integration is typically done through Facebook and/or Google and allows these firms to effectively expand their ecosystems.
108. **A new differentiated good/service that induces consumers to abandon the ecosystem may decrease the extent of consumption synergies generated on the platform and, as a result, reduce its value⁷¹.** In the case of an audience-providing platform, this competing product may decrease the number of potential consumers that it is able to direct to the advertiser side, or decrease the quality of the matching algorithms that select which adverts to exhibit.
109. **For this reason, when facing a new competitor that induces consumers to abandon the ecosystem, the incumbent platform may adopt a set of strategies to eliminate that competitive threat and "close the entry point" to the market.** These strategies may entail the acquisition of the entrant firm, the aforementioned exclusionary strategies⁷² or the entry into the market niche the entrant firm is using as an "entry point", including through imitation – *vide* Box 3.

⁷¹ *Vide* Bourreau & de Streel (2019, pp. 15).

⁷² *Vide* paragraph 102.

110. **It is important to consider the specificities of platforms when assessing the impact of certain strategies on competition.** In the context of digital ecosystems, for example, bundling and tying strategies may have an amplified negative effect on the ability and incentives of new competitors to enter and innovate in the market⁷³. These strategies may aim to reduce potential competition and leverage market power.

Box 3. Integration between Google+ and YouTube

The social network Google+, created in 2011 by Google, was integrated in 2012 with YouTube, a video-sharing platform acquired by Google in 2006.

Even though the social network was separately available, only users with a Google+ account could subscribe channels or comment, rate and publish videos on YouTube. Until then, YouTube had its own account registration process, such that existing user accounts were automatically registered in Google+. From this integration onwards, it was no longer possible to exclusively register on YouTube.

By adopting this strategy, Google may have sought to leverage YouTube's market position, as a video-sharing platform, to enter the market where Facebook is active.

However, this strategy was not successful. Even though the number of Google+ users increased significantly, the majority of accounts had little to no activity. Moreover, YouTube users reacted negatively. For this reason, the integration between Google+ and YouTube was partially undone, in 2015, as users could only access YouTube by using accounts common to all Google services. More recently, in October 2018, Google announced that it will shut down Google+ in August 2019 and, therefore, its integration with YouTube.

Source: <https://techcrunch.com/2018/10/08/looking-back-at-google/>

111. **The incumbent platform may enter the market of the differentiated good/service, namely via imitation⁷⁴, and leverage network effects in the ecosystem.** As a result, the platform may limit or stop the penetration of the product in the market. The integration between goods/services available in the ecosystem allows the platform to minimize the effects of a potential consumer inertia when experimenting the innovation-product. For this reason, the platform may be able to direct the users of the ecosystem to the imitation-product and, thus, gain a competitive advantage over the entrant, as the network effects of the imitation-product grow faster⁷⁵.
112. **The fear of this type of reaction by the incumbent to market entry may have a negative impact on innovation.** Cabral (2018) calls this the "Google shadow effect", in reference to a common complaint in high-tech industries where there is a fear of imitation by the incumbent⁷⁶.
113. **The ecosystem may also acquire the competing good or service and integrate it in the ecosystem or discontinue its development/entry in the market** (*vide* section 2.4.6 on pre-emptive and killer mergers).

⁷³ *Vide* Bourreau & de Stree, 2019, for a discussion of the relevant literature.

⁷⁴ *Vide*, for example, the [new feature Stories introduce by Instagram \(Facebook\), in 2017, allegedly an almost perfect replica of a Snapchat feature with the same name](#), after [reports of failed acquisition attempts of Snapchat by Facebook, in 2013 and 2016](#). Another example is [Facebook's reaction to the market entry of the TikTok app. Facebook created an alleged imitation-product named Lasso](#).

⁷⁵ *Vide* Bourreau & de Stree (2019, pp. 21).

⁷⁶ To illustrate this effect, Cabral (2018) cites an article from [The New York Times, from 2 May 2006](#), according to which in certain niches of the software industry, Google is casting the same sort of shadow over Silicon Valley that Microsoft once did: "You've got people who don't even feel they can launch a product for fear that Google will get in."

Attention markets

114. **Consumer attention is scarce, cannot be shared between content – i.e., it is rival – and cannot be transferred to the future – i.e., it is perishable.** These constraints mean that capturing additional attention from consumers, by a platform, may be done at the expense of other platforms in the market⁷⁷.
115. **Capturing consumer attention may have a dual purpose – directly increase the value of the platform and protect or strengthen the platform’s market power through the creation of strategic barriers to entry and expansion.** On the one hand, since platforms sell consumer attention to advertisers, the more consumer attention a platform concentrates, the greater the market size on the advertiser side. In addition, consumer attention implies the consumption of content in the platform which may be monitored. The data gathered this way can be used to increase the value of the platform. On the other hand, ensuring that rival platforms do not have access to consumer attention decreases their advertiser market size and the extent of indirect network effects enjoyed by competitors.
116. **In a context of competition for consumer attention, platforms may provide content with greater value to users or exploit potential consumer behavioural biases, by providing them with lower quality content that however keeps users engaged with the platform^{78,79}.** This is the case of content produced to generate outrage⁸⁰. Platforms may also adopt nudging strategies⁸¹ to keep consumers for longer on their platform. Video-sharing platforms, for example, may recommend new videos when a video ends through pop-ups or automatically reproduce the next video. Audio streaming platforms, in turn, may keep on playing a set of recommended songs after a playlist ends. Lastly, news articles are often surrounded by recommendations to other articles on the same website.

Strategies that strengthen consumer inertia and platform incompatibilities

117. **Platforms make take advantage of switching costs between platforms or between goods and services in an ecosystem to reduce market contestability.** Introducing incompatibilities may be a means to increase switching costs, which may, in multi-sided platforms, create lock-in effects and decreases incentives for multi-homing.
118. **Platforms may exploit and promote consumer behavioural biases to strengthen their market power.** This may include default options, the promotion of salience effects and other strategies that aim to concentrate the users’ attention on a platform (*vide* paragraph 116).
119. **Consumer behavioural biases may also be instrumental in the context of exclusionary strategies.** An investigation by CADE⁸² on the bank Bradesco for an alleged anticompetitive practice, for example, focused on the difficulties allegedly imposed by the bank to give access to its client data. This strategy may have hampered the ability of FinTech GuiaBolso to provide its services, by introducing an additional authentication step when Bradesco clients try to access their current accounts on the platform.

⁷⁷ *Vide* recent literature on attention markets, such as Evans (2017), Wu (2018) e Prat & Valletti (2019).

⁷⁸ *Vide* “*phishing equilibrium*” in Akerlof & Shiller (2015, pp. 1-11)

⁷⁹ Some authors, *e.g.*, Stigler Report (2019), refer that the exploitation of consumer behavioural biases may reduce the quality of the content provided in platforms.

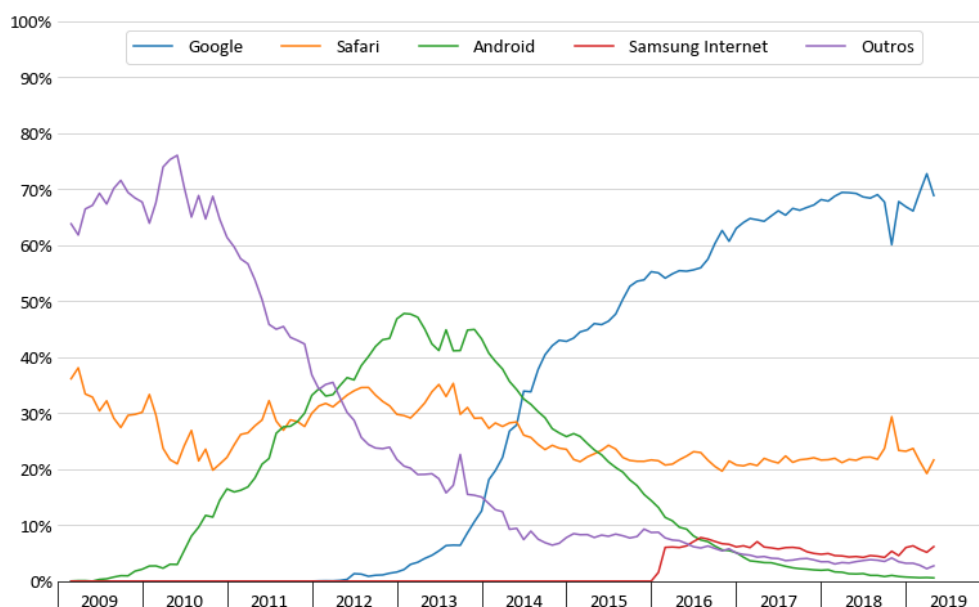
⁸⁰ *Vide* Stigler Report (2019, pp. 40)

⁸¹ Thaler & Sunstein (2009).

⁸² Conselho Administrativo de Defesa Econômica (Brazilian competition authority).

120. **Box 4 includes some recommendations by the AdC in its Issues Paper on innovation in the financial sector (FinTech) to reduce the risk of foreclosure in access to data.** Among the strategies incumbent banks may adopt to hamper the ability of FinTech operators to access to their client data, the AdC highlighted the increase of the number of steps in the customer journey to get client consent, which FinTech operators need in order to access client data⁸³.
121. Consumer behavioural biases play a role in the strategy adopted by Google to make Google Search and Google Chrome default apps on mobile devices – *vide* Box 2. Google's tying strategy is related to consumer inertia, in particular to the advantage granted by making its browsing and search apps default⁸⁴.
122. **Estimates of high value contracts related to default options, such as making Google Search default on iPhone, point to the importance consumer inertia may have in protecting ecosystems of goods and services and in reducing market contestability⁸⁵.** In this respect, Figure 4 shows a significant increase in the share of usage of Google Chrome in mobile devices in Portugal (and following the same trend as the rest of Europe⁸⁶) and that may be explained by the pre-installation of Google Chrome in mobile devices since the end of 2013.

Figure 4: Share of usage of browsers on mobile devices, in Portugal, based on page views



Source: [StatCounter](#) – data processed by the AdC.

Subsidisation strategies

123. **Platforms, when expanding, may subsidise the sides of the market. This strategy may encompass all sides of the market,** so that platforms may expand rapidly, accumulate network effects and subsequently gain a competitive advantage over competing platforms.

⁸³ This is in line with the General Data Protection Regulations and the Second Payment Services Directive.

⁸⁴ *Vide* speech by Johannes Laitenberger “EU Competition Law, Relevance anchored in empiricism”, CRA conference, 5 December 2018.

⁸⁵ For Apple devices, there are [reports of estimates made by Goldman Sachs’ analysts that claim that Google may have paid Apple 9 billion dollars in 2018 and that it will pay 12 billion dollars in 2019 to make its search engine default on the Safari browser and on the Siri virtual assistant.](#)

⁸⁶ Source: [StatCounter](#) – data processed by the AdC.

124. This subsidisation strategy was followed, for example, by Uber, which in its passenger transport platform has granted subsidies and discounts to both drivers and passengers in markets where Uber is not the leading platform. According to the Uber, this may have negatively affected its financial performance⁸⁷.

2.4.4. Methodological considerations in market power assessment

125. **The existence of cross-side network effects introduces additional difficulties when assessing the market power of a multi-sided platform.** Network effects may mitigate the informational nature of some of the most common indicators of market power, to the extent they affect the pricing structure of a platform. The price charged by the platform to each side of the market will reflect, at the same time, the cost of production and the network effects, both positive and negative, generated on other sides of the market.
126. **For this reason, a negative profit margin on one side of the market is not necessarily an indicator of more competition.** The sides that generate significant positive network effects may be subsidised by other sides of the platform. That may ultimately result in a zero-pricing or even negative price strategy on one side of the market. The subsidisation of the sides of the market that generate positive network effects is provided for by other sides of the platform that benefit from these externalities.
127. **A firm's Lerner index, in the context of a multi-sided platform, may lose its informational value⁸⁸ in the absence of adjustments that incorporate cross-side network effects.** In a multi-sided market, an operator may, as mentioned above, subsidise one (or more) side(s) of the platform to promote user participation on that side, with the aim of extracting benefits on another side of the platform, by charging higher prices⁸⁹. A simple Lerner index will account for this relationship and interpreting the value of these indicators alone may carry little informational value on the degree of market power. It is possible that the Lerner index is zero or negative on one side of the market and that, due to that subsidisation, the firm gains market power on another side of the platform. The economic literature puts forward and discusses some adjustments to the calculation of the Lerner index for multi-sided platforms, in order to incorporate these effects and restore the informational nature of this indicator of market power⁹⁰.
128. **Pricing pressure indicators, in the context of merger control, do not incorporate existing network effects,** including those generated within multi-sided platforms⁹¹. Accordingly, the calculation of these indicators for digital platforms may require adjustments to account for the multi-sided nature of the market⁹².
129. **As for market shares and concentration indices, these must be assessed in light of the network effects** on the different sides of platforms. A high market share on one side of a platform may entail, on another side of the platform, a higher market power than a simple market share would suggest.

⁸⁷ Uber Technologies Inc. (2019, pp. 26-27).

⁸⁸ Argentesi & Filistrucchi (2007).

⁸⁹ *Vide* Franck & Peitz (2019, pp. 84).

⁹⁰ *Vide*, among others, Rochet & Tirole (2003), Rochet & Tirole (2006) and, more recently, Belleflame & Peitz (2015, pp. 665) and Franck & Peitz (2019, pp. 84).

⁹¹ *Cfr.* Autoridade da Concorrência (2013). Linhas de Orientação para a Análise Económica de Operações de Concentração Horizontais (Horizontal Merger Guidelines).

⁹² The economic literature suggests some adjustments. *Vide, e.g.*, Affeldt et al. (2013) and Cosnita-Langlais et al. (2018).

130. **The interdependence between the sides of a multi-sided market also introduces specificities on the computation of market shares and concentration indices.** Depending on the type of the market, market shares can be defined according to the value or volume of sales. Moreover, depending on the availability and reliability of data, other measures of volume may be used, such as the number of active users on the platform, the number of queries to servers, page views or the number of user sessions⁹³. In this regard, the degree of user heterogeneity may make proxies that capture the intensity of use of the platform more relevant, as a complement to information on user shares⁹⁴.
131. **Market power assessment may be complemented with additional elements. The strategies adopted by a platform may indicate market power,** namely strategies that reduce the magnitude of network effects. This may be the case in a scenario where search engines, for example, have an incentive to distort search results, decreasing the quality of the search for consumers, in order to maximize the value of commissions obtained from sellers (the monetised side of the platform). This strategy may soften competition between sellers (*e.g.*, by giving more salience in search results to sellers who have paid higher commissions to the platform)⁹⁵.
132. In addition, the absence of market entry attempts may also signal the existence of strong barriers to entry and, as such, be an indicator of the incumbent's market power⁹⁶.
133. **In terms of the AdC's decisional practice, the approach to market power assessment, in the context of multi-sided platforms and big data, in a merger between digital platforms of classified ads (FixeAds/Custo Justo) should be noted.** With this merger, notified in June 2015, FixeAds proposed to acquire certain assets owned by Custo Justo. Both FixeAds and Custo Justo owned digital platforms on classified ads⁹⁷. This proceeding was terminated after the withdrawal of the merger by the undertakings, following the competition concerns identified by the AdC. In particular, the AdC considered that the transaction could have significantly reduced competition in the domestic market for classified ads in digital platforms. This conclusion rested on the high market shares of the brands of these two firms, the strong demand-side substitutability of the products provided by the two parties and the presence of cross-side network effects⁹⁸.

2.4.5. Access to data and competitive conditions

134. **Access to data, timely and with sufficient extent and coverage/reach may be a relevant dimension for competitive conditions,** given the importance data may have for firms in the different sides of the platform and the big data powered network effects.
135. Depending on the characteristics of each market, data may be a crucial input for firms to competitively provide their goods and services. The role of data as an input thus introduces a further dimension in the assessment of market power and competition that takes added relevance in the context of digital platforms.

⁹³ *Vide* the EC's decision, on 27 June 2017, in the Google Search (Shopping) case, COMP/AT.39740.

⁹⁴ *Vide*, on this example, Franck & Peitz (2019, pp. 71).

⁹⁵ *Vide* Franck & Peitz (2019, pp. 87-88) e Belleflamme & Peitz (2019).

⁹⁶ *Vide* Franck & Peitz (2019, pp. 87).

⁹⁷ Namely www.olx.pt, www.imovirtual.com, www.standvirtual.com e o www.coisas.pt.

⁹⁸ Cent. 26/2015 Fixeads/Ativos Custo Justo, proceeding terminated on 29 October 2015. *Vide* Press Release 25/2015, available [here](#) (in Portuguese).

136. In this context, the competitive advantage of incumbents may result from privileged access to data collected by a third party or client data gathered by the firm in the course of its activity. In the first case, the fixed costs associated with data collection may be smaller, but the variable costs may be more significant than in the case where data collection is a by-product of the firm's own activity⁹⁹.
137. **The accumulation of a vast and varied data set throughout time may provide the incumbent with a competitive advantage vis-à-vis its competitors**¹⁰⁰. This is particularly relevant in the case of multi-sided platforms based on big data, to the extent that data may improve the quality of the products supplied to the various sides platform. A search engine, such as that of Google, monitors user behaviour to improve its search algorithm, as well as recommendation/ranking algorithms on the advertising side (associated with Google Ads). This way, it generates direct and indirect network effects with big data.
138. **Note that data collection may only occur if users stay in the ecosystem.** As a result, the incumbent platform's advantage in terms of data collection, together with the side-lining of smaller players or newcomers, may be self-reinforcing, giving rise to a "snow-ball" effect¹⁰¹, to the extent that access to data allows the platform to improve its products/services, thereby attracting more users, which in turn bring further data to the platform.
139. **Access to data may thus become a barrier to entry and expansion, with an impact on the competitive conditions in the market,** given the difficulties of new entrants and smaller platforms to timely access the data they need in order to compete with the incumbent platform.
140. **This context may create the conditions for incumbents to engage in exclusionary strategies by restricting their competitors' access to the data they need to effectively compete in the market**¹⁰². The AdC's FinTech Issues Paper illustrates, within the digitalisation of the financial sector, the risk that incumbent banks foreclose FinTech competitors' access to client data. Also, the EC undertook, on October, 3th 2017, unannounced inspections in some Member States on suspicions that banks and their associations infringed the European competition legal framework, by impeding third party providers access to client data, in spite of the latter's consent¹⁰³.
141. **If this type of exclusionary strategy is adopted by firms with a dominant position in the market, and depending on the specificities of the case, they may amount to potential competition law infringements.** This possibility and the way in which this type of strategy may occur in the context of digital platforms and big data is addressed in a variety of reports (e.g., OCDE, 2016; Joint Report Autorité de la Concurrence & Bundeskartellamt, 2016; Crémer et al. 2019; Stigler et al., 2019).
142. **One of the potential exclusionary strategies in which data may take an instrumental role is the refusal to give access to data essential for the activity of firm that request the access.** The jurisprudence of the European Courts has circumscribed the cumulative circumstances upon which a refusal to give access can be incompatible with European competition law. In particular, it establishes that a firm in a dominant position in the supply of an infrastructure, product or service that is essential to compete in a downstream market, abuses its dominant position when it refuses to

⁹⁹ *Vide* Autorité de la Concurrence & BundesKartellamt (2016).

¹⁰⁰ *Vide* Crémer et al. Report (2019, pp. 30-31).

¹⁰¹ *Vide* Autorité de la Concurrence & Bundeskartellamt (2016).

¹⁰² *Vide*, e.g., CMA (2015).

¹⁰³ European Commission, MEMO/17/3761, available [here](#).

grant access to the infrastructure, product or service to its competitors, without an objective justification, with the effect of eliminating effective competition in the downstream market, in detriment to consumers. Additionally, in *Bronner*, the Court of Justice clarifies that an infrastructure, product or service can only be considered as essential or indispensable if there is no real or potential alternative and it is impossible or unreasonably difficult to replicate the infrastructure for technical, regulatory or economic reasons¹⁰⁴.

143. **To this respect, it is important to mention the debate regarding the suitability of the essential infrastructure doctrine in the case of access to data.** In the report prepared for the EC, Crémer et al. (2019) highlight the fact that the criteria were developed for “classic” infrastructure and, later on, for intellectual property rights and, as such, may not be the adequate framework to assess cases of refusal to grant access to data. Bourreau & de Streel (2019) highlight that the threshold for demonstrating a refusal to grant access to data may be lower than in cases of refusal to grant access to infrastructure or of intellectual property rights¹⁰⁵. The Stigler Report (2019) argues for the need to reconsider the refusal of access doctrine in the case of data, taking into account the dominance of digital platforms.
144. **In particular, Crémer et al. (2019) revisit the principles underlying the balance of interests in the essential facility doctrine and put forward some adaptations for the case of access to data.** In particular, they put forward as a key precondition, just as in the standard test, the indispensability of data to effectively compete in the market. They further propose a case-by-case assessment of the specific circumstances taking into account, on the one hand, the relevance of preserving the dominant firm’s incentives to invest and, on the other hand, the relevance of that strongly entrenched market positions, protected by high barriers to entry. In this analysis, they argue that the exclusionary effect associated with a refusal to grant access is particularly high when (i) the degree of concentration in the market is high and translates into a high degree of high degree of data concentration; and (ii) when data access grants an important competitive advantage in servicing neighbouring markets. The exclusionary effect, in these cases, may argue in favour of mandating access to data¹⁰⁶.
145. **Competitors’ access to data may also be strategically hindered by the dominant firm via exclusivity contracts** with third party data suppliers, or by creating obstacles to data portability.
146. Finally, in limiting the ability of rivals to achieve critical mass, the strategies aforementioned for their potential to strengthen the market power of digital platforms (section 2.4.3) may also limit rivals’ capacity to collect data and benefit from data-powered network effects.
147. **There is precedent of sanctioning decisions for anticompetitive practices where access to data played a crucial role**, albeit not in the context of multi-sided platforms.
148. In Portugal, the AdC has sanctioned the Associação Nacional de Farmácias (ANF, National Association of Pharmacies) of margin squeeze, via discriminatory access to commercial data on pharmacies. In this case, the data was considered as an input in

¹⁰⁴ *Vide*, in particular, Judgment of the Court of Justice of 26 November 1998, in case C-7/97, *Oscar Bronner/Mediaprint*.

¹⁰⁵ *Vide*, e.g., the Judgment of the Court of First Instance of 26 October 2001, in case T -184/01 R, *IMS Health Inc vs Commission* and the Judgment of the General Court, 27 June 2012, in case T-167/08 *Microsoft Corp. vs Commission*.

¹⁰⁶ *Vide* Crémer et al. (2019, pp. 98-107).

the downstream market of market studies, where both the ANF and other competitors participated¹⁰⁷.

149. In addition, in 2014, the Autorité de la Concurrence has accused the firm Cegedim of refusing to sell its medical database, the leading provider in France, to clients that used software from the firm Euris instead of its own, between 2008 and 2012, even though it would sell it to other customers¹⁰⁸. In both these cases, the competition authorities demonstrated the dominant position of the data holders in the relevant data market, the indispensability and uniqueness of the databases and the negative effect in downstream markets.
150. **Data access in the digital era has also been subject of legal and regulatory developments. In this regard, one should note the legal and regulatory framework in the context of technological innovation applied to the financial sector (FinTech).** New FinTech entrants require access to client data in order to provide some services, such as payments initiation or the aggregation of financial information. These data inputs, crucial to the activity of FinTech operators, are provided by incumbent banks.
151. In order to open the market to innovation and competition, and materialise the benefits that innovation may bring to efficiency and consumer welfare, the European Parliament and the Council approved, in 25 November 2015, the Second Payment Services Directive (PSD2) (*vide* Box 4)
152. **PSD2 requires banks, upon client consent, to grant access to client data to FinTech operators so that the latter may provide the payment service requested by the client.** In October 2018, the AdC published the Issues Paper “Technological Innovation and Competition in the Financial Sector in Portugal” (FinTech) where it identifies risks of foreclosure by the incumbent banks to the access of FinTech operators to client data, and issues recommendations aiming to mitigate this risk.
153. **The recommendations issued by the AdC in the Issues Paper FinTech focus on access to data, on the barriers to entry that result from consumer inertia and on the potential strategies incumbents may adopt to reduce market contestability, in a digital context.**

¹⁰⁷ Autoridade da Concorrência. (2015). *The Portuguese Competition Authority fined ANF Group for abusing its dominant position*. Available [here](#) (in English).

¹⁰⁸ Autorité de la Concurrence. (2014). *The Autorité de la concurrence has imposed Cegedim a 5.7 million euros fine for having abusively refused to sell its medical information database*. Available [here](#).

Box 4. Regulation and access to data in the context of digitalisation in the financial sector

In the context of the digitalisation of the financial sector, client account data held by banks may be a crucial input for new FinTech operators to provide payment services.

In this regard, the EU concluded there was need for a new directive for payment services, in order to ensure competitive conditions and innovation in the sector. The Second Payment Services Directive (PSD2)¹⁰⁹ aims to regulate access to client account data, so as to promote a payment market where consumers, retailers and firms benefit from greater innovation, choice and transparency. PSD2 imposes that payment services providers managing client payment accounts, such as banks, grant access to account information so that other payment service providers may, upon the consumers' consent, initiate payments on their behalf and aggregate their financial information.

The implementation of the legislation that regulates access to data poses some challenges. PSD2 is illustrative of some of the aspects that need to be safeguarded to avoid that access to data is hindered. PSD2 was accompanied by Regulatory Technical Standards¹¹⁰ (RTS) on open standards of communication. RTS establish the technical conditions according to which communication and data access must be implemented. For example, under RTS, providers holding payment accounts must make them accessible through APIs based on open standards. Even though the RTS detail how access to data must be guaranteed, challenges may remain in what concerns their effective implementation.

The AdC has identified a risk that incumbents may strategically promote or strengthen consumer inertia by hindering new FinTech players' access to data. The Issues Paper that the AdC published in October 2018¹¹¹, in order to promote competition in the Portuguese financial sector and the benefits of digitalisation for consumers, includes several recommendations that aim to effectively open the payment services sector to innovation and competition.

Among the recommendations issued, the AdC highlights the need to reduce the degrees of freedom granted to incumbents in the obligations to provide access to data. These degrees of freedom may be used, for example, to create unnecessary barriers to obtain consumers' consent to access their data, such as, increasing the number of steps to obtain consent or by creating hurdles in the customer journey. Incumbents may also reduce the coverage of the data other firms need to effectively provide their services. The AdC also highlights the importance of the time length between the client consent and access authorisation and that access to data is not, in any way, subject to charges, as that would undermine the very own objectives of PSD2.

Source: *Issues Paper AdC "Technological Innovation and Competition in the Financial Sector in Portugal"*.

154. Legislation on privacy and personal data protection, as well as data portability, are also relevant for data access in the context of competition policy . Data portability policies may reduce the advantages resulting from data-powered network effects, by allowing users to transfer their information to competing platforms (*vide* Box 5).
155. Alongside these developments, one should also note those related to the self-regulatory codes of conduct that address some of these issues.

¹⁰⁹ Directive (EU) 2015/2366 of the European Parliament and the Council of 25 November 2015.

¹¹⁰ Commission Delegated Regulation 2018/389/EU of 27 November, supplementing Directive (EU) 2015/2366 of the European Parliament and the Council, with regard to regulatory technical standards for strong customer authentication and common and secure open standards of communication.

¹¹¹ Autoridade da Concorrência. (2018). *Technological Innovation and Competition in the Financial Sector in Portugal*. Available [here](#). A preliminary version was submitted to public consultation in April 2018.

Box 5. Recent developments in regulation and self-regulation regarding access to data

The increasing digitalisation and the importance of data to develop goods/services has prompted the discussion and adoption of instruments and policies aimed at ensuring data openness, as well as greater security and consumer/user trust.

At the European level, it is important to highlight two regulations, one on **personal data** and another on **non-personal data** that aim at establishing a clear legal regime on how data should be handled. These regulations are integrated in the overall EU strategy for the Digital Single Market.

- **General Data Protection Regulation**¹¹²: sets rules for protecting citizens in what regards the processing and the free movement of their personal data. In article 20, the GDPR grants the right to data portability, determining that the data owners may give consent to have their personal data transmitted between parties.
- **Regulation on the free flow of non-personal data**¹¹³: sets rules for the free flow of non-personal data in the EU, in order to remove barriers associated with data mobility. In particular, the regulation establishes rules on the location of data, on the availability of data for competent authorities and on data portability between professional users. Regarding data portability, the regulation aims at promoting the development of self-regulatory codes of conduct, in order to contribute to a competitive data economy, based on the principles of transparency and interoperability.

The development of codes of conduct aimed at establishing principles for providers of digital goods and services has also been addressed in other contexts.

- In May 2019, the OECD published a recommendation which identifies a **set of principles for the use of artificial intelligence**. The OECD's recommendation aims to promote innovation and the trustworthiness of artificial intelligence through principles of inclusive growth, fairness, transparency, safety and accountability¹¹⁴.
- The Furman Report (2019) recommends **the development of a specific code of conduct for digital platforms with a "strategic market status"**¹¹⁵ to clarify the conduct of these platforms in relation to their users and other platforms. The report proposes principles, such as ensuring third parties access to designated platforms and reviews and rankings on a fair, consistent and transparent basis.
- The development of codes of practice is also argued for, in broader sense, in a discussion/report from March 2019 on regulation in the digital world. It also **calls for the establishment of a Digital Authority** with regulatory powers in the digital sector, in particular for incumbent platforms¹¹⁶.
- In February 2019, the UK government published the final version of the **specific code of conduct for data in the health sector**, which sets principles to be followed by suppliers, developers and users of data-driven technologies¹¹⁷.

2.4.6. Pre-emptive mergers, killer acquisitions and data-driven mergers

156. **In a context of competition for the market, incumbent platforms may adopt an aggressive merger policy**¹¹⁸, directed at firms that are still developing their products or that have recently entered the market and are in an initial expansion phase – **pre-**

¹¹² Regulation (EU) 2016/679 of the European Parliament and of the Council, of 27 April 2016, on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Available [here](#).

¹¹³ Regulation (EU) 2018/1807 of the European Parliament and of the Council, of 14 November 2018, on a framework for the free flow of non-personal data in the European Union. Available [here](#).

¹¹⁴ Vide [Recommendation of the OECD Council on Artificial Intelligence](#), adopted on 22 May 2019.

¹¹⁵ According to the Furman Report (2019), these platforms can exercise market power on a bottleneck of a given digital market, controlling, thus, the access of potential entrants or competitors to the market.

¹¹⁶ House of Lords, Select Committee on Communications. (2019). *Regulating in a digital world*. Available [here](#).

emptive mergers. These mergers may target assets of the acquired firms, including infrastructures, patents, brands or human capital.

157. **Pre-emptive mergers may aim to integrate the goods and services of the acquired firms in the ecosystem of the incumbent platform, in order to protect or strengthen the ecosystem.** In this sense, pre-emptive mergers maintain or increase the value of the platform, by ensuring that network effects are generated inside the platform's ecosystem.
158. **A good or service that induces users to abandon the ecosystem may reduce the magnitude of network effects in the ecosystem and/or transfer those network effects to competing platforms or ecosystems**¹¹⁹. In an audience-providing platform, decreasing the number of potential consumers reduces the attractiveness of the platform for the advertiser side; whether due to smaller target audiences or due to the lower volume and diversity of data gathered about users.
159. **Additionally, pre-emptive mergers may aim to delay, discontinue or limit the scope of ongoing innovation projects or the introduction of innovative products in the market – killer acquisitions –, at the expense of consumer welfare.** This may be the case namely when there is high substitutability between the new products of the acquired firm and the products provided by the incumbent, so as to avoid profit cannibalization¹²⁰. Killer acquisitions may aim at concentrating, in the incumbent, assets which are difficult to replicate, such as data, infrastructure or human capital. Killer acquisitions, to the extent they limit innovation and the expansion of competitors in the market, may reduce market contestability and consumer welfare.
160. In multi-sided markets with a tendency towards concentration, the threat of a reduction of network effects may confer additional incentives for incumbents to engage in killer acquisitions.
161. **Acquisitions aiming to incorporate goods and services in the ecosystem and killer acquisitions may also be driven by the threat of potential competition posed by the target firm.** The diversion of users away from the incumbent to another firm may enable other players active in related digital markets to enter the core market of the incumbent.
162. **The risk of elimination of potential competition in multi-sided platforms is strengthened by the ability of incumbent platforms to gather data about the market and the profile of their users, in real time.** This ability allows incumbent firms to monitor market trends and quickly detect competitive threats for the ecosystem. This detection may trigger strategic reactions by the incumbent to protect its ecosystem and close possible “entry points”¹²¹ to the market, namely by acquiring new entrants or through other pre-emptive strategies (*vide* paragraph 108 and subsequent paragraphs). This effect has been referred to as the creation of “kill zones”¹²² (*e.g.*, Stigler Report, 2019 and Bourreau & de Streel, 2019) or “zones of interest”¹²³ (*e.g.*,

¹¹⁷ *Vide* [Code of conduct for data-driven health and care technology](#). Also in the UK, in April 2019, a code of practice for providers of online social media platforms was approved, so as to set out the principles these platforms should adopt, to ensure the rights of users. *Vide* [Statutory Code of Practice for providers of online social media platforms](#).

¹¹⁸ See, as an illustration, that, according to Wikipedia, Google (1998), since its foundation, [has participated in 225 mergers](#), almost one each month. Facebook (2004), on the other hand, [has participated in 76 mergers](#), almost one every two months.

¹¹⁹ See, on this point, the theory of harm proposed in the Crémer et al. (2019, pp. 121-123).

¹²⁰ Cunningham et al. (2019).

¹²¹ *Vide* “nowcasting radar” in Grunes & Stucke (2015, pp. 287).

¹²² *E.g.*, Stigler Report (2019, pp. 53-57) and Bourreau & de Streel (2019, pp. 21-23).

¹²³ *E.g.*, Crémer et al. (2019, pp. 121)

Crémer et al., 2019), where incumbents react strategically with the aim of eliminating/mitigating potential competition to protect the core of their ecosystem¹²⁴.

163. **Access to data may be one of the motivations, or even the main motivation, prompting a merger.** In merger control in the context of big data and digital platforms, it may be relevant to assess the merger's impact on competition in what concerns access to data. In this analysis, the legislation on privacy and data protection should be taken into account¹²⁵.
164. **If the merger brings together different databases, then it may be particularly relevant to assess the horizontal overlap between merging parties in the market for data.** On the other hand, data as an input and the role of access to data in digital ecosystems may raise vertical and/or conglomerate competition concerns, namely in terms of risks of foreclosure of rivals' access to data and data pooling with the aim of strengthening ecosystems. In the Microsoft/LinkedIn merger, for example, the EC analysed the impact bringing together the merging parties' databases¹²⁶ for digital advertising and the risk of foreclosure of competitors' access to LinkedIn's data as an input for machine learning. In the Google/DoubleClick case, as both parties had large volumes of data, the EC assessment has also looked at data, namely in terms of network effects and the risk of foreclosure.
165. **When assessing market power, it is important to consider the impact of the merger in strengthening data-driven network effects.** More broadly, merger analysis may also focus on the pooling of resources in an ecosystem. The pooling of data in a single firm, following a merger, may have an impact in the market. It may also be relevant to assess the impact of data pooling on the ability of the merged entity to, post-merger, engage in price discrimination and extract consumer surplus (*vide* paragraph 242).
166. **In what regards mergers in the digital space, it is relevant to highlight that firms may enter the market aiming to be acquired by an incumbent – entry for buyout.** This allows entrants to appropriate part of the incumbent's profits. The effects of mergers in the digital space on the incentives to innovate have been under discussion. Cabral (2018) concludes that the acquisition of start-ups by incumbents creates incentives for incremental innovation (*competition in the market*) and reduces incentives to disruptive innovation (*competition for the market*). On this point, Tirole (2019)¹²⁷ highlights that entry for buyout has a negligible impact on social welfare, as it is limited to entrants capturing part of the incumbent's profits. He also argues that a pattern of market entry driven by the expectation of a buyout, followed by an acquisition by the incumbent, may weaken competition and eliminate price competition, and that in killer acquisitions the product itself may be removed from the market¹²⁸.
167. **Mergers in multi-sided markets may be associated, amongst others, with efficiencies resulting from network effects**¹²⁹. In this context, a merger may generate direct efficiencies for the consumer, *e.g.*, if the merging of platforms or the expansion of the ecosystem increases the valuation consumers attribute to the platform.

¹²⁴ *Vide*, for example, Stigler Report (2019) and Bourreau & de Streel (2019).

¹²⁵ It should be noted that some authors have argued for considering privacy as contributing to the quality of a product – EDPS (2012), Lande (2008), Stucke & Grunes (2015) and Newman (2013).

¹²⁶ Databases on personal information, such as job, career, personal network, e-mail addresses, telephone numbers, search history, among others.

¹²⁷ *Vide* Tirole (2019), *Regulating the disrupters*. Project Syndicate.

¹²⁸ *Vide* [speech by Jean Tirole in the conference "Shaping Competition in the Era of Digitalisation"](#), organised by the EC.

¹²⁹ *Vide* Autoridade da Concorrência (2013, pp. 110-111). *Linhas de Orientação para a Análise Económica de Operações de Concentração Horizontais* (Horizontal Merger Guidelines).

168. **However, in order for these efficiencies to be considered and weighted against the potential negative effects of the merger on competition, it is on the merging parties to show that they are verifiable and merger-specific.** In this respect, it is important to consider whether the firms could generate the same alleged efficiencies in alternative scenarios, less restrictive for competition (*e.g.*, interoperability agreements or access to data). Moreover, firms must show that the resulting benefits will be passed on to consumers.
169. **One of the challenges that has arisen for merger control in the digital era is the risk that pre-emptive mergers escape competition authorities' scrutiny for not meeting the legally established notification thresholds.** In the absence of scrutiny from competition authorities, these mergers may harm consumer welfare. In addition, these limitations may give added incentives for incumbents to acquire potential competitors very early on, so as to circumvent merger control. The Furman Report (2019) highlights some mergers in digital markets, their potential impact on competitive conditions and the fact that many have not been subject to merger control¹³⁰.
170. **Under the Portuguese Competition Act¹³¹, mergers are notifiable if they meet a set of criteria that combine market shares and business turnover – *vide* Box 6.** Using thresholds based on market shares may mitigate this issue, to some extent, by increasing the likelihood that at least some of these mergers meet the notification thresholds. Indeed, the Apple/Shazam and Facebook/WhatsApp mergers met the legally defined notification thresholds in Spain. As Crémer et al. (2019) highlight, the Apple/Shazam case was analysed by the EC after a referral by several Member States¹³². The Google/Waze and Facebook/Instagram cases, which were not the scrutiny of the EC, were analysed by the CMA under the “share of supply” notification criterion.

Box 6. Notification thresholds under the Portuguese Competition Act

Under the Portuguese Competition Act, a merger is notifiable if any of these conditions is met (*cfr.* article 37 of Law 19/2012, of 8 May):

- a. Following the merger, the resulting firm reaches or reinforces a market share equal to or larger than 50% in a given relevant market;
- b. Following the merger, the resulting firm reaches or reinforces a market share equal to or larger than 30% but lower than 50%, if the business turnover for the preceding year of the at least two of the undertakings exceeded 5 million euros;
- c. The undertakings have an aggregate business turnover for the preceding year of, at least, 100 million euros, and the business turnover for the preceding year of at least two of the undertakings exceeded 5 million euros.

171. **These concerns have triggered a discussion on adjustments to the notification thresholds to increase the likelihood that pre-emptive mergers are subject to merger control.** In 2017, Germany and Austria expanded their notification thresholds by introducing transaction value thresholds. As a result, any merger whose transaction

¹³⁰ Furman Report (2019), pp. 11.

¹³¹ Law 19/2012, of 8 May.

¹³² According to the EU competition law, the cases notified in Member States or in the EC may be referred, respectively, to the EC or to Member States, under the referral system, *cfr.* Council Regulation No 139/2004 of 20 January 2004 on the control of concentrations between undertakings (EUMR). The Apple/Shazam merger was analysed by the EC following a request by Austria, France, Iceland, Italy, Norway, Spain and Sweden. The transaction was initially notified in Austria.

value is greater than 400 million euros has become notifiable in Germany¹³³. In Austria, the threshold is 200 million euros¹³⁴. The German and Austrian competition authorities have jointly issued guidelines on the application of this new notification threshold¹³⁵. These new notification thresholds have allowed the Microsoft/GitHub¹³⁶ merger to be referred to the EC. However, so far, no killer acquisitions have been captured, and the mergers notifiable under this new transaction value threshold have been mainly related to the pharmaceutical and healthcare sectors¹³⁷.

172. **Ex-post merger control has been addressed in the discussion as it gives competition authorities greater ability to capture pre-emptive mergers.** This possibility is under discussion in France¹³⁸ and was implemented in Hungary, Ireland, Lithuania, the UK and Sweden¹³⁹. Outside Europe, the Canadian competition authority, for example, may assess and oppose mergers one year after the transaction is closed, even though this legal mechanism is rarely used¹⁴⁰. It should be noted, however, that the *ex-post* merger control systems have not necessarily arisen associated with the digital economy.
173. **Another concern addressed in the discussion on pre-emptive mergers is the scarcity of information required for merger control analysis**¹⁴¹. Pre-emptive mergers often occur when the acquired firm is yet to gain a foothold in the market and in markets characterised by innovation. For this reason, the lack of data may hinder these mergers' competitive assessment.
174. **The limitations of merger control in the digital economy have prompted some proposals** regarding the substantive assessment of a merger's impact on competition. The Furman Report (2019) proposes, in its recommendation n.º 10, a change in the UK's legal framework to allow for a test which takes into account the scale as well as the likelihood of harm a merger may bring to competition¹⁴². Crémer et al. (2019) consider that it is not necessary to change the substantive assessment of EUMR's "significant impediments to effective competition". Nonetheless, they argue that theories of harm should be revisited to properly assess specific cases, such as the acquisition, by dominant platforms and/or ecosystems protected by strong network effects and data access, of target firms with low turnover but with a large or fast-growing user base and with a high potential for future growth.
175. **The reversal of the burden of proof for potential anticompetitive effects has been suggested as a means to deal with the challenges associated with the scarcity of information, albeit limited to specific mergers.** In particular, the suggestions are to limit the reversal of the burden of proof to contexts where markets are highly concentrated, characterised by strong network effects and significant barriers to

¹³³ [Article 1 of the Neues Gesetz zur Änderung des Gesetzes gegen Wettbewerbsbeschränkungen \(GWB\), of 1 June 2017](#), which alters, among others, [article 35\(1a\) of GWB](#).

¹³⁴ [Article 1 of the Kartell- und Wettbewerbsrechts-Änderungsgesetz 2017, of 24 April 2017](#), which alters, among others, [article 9\(4\) of the Kartellgesetz \(KartG\)](#).

¹³⁵ Bundeskartellamt (Germany) & Bundes Wettbewerbs Behörde (Austria). (2018). Guidance on Transaction Value Thresholds for Mandatory Pre-merger Notification (Section 35 (1a) GWB and Section 9 (4) KartG). Available [here](#).

¹³⁶ Microsoft/GitHub, COMP/M.8894.

¹³⁷ MLex (2019). *Merger-value thresholds catch few deals and no unicorns in Austria, official says*.

¹³⁸ ["Reform of merger law and ex-post control"](#), document accompanying the press release ["Modernization and simplification of merger control"](#), de 7 June 2018, from the Autorité de la Concurrence (France).

¹³⁹ *Ibid.*

¹⁴⁰ Competition Bureau (Canada). (2017, pp. 20).

¹⁴¹ *E.g.*, footnote no. 128.

¹⁴² Nonetheless, the CMA considers that the UK's legal framework already allows for a proper analysis of these cases, *cfr.* [CMA's letter to BEIS - Digital Competition Expert Panel recommendations – CMA view](#).

entry¹⁴³ and mergers occur in the beginning of the life cycle of the target firm's products¹⁴⁴.

176. In the discussion on the need to adjust the competition legal framework to deal with the challenges posed by the digital economy, the potential effects of the proposed changes in terms of legal uncertainty of merger control, as well as additional bureaucratic and transaction costs for the parties involved, have been highlighted¹⁴⁵.

¹⁴³ *Vide* Crémer et al. (2019, pp. 51).

¹⁴⁴ *Vide* footnote no. 128.

¹⁴⁵ See Crémer et al. (2019, pp. 10) on the possibility of altering notification thresholds in the EU competition law (EUMR).

3. BIG DATA AND ALGORITHMS

177. Big data has allowed the development of tools that aid firms' decisions on strategic variables and facilitate product discovery. In particular, **pricing, monitoring, ranking and recommendation algorithms** allow firms to adapt their strategies to their competitors, discriminate prices and facilitate product discovery.
178. The availability of large volumes of data and of means for data analysis and the proliferation of price comparison services have made consumers more informed, increased available options and created conditions for new firms to enter the market, to the benefit of competition.
179. **These algorithms may, nonetheless, change the way in which competition takes place in the market.** Algorithms may, on the one hand, structurally change firms' pricing strategies in the market (*e.g.*, as a result of their increased or decreased ability to price discriminate). On the other hand, their use may change the nature of firm interaction in the market by, for example, increasing their ability to reach collusive equilibria, whether explicit or tacit (*e.g.*, by making it easier to detect deviations from collusive equilibria or by reducing the time span for retaliation).
180. **Additionally, the use of algorithms may affect the market outcome, for example, in terms of welfare distribution,** if firms have an increased ability to appropriate consumer surplus.
181. **Pricing algorithms may be used both to set uniform prices (*i.e.*, when there is no price discrimination) and to implement price discrimination.** In a uniform pricing strategy, there is a single price in the market for all consumers, at a given point in time. Price discrimination, in turn, may be direct or indirect¹⁴⁶. Price discrimination is direct¹⁴⁷ when the pricing decision is based on the consumers' observable characteristics, used to obtain an estimate of their willingness to pay. There is indirect price discrimination¹⁴⁸ if firms display different price menus to consumers who subsequently self-identify their types.
182. **The different pricing policies adopted by firms will depend on the specificities of each market,** namely on strategic considerations, on the type of information that may be gathered and utilised, on the distribution of consumer heterogeneity, on how consumers acquire products, or on social norms.
183. **Monitoring algorithms are automatized systems implemented by firms to track the evolution of strategic decisions of their competitors, namely prices.** Monitoring may be done up to real time and encompass a large volume and variety of products. As such, monitoring algorithms allow firms to quickly detect changes in their competitors' strategic decisions, such as occasional rebates.
184. **Monitoring algorithms may also be used in tandem with pricing algorithms,** which tend to be demanding in terms of information.

¹⁴⁶ In some cases, price discrimination may be random. This will happen, namely, if a firm is trying to infer the shape of the demand curve for its products. Hence, the firm exhibits slightly different prices to random consumers to measure their price sensitivity. See, in this context, the [“random price tests” used by Amazon in 2000](#), as well as the case of ZipRecruiter, a marketplace for jobs, which [charged random prices to firms publishing employment adverts](#).

¹⁴⁷ In this case, price discrimination is said to be direct, because it is the firm that segments consumers into different types. Direct price discrimination includes first-degree price discrimination, third-degree price discrimination and personalised pricing.

¹⁴⁸ In this case, price discrimination is said to be indirect, because consumers segment themselves into different types. Indirect price discrimination is also known as second degree price discrimination.

185. **Monitoring algorithms may, nonetheless, be used independently of pricing algorithms *per se*.**
186. Lastly, **ranking and recommendation algorithms¹⁴⁹ are implemented in recommendation systems, digital advertising and search services.** These algorithms focus on other strategic variables, such as exhibiting (or not) products to consumers and the salience of the exhibition.
187. Monitoring, pricing, ranking and recommendation algorithms may be developed internally by firms, implemented by third parties or be available in open-source.
188. **Gathering information about consumers, monitoring the strategies of competitors and adjusting the price/other strategic variables based on the information gathered has always been part of the normal functioning of any market.**
189. **However, the frequency and/or extent of monitoring are intensified in the digital economy.** Moreover, big data and algorithms strengthen the ability of firms to promote the discovery of their products by customers, even though firms have also always resorted to strategies with this purpose.
190. As such, while the current conceptual framework of competition policy remains adequate to assess the competition issues raised by big data, incorporating these new realities in competitive assessments requires further emphasis on some aspects often less relevant in traditional markets.

3.1. Prevalence of use of pricing and online monitoring algorithms (in Portugal)

191. **During the preparation of this Issues Paper, the AdC made a request for information to a sample of firms active online in Portugal, so as to understand the role played by new digital technologies,** such as monitoring and pricing algorithms, in defining firms' strategies. Box 7 provides a summary of the questionnaire and the group of inquired firms.

¹⁴⁹ These algorithms are referred to as "selection algorithms" in this Issues Paper.

Box 7. Inquiry by the AdC in order to understand the role of new digital technologies on firms' strategies

In April 2019, the AdC made a survey on the use of monitoring and pricing algorithms by firms, while undertaking their activities in the market. The AdC gathered the answers of 38 firms with active online presence in Portugal in several economic sectors on the following questions:

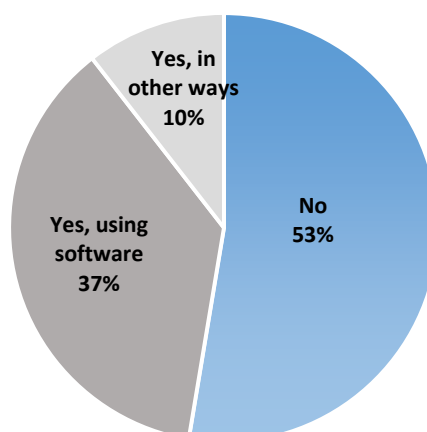
- (i) Do you systematically track the online prices of your competitors?
- (ii) If you systematically track the online prices of your competitors, which methods do you use?
 - Software that tracks prices
 - Purchase of information on prices from a third-party
 - Another method (specifying which)
- (iii) If you use software to track the online prices of your competitors, how is that software developed?
 - Internally
 - By third-parties (specifying the third-parties)
 - Both internally and externally (specifying the third-parties)
- (iv) Do you use software to set the prices of your products automatically?
- (v) If you change your online prices automatically, how is the algorithm you use developed?
 - Internally
 - By third-parties (specifying the third-parties)
 - Both internally and externally (specifying the third-parties)
- (vi) If you use software to track the online prices of your competitors, do you adjust your own prices in response to changes in the online prices of your competitors?
 - Yes, manually
 - Yes, automatically
 - Yes, both manually and automatically
 - No

The inquired firms included firms active in the following sectors: (i) passenger car rentals; (ii) retail of cultural and recreational goods; (iii) retail of other equipment for domestic use; (iv) retail of other products; (v) clothing retail; (vi) supermarkets and hypermarkets; (vii) non-specialised retail; (viii) mail order and online retail; and (ix) booking services and related activities.

192. **The information gathered sheds some light on the frequency of usage of monitoring algorithms to track competitors' prices, with about 37% of firms reporting using this type of algorithms – vide Figure 5.** From the responses, it was found that 47.4% of the inquired firms systematically track the online prices of their competitors, among which 77.8% stated using software to do so.

Figure 5: Price monitoring and algorithms

Do you systematically track the online prices of your competitors?

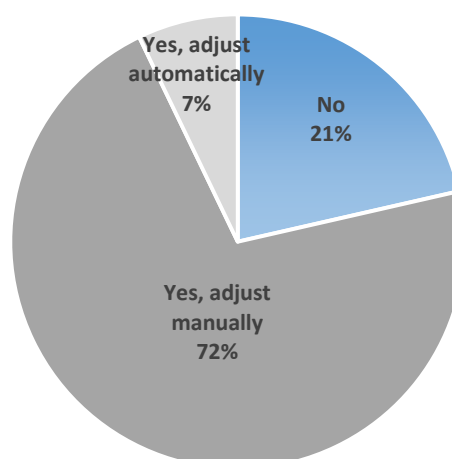


Source: Answers to a questionnaire by the AdC – Box 7, questions (i) and (ii).

193. Moreover, amongst the firms that stated systematically tracking the online prices of competitors, 33.3% said they purchased pricing information from a third-party, 22.2% stated they check the webpages of their competitors and 33.3% reported combining more than one of these methods.
194. Among the inquired firms that reported using software to systematically track the online prices of their competitors, 78.6% noted they adjust their prices in responses to changes in the online prices of their competitors. All firms said they do these price adjustments manually, albeit one of them claimed it also does these adjustments automatically.

Figure 6: Price monitoring, algorithms and price adjustments

If you use software to track the online prices, do you adjust your own prices in response to changes in the online prices of your competitors?



Source: Answers to a questionnaire by the AdC – Box 7, question (vi).

195. **From the responses, it was found that monitoring algorithms are developed by third-parties.** All inquired firms that reported using software to systematically track the online prices of their competitors stated that the software they use is developed by a third-party. Amongst the identified third-party developers, two are used by more than

one of the inquired firms. One of these software is used by four firms, while the other is used by two firms.

196. **The use of pricing algorithms is still relatively uncommon among the inquired firms active online in Portugal. Only 7.9% of the inquired firms reported using software that sets prices automatically.** All firms stated that this software is developed internally, and one of them also mentioned that the software it uses is also developed by a third-party.
197. **Despite the small sample size, these results are, in general, in line with those obtained in the sector inquiry on e-commerce of consumer goods and digital content in the EU,** launched by the EC in May 2015. The final report, as well as the accompanying Commission Staff Working Document, were published by the EC in May 2017.
198. **In their results, the EC reports that, in 2016, 49.0% of the inquired retail firms tracked the online prices of their competitors, among which 66.6% resorted to specialised software to do so.** Monitoring the online prices of competitors is more common among the largest firms¹⁵⁰.
199. According to the EC report, amongst the firms that use software to track the online prices of their competitors, 78% reported to adjusting their own prices in response to their competitors' prices. In particular, about 35% did these adjustments using specific software to set prices¹⁵¹ and about 43% adjusted their prices manually¹⁵².

3.2. Monitoring algorithms

200. **Monitoring algorithms provide firms with more complete and accurate information about the strategic behaviour of their competitors.** Monitoring competitors and holding information on their strategic variables is part of the normal functioning of the competitive process.
201. **Information on firms' strategic variables may be gathered by monitoring algorithms through APIs¹⁵³** associated with e-commerce platforms or marketplaces. See, as an illustration, Amazon's marketplace, where a third-party seller¹⁵⁴ can automatically track the price of other sellers through an API provided by Amazon itself, Amazon MWS (Marketplace Web Service)¹⁵⁵.
202. **In addition, firms may resort to web scraping techniques to monitor their competitors.** For this, firms develop specific algorithms for each competitor monitored to gather the information available, for example, on their online stores.
203. **Third-party providers of monitoring algorithms may also have an agreement with the firms they monitor.** In these agreements, retailers regularly send (e.g., up to several times a day) data feeds to the third-party provider of monitoring algorithms, containing strategic information about their products (e.g., prices). These agreements may be also be associated with price comparison services for consumers, as in the case of Kuantokusta/PriceBench¹⁵⁶, in Portugal.

¹⁵⁰ European Commission (2017a, pp. 175).

¹⁵¹ Frequently, the same software used to track prices. *Ibid.*

¹⁵² *Ibid.*

¹⁵³ *Application Programming Interface*

¹⁵⁴ It should be noted that third-party sellers account [for more than half of the units sold on Amazon](#).

¹⁵⁵ *Vide* Amazon MWS' documentation, available [here](#).

¹⁵⁶ *Vide* <https://www.kuantokusta.pt/> and <https://www.pricebench.pt/>.

204. **The bundle of goods to be monitored may be identified using standardised product identification numbers**, namely EAN-13 (European Article Number, with 13 digits) – also known as **barcodes**. Other identification numbers that can be used include, for example, SKUs (Stock Keeping Units), used on Amazon; or ISBN (International Standard Book Number), usually available in online bookstores. Products may also be identified from images, descriptions, keywords, or their name or model¹⁵⁷.
205. **The information about products may be displayed graphically on a dashboard, an interactive panel where the firm may specify on-demand the products, timeframe and competitors it wishes to monitor**. In the case of prices, a dashboard can provide some descriptive statistics on competitors' prices for a given product, such as the prevailing price or mean, median, minimum or maximum prices in a given period (*vide* Figure 7, for an example). In addition, a dashboard may include graphs that display the evolution of the prices of a given product across time, for each competitor. These may also include time series on minimum, average and/or maximum prices for each period (*vide* Figure 8, for an example).

Figure 7: Descriptive statistics on competitors' prices – Detail on the dashboard of the monitoring algorithm Minderest

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







New export

Display

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Product	Price	Min. Price	Max. Price	amazon.market	elcorteingles	carrefour	fnac
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 Tv led 40" - samsung 40ju6400, ultra hd, s	▲ 692.00	554.88 -25%	679.00 -2%	641.89 -8%	-	▼ 554.88 -25%	643.28 -8%
 Tv led 40" - sony 40r550c, full hd, wifi	▲ 429.00	395.38 -9%	399.00 -8%	396.50 -8%	399.00 -8%	399.00 -8%	▼ 395.38 -9%
 Ue50ju6800kxxc	872.64	814.98 -7%	899.00 +3%	823.30 -6%	-	▼ 814.98 -7%	
 Tv led 32" - philips 32phh4100/88 100hz p	222.00	200.77 -11%	239.00 +8%	▼ 200.77 -11%	▲ 239.00 +8%	229.00 +3%	
 Tv led 24" - philips 24phh4000/88, hd read	149.00	144.39 -3%	159.00 +7%	▼ 144.39 -3%	-	149.00	
 Tv led 48" - samsung ue48ju7500, curvo, u	1322.00	1199.00 -10%	1498.01 +13%	▲ 1498.01 +13%	-	1348.44 +2%	
 Tv led 55" - samsung 55ju6400 ultra hd, s	▲ 1095.00	999.00 -10%	1076.93 -2%	1076.93 -2%	-	1049.00 -4%	
 40ph5500/88	▲ 429.92	394.00 -9%	406.98 -6%	▼ 394.00 -9%	-	406.98 -6%	
 Tv led 50" - lg 50lf5800, fullhd, smart tv, wi	688.00	549.00 -25%	699.00 +2%	569.00 -21%	▲ 699.00 +2%	579.00 -19%	

Showing 1 to 10 of 44 results

First

Previous

1

2

3

4

5

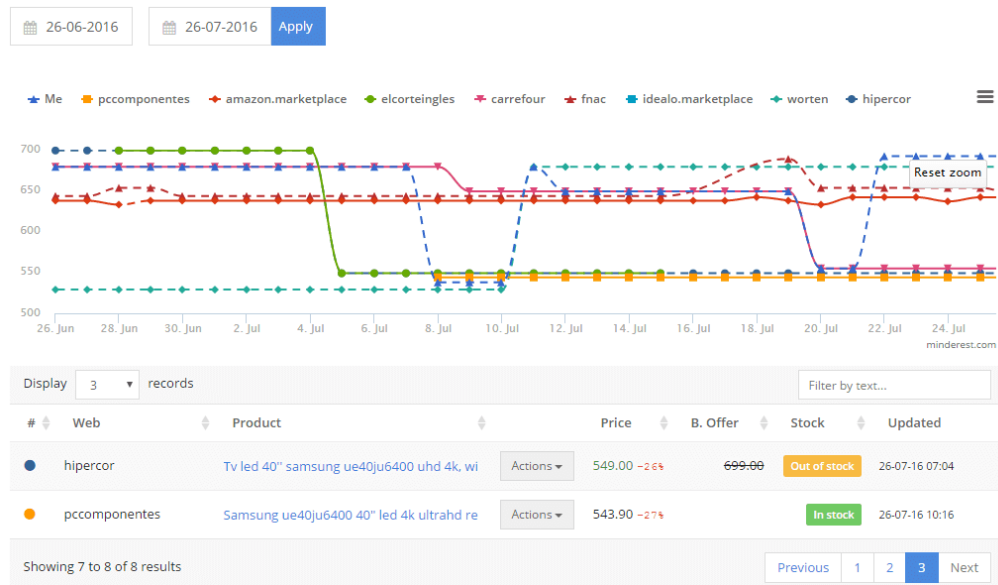
Next

Last

Source: [Minderest](#)

¹⁵⁷ See, for example, the [presentation of the monitoring algorithm Edited](#), designed for online clothing retail. It resorts to computer vision and natural language processing to identify products.

Figure 8: Evolution of competitors' prices across time – Detail of the dashboard of the monitoring algorithm Minderest



Source: [Minderest](#)

206. **The information gathered about competitors is not limited to prices.** It may also include, for example, the stock or catalogue of available products. This information allows firms to track competitors' online stores, for example, in terms of new products.
207. **Monitoring algorithms may also be used by consumers, in price comparison services.** These may intensify market competition, due to the increase in vertical transparency (*i.e.*, between sellers and consumers) and the reduction of search costs.

3.3. Pricing algorithms

3.3.1. Uniform pricing

208. **The use of algorithms to set uniform prices** (*i.e.*, each firm sets, for the same product, a single price in the market for all consumers, at a given point in time) **allows firms to rapidly react to changes in market conditions, without the need for direct human intervention at all times.**
209. **Pricing algorithms may be implemented so that firms can rapidly react to changes in the strategic behaviour of their competitors.** Therefore, if a competitor, for example, offers a discount for a range of products, the firm may react by reducing its prices as well. This strategy may be adopted, in particular, in e-commerce platforms and/or marketplaces. This is well illustrated by the wide range of specific pricing algorithms available for Amazon¹⁵⁸, which may be acquired by third-party sellers on the platform. Amazon's API for third-party sellers, Amazon MWS, allows them to easily integrate external pricing algorithms and also provides its own pricing algorithm, albeit with less features¹⁵⁹.
210. **These pricing algorithms may be associated with dynamic pricing strategies¹⁶⁰, which aim to balance demand and supply in the market, at each period of time.** Dynamic

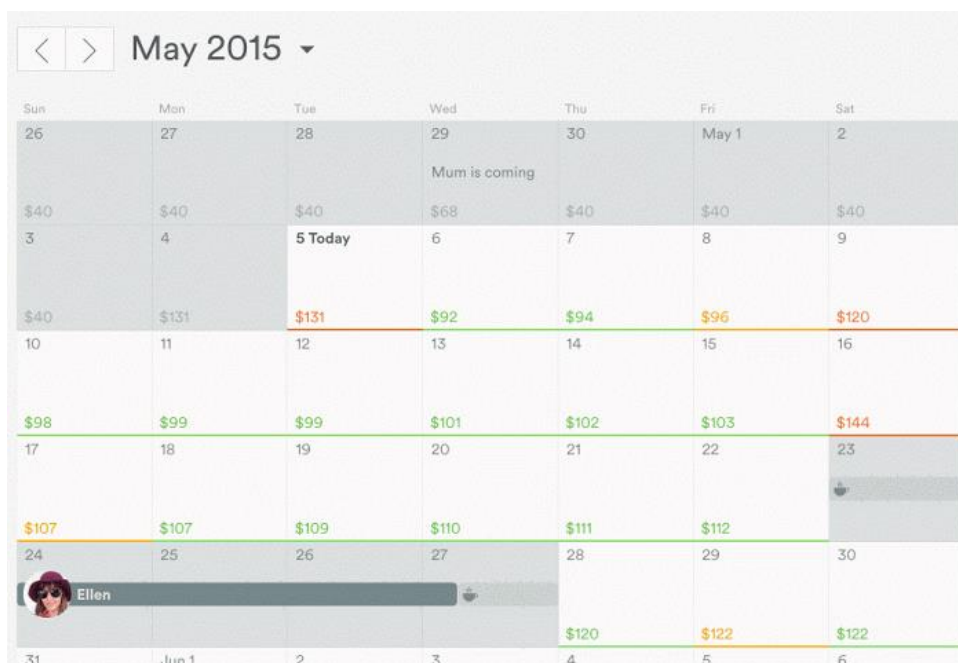
¹⁵⁸ Some of the pricing algorithms that may be used in Amazon's marketplace may be found in webpages targeted to online retailers, [such as this one](#). See, in addition, [a demonstration video presenting the features of one of these pricing algorithms](#), RepricerExpress, available on its developer's YouTube channel.

¹⁵⁹ *Vide* [an article on the creation of "pricing rules" in Amazon UK's help section for third-party sellers](#).

¹⁶⁰ Also known as surge pricing.

pricing may be used in digital platforms, in sectors such as passenger transportation (e.g., Uber¹⁶¹) or short-term rentals (vide Figure 9, for Airbnb's case¹⁶²). Therefore if, for example, an event attracts many people to a given place, such as a concert or a football match, there will be an increase in demand for transportation and hospitality services. These platforms, in response, will increase the price of these services, decreasing demand, increasing supply and balancing the market.

Figure 9: Price suggestions to Airbnb hosts – Detail of the pricing algorithm Aerosolve



Source: [Airbnb Engineering & Data Science](#)

211. **Pricing algorithms may be a source of allocative efficiency to the extent they promote the equilibrium between supply and demand in the market at each period of time.** Nonetheless, consumers may perceive dynamic pricing as unfair, especially when price increases result from *force majeure* events, such as storms, natural disasters or terrorist attacks. In a snowstorm in New York, for example, Uber increased its prices up to 8.25 times their base rate. These price changes caused a backlash¹⁶³ and led Uber to revise its pricing policy. Uber reportedly introduced limits to price increases across the United States and started donating part of the new revenue from surge pricing to the American Red Cross¹⁶⁴.
212. **The pricing algorithms used by firms may be developed by third-parties.** Firms may use these algorithms to delegate/subcontract their pricing decisions to other firms, which thus offer pricing services. Moreover, third-party pricing algorithms may allow firms to just configure their own automatic pricing rules, such that the third-party does not make decisions on prices.

¹⁶¹ Hall, Kendrick & Nosko (2015) and Chen, Mislove & Wilson (2015).

¹⁶² Airbnb uses a pricing algorithms called Aerosolve, especially designed to set rental values according to endogenous regional divisions, demand and available supply. See the [presentation of the algorithm by Airbnb](#). See, as well, [the algorithm's page and documentation](#).

¹⁶³ E.g., The New York Times. (2014). *Is Uber's Surge-Pricing an Example of High-Tech Gouging?*. Available [here](#).

¹⁶⁴ [Uber's press release](#), from 2014, which announces changes in Uber's dynamic pricing policy. See, in addition, an [agreement](#) signed between Uber and the New York State, following the backlash to Uber's dynamic pricing policy.

Illustration of the potential impact of pricing algorithms on the strategic interaction between firms, under uniform pricing

213. **When setting a single price (uniform pricing), the pricing algorithm's decision may be based on simple rules, pre-defined by the developer or the user of the algorithm.** The combination of several simple rules may, nonetheless, entail an algorithm with complex behaviour.
214. **Simple-rule pricing algorithms may allow firms to set their prices a function of their competitors' prices** (*vide* Figure 10, for an example). Firms may, therefore, pre-define pricing rules which depend on the difference between their prices and their competitors' prices. For example, a firm may define a pricing rule to match their competitors' prices, to keep a given percentage difference in prices (*e.g.*, price must be 5% lower than the lowest price of competitors) or to keep a given absolute difference in prices (*e.g.*, price must be €1 lower than the lowest price of competitors). Since the time span between price updates may be a few minutes, this type of algorithms may significantly reduce firms' response delay when retaliating price decreases.

Figure 10: Setting prices in function of competitors' prices – Detail of the pricing algorithm Informed.co¹⁶⁵

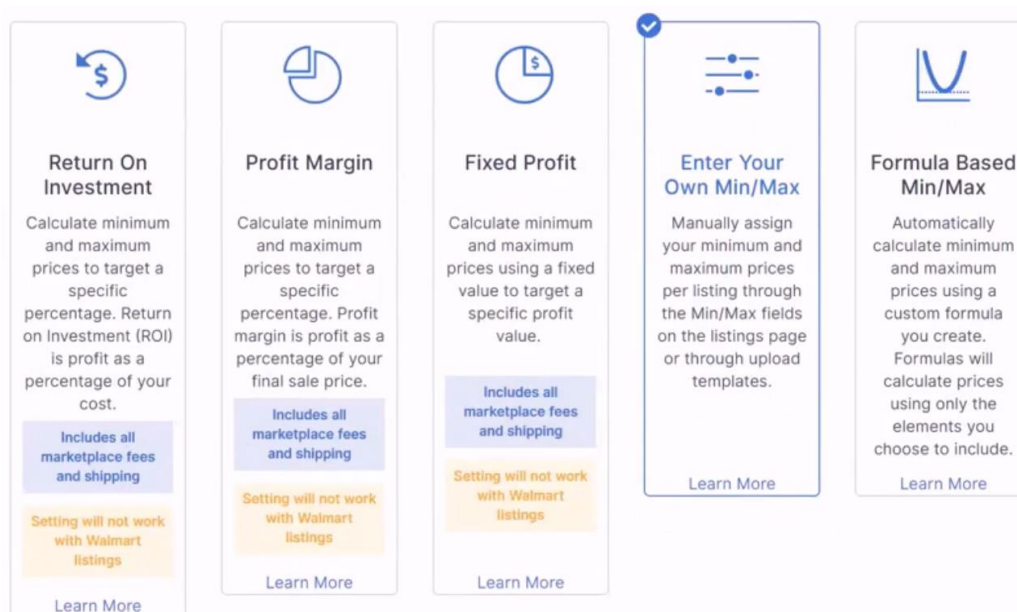
Source: [Informed.co](https://informed.co)

215. **Simple-rule pricing algorithms may allow firms to set base prices, maximum prices and minimum prices** (*vide* Figure 11). These prices may be set in order to limit price variability in strategies where prices are defined as a function of competitors' prices. This option may, thus, limit the extent of undercutting between competitors¹⁶⁶. Minimum and maximum prices may be determined by the firm itself or automatically, through systems that ensure a given return, profit margin, fixed profit or other pre-defined formulae. These systems may require additional information, such as information on costs.

¹⁶⁵ Pricing algorithm for third-party sellers in marketplaces.

¹⁶⁶ See, in addition, [the opposite case of a book on Amazon whose price surpassed 23 million euros](#), apparently because two sellers were adjusted their prices in relation to each other. The first seller would undercut the second seller by 0.17%. The latter, in turn, would charge 27.1% more than the first seller. Applying these two pricing rules sequentially and systematically generates makes prices grow exponentially.

**Figure 11: Setting minimum and maximum prices – Detail of the pricing algorithm
Informed.co**



Source: [Informed.co](https://informed.co)

216. **The pricing strategies detailed above may be adopted depending on the type of competitor in question.** In particular, it is possible, for example, to exclude some competitors from strategies defined in the pricing algorithm and ignore their strategic behaviour. In the case of Amazon's marketplace, the pricing algorithm may discriminate its price adjustment strategies depending on the type of the competing seller that has changed its price: whether it is Amazon itself, operating under FBA¹⁶⁷ (Fulfilled by Amazon) or under MFN¹⁶⁸ (Merchant Fulfilled Network). Other exclusion criteria in pricing algorithms for Amazon include sellers' ratings, location or estimated shipping time for a given product (*vide* Figure 12).

¹⁶⁷ On Amazon, a third-party seller operating under FBA, or Fulfilled by Amazon, stores and ships her products using Amazon's distribution network. She pays Amazon for this service, depending on the number, size and weight of units stored and/or sold. A third-party seller under FBA may also offer Prime shipping – *i.e.*, shipping within, at most, two days.

¹⁶⁸ On Amazon, a third-party seller under MFN, or Merchant Fulfilled Network, will manage her own stock and shipping to the final consumer.

Figure 12: Pricing strategies depending on characteristics of competitors – Detail of the pricing algorithm RepricerExpress for Amazon's¹⁶⁹

▲ **Compete With**

Amazon	Ignore ▼				
FBA	Beat By ▼	£	0.10	Plus	5.00 %
Merchant Fulfilled (MFN)	Price Above By ▼	£	0.10	Plus	0.00 %

Only compete with: ☒ Buy Box Sellers (Buy Box Eligible Sellers) ?
Optional

Additional Buy Box Options

☐ Price only against the seller who holds the Buy Box spot ?

▲ **Include or Exclude Sellers** (optional)

Seller Settings ☐ Enable

☐ All ☐ Seller Rating % ☐ Seller Feedback Count ☐ Seller Location

☐ Seller ID ☐ Dispatch Time

You can choose to filter your competition by Seller Rating, Feedback, Shipping Country, ID and Shipping Time.

Source: [RepricerExpress](https://www.repricerexpress.com/)

217. When using simple-rule pricing algorithms, the sellers in a marketplace may also configure which pricing strategy to adopt when, for example, there are no competing sellers or when competitors have no available stock left. In both cases, for example, the seller may set the prices of these products to be the maximum pre-defined prices, as detailed above. It is also possible to specify what the algorithms ought to do when the lowest price of competitors is lower than the pre-defined minimum price. Lastly, in the case of Amazon's marketplace, a seller may choose different pricing strategies when she "wins the Buy Box"¹⁷⁰ (*vide* Figure 13).

¹⁶⁹ Vide <https://www.repricerexpress.com/> and a [demonstration video](#) by its developers.

¹⁷⁰ "Winning the Buy Box" means that a seller on Amazon is the default seller for a given product, in a context with several competing sellers. Therefore, when a consumer visits a product's page and immediately adds the product to cart, the chosen seller will be seller in the Buy Box. To consider the other sellers, the consumer must actively check the list of sellers in the product's page.

Figure 13: Other pricing strategies – Detail of the pricing algorithm Informed.co

When There is No Competition

Do not reprice

Do not reprice
Use Min Price
Use Max Price

When the Competition is Below Your Min Price

Do not reprice

Do not reprice
Ignore competition
Use Min Price
Use Max Price

When the Competition Matches Your Min Price

Do not reprice

Do not reprice
Ignore competition
Use Min Price
Use Max Price

When Your Own Price Matches Your Min Price

Use Min Price

Use Min Price
Use Max Price

Price out of stock listings to max price

Enabled

Disabled

Maintain your max price on listings when out of stock. In stock listings will price according to strategy settings

Don't Lower My Price When in the Buy Box

Enabled

Disabled

Prevent your price from being lowered when you have the Buy Box, even if there are competitors lower than you.

Source: [Informed.co](https://www.informed.co)

218. Pricing algorithms may also allow firms to create pricing regimes, which are activated depending on pre-defined market conditions. Using this feature, firms may detect sudden or frequent price decreases in a given time span, which may be price wars. Once a price war is detected, a firm may configure its algorithm to change pricing regimes and then, for each specific pricing regime, the settings displayed above may be different. For example, an algorithm may include an option to stop undercutting competitors and, instead, return to the base price (*vide* Figure 14). Firms may also define a “sleep mode” during which the pricing algorithm is inactive (*vide* Figure 15).

Figure 14: Pricing strategies regimes (or repricing rules) – Detail of the pricing algorithm RepricerExpress for Amazon’s marketplace¹⁷¹

Price War This is an 'Amazon Only' setting

You can set when a SKU is highlighted as being in a Price War in RepricerExpress based on the number of times a price goes down during a certain period of time.

ON

The default value is 6 per hour.

A SKU on my Amazon UK account is in a Price War when it...

Goes down in price more than times in

☒ Use this setting for all my marketplaces below

Choose your triggers and rule movements

1. Choose what will trigger products to move from one rule to another.

2. Choose which repricing rule triggered products should move from.

3. Choose which repricing rule triggered products should move to.

When...

Stock Quantity

Best Seller

Haven't Won Buy Box

Orders

Price War

Product is FBA

Product is MFN

Repricing Result

Restock Age (Date Restocked)

Sales

Sales Rank

Stock Age (Date Created)

Stock Quantity

Stock Quantity of FBA Long Term Storage Fee Due (6 mths+)

Stock Quantity of FBA Long Term Storage Fee Due (12 mths+)

TO...

Default AUK Rule

Source: [RepricerExpress](#)

¹⁷¹ See, in addition, [two articles](#) by the pricing algorithm’s developer on how to avoid price wars.

Figure 15: Sleep mode¹⁷² – Detail of the pricing algorithm RepricerExpress for Amazon's

Source: [RepricerExpress](#)

219. **Instead of using simple-rule pricing algorithms, firms may resort to automatized systems that maximise profit** (or other measures). These algorithms may be associated with techniques such as yield management or revenue management, often used, for example, in the air transport and hospitality industries.
220. **In addition, pricing algorithms may be based on reinforcement learning algorithms (sometimes also called self-learning algorithms)**, which improve by trial and error and do not require specific prior knowledge about the environment they operate on (*i.e.*, they are model-free)¹⁷³. It should be noted that these algorithms may recommend rather than set prices – *vide* Figure 9.
221. **Pricing algorithms may also be used to implement indirect price discrimination that discriminate consumers over time**¹⁷⁴. Firms may, for example, introduce random discounts over time, which may allow them to discriminate between sophisticated consumers, who only buy during sales; and unsophisticated consumers, who buy products at any time¹⁷⁵.

3.3.2. Direct price discrimination

222. The digitalisation of the economy has increased firms' ability to gather data about consumers, namely with the emergence of big data technologies.
223. This context represents a change in how firms operate, since they not only gather a larger volume of information on the same variables (*e.g.*, greater frequency in data gathering and more varied sources), but they may also be able to directly observe consumer behaviour (*e.g.*, browsing history) - *vide* section 2.3 on data gathered about consumers in digital platforms.
224. These developments broaden the means available to firms for profit maximization in terms of pricing policy, namely by increasing their ability to implement direct price discrimination online.

¹⁷² According to what is shown in the [demonstration video of the pricing algorithm RepricerExpress](#), this feature may be used "if you want to force your competitors' prices to increase by increasing your own price overnight"-

¹⁷³ *Vide* the Q-learning algorithm to set prices used in Calvano et al. (2019).

¹⁷⁴ It should be noted that, according to the definition of uniform pricing used in this document, uniform prices are compatible with indirect price discrimination over time, since consumers are charged the same prices at a given point in time.

¹⁷⁵ *Vide* Varian (1980).

225. In direct price discrimination, firms segment their consumers in different consumer types, according to their willingness to pay. This segmentation is done according to consumer characteristics observable by firms, using the data they gathered or acquired. The firm will then charge different prices to each segment.
226. **The difference in how firms and consumers interact in online markets, in comparison to offline markets, may also facilitate the implementation of direct price discrimination.** Firstly, menu costs and time delays in price adjustments are lower in comparison with traditional retail outlets (“brick and mortar”). Therefore, the only impediments to continuous price updates are the volume of information available and potential negative reactions from the demand side to high price volatility or fairness concerns. Secondly, there tends to be a higher degree of privacy of information in online prices in comparison to offline prices, which may make the detection of price discrimination more difficult. While in traditional retail prices are usually visible and the same for all consumers¹⁷⁶, in online retail, consumers have no guarantee that they are being charged similar prices. Lastly, goods and services sold in online markets are often tied to a single user or group of users, hindering arbitrage. This tie may be done using user accounts or content encryption, as in the case of subscription of audio or video streaming services, videogames, tickets or online news. The highly differentiated nature of the goods being transacted may also tie goods to particular users or groups of users.
227. **Direct price discriminations requires 1) that firms have some degree of market power, 2) that there is observable heterogeneity among consumers, 3) that firms are able to fine-tune prices according to this heterogeneity and 4) that there is no arbitrage among consumers.** As such, the combination of big data, costless price adjustments and the greater ease of enforcing price discrimination may increase the frequency with which this pricing strategy is used.
228. Direct price discrimination encompasses first-degree price discrimination, third-degree price discrimination and the intermediate case of personalised pricing:
- **First-degree price discrimination** refers to a theoretical scenario where a firm would know, without uncertainty, the willingness to pay of each of its customers from their characteristics;
 - In **third-degree price discrimination**, firms charge different prices to consumer segments with a different willingness to pay. Consumer segmentation, in turn, is done according to consumers’ observable characteristics.
 - **Personalised pricing** is an intermediate case in the sliding scale between first and third-degree price discrimination. For this reason, it may be difficult to distinguish between third-degree price discrimination and personalised pricing. Usually, consumers are segmented into smaller consumers than those considered in third-degree price discrimination, but not necessarily composed by a single individual. In addition, it is applied in a context of uncertainty. Therefore, at most, it is a form of imperfect first-degree price discrimination, where there is an individual price for each consumer, but the firm faces uncertainty about the consumers’ willingness to pay.

¹⁷⁶ In both cases, however, prices are partly public and partly private. Online consumers may still be able to detect, in some cases, that they are being charged different prices, for example, by opening a webpage, in privacy mode. Likewise, in traditional retail, there might be customer-specific discounts, such as coupons, which make the price partially private.

229. **Personalised pricing is a form of direct price discrimination, located along a sliding scale in the strength of price discrimination**, according to the firms' ability to segment the market.
230. **It should be noted that there is no evidence of a generalised use of personalised pricing as a form of price discrimination**¹⁷⁸, namely strategies approach first-degree price discrimination. Nonetheless, offering discount coupons to customers according to their history is relatively common, and may be considered either third-degree price discrimination or personalised pricing.
231. **Consumers typically find personalised pricing to be unfair**. This type of strategy may raise concerns with consumer protection and fairness. Nonetheless, and despite the gap that may exist between the expectations of the civil society regarding the role of competition authorities, these issues, when unrelated to the degree of competition in the market, are outsider the scope of the AdC¹⁷⁹.
232. **The impact of personalised pricing on consumer welfare is ambiguous and depends on the characteristics of the market under analysis**. In particular, the impact will depend on the firms' ability to segment consumers and on where they are located on the aforementioned sliding scale of price discrimination (between first-degree and third-degree price discrimination).
233. On the one hand, personalised pricing may reflect a greater ability of firms to extract consumer surplus – **appropriation effect**. On the other hand, the ability to price discriminate may generate efficiencies and increase the number of transactions in the market – **expansion effect**. Lastly, personalised pricing may also have an impact on the intensity of competition in the market – **competition effect**.
234. **As the ability to identify consumers and to price discriminate increases, the market evolves along the sliding scale of price discrimination towards the perfect segmentation of consumers and the appropriation effect dominates the expansion effect**¹⁸⁰.
235. **Direct price discrimination may increase the volume of transactions in the market**, since firms may sell their products to consumers with a lower willingness to pay, without sacrificing revenue from the consumers with a higher willingness to pay (expansion effect).
236. **Despite potential efficiency gains from output expansion, price discrimination may grant firms a greater ability to extract consumer surplus** (appropriation effect). This ability increases as firms approach perfect segmentation (*i.e.*, each consumer is a market segment) and have a lower uncertainty about the consumers' willingness to pay (*e.g.*, as they gather more data about their customers). The appropriation of consumer surplus may dominate any potential efficiencies generated by expanding output to groups with a lower willingness to pay.

¹⁷⁷ For a more detailed discussion on the possible effects of direct price discrimination on consumers, *vide* Armstrong (2006), Stole (2007), Office of Fair Trading (2013) and AdC (2018).

¹⁷⁸ *Vide* Mikians et al. (2012) for some examples of price discrimination online.

¹⁷⁹ It should be noted that, in general, consumer price discrimination is not a restriction to competition. Nonetheless, conceptually, personalised pricing by a firm in a dominant position that harms competition and consumers may, from a theoretical viewpoint, be considered as an exploitative abuse (*cfr.* article 11(2)(a) of the Portuguese Competition Act). On the other hand, the case in which a firm in a dominant position applies dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage is foreseen in article 11(2)(c) of the Portuguese Competition Act.

¹⁸⁰ *Vide* Office of Fair Trading (2013) and AdC (2018).

237. **The adoption of direct price discrimination in a market may also structurally change the way firms compete** (competition effect). In this regard, the intensification and enhanced accuracy of direct price discrimination may have effects on consumer welfare, not only due to consumer surplus appropriation but also due to changes in the strategic behaviour of firms in the market.
238. When going from uniform pricing to direct price discrimination, firms acquire the ability to distinguish between i) the consumers who have a higher willingness to pay for their products – referred here as the **high willingness to pay consumer group** – and ii) the consumers who have a lower willingness to pay for their products – the **low willingness to pay consumer group**¹⁸¹.
239. **Firms are, thus, able to rank their consumers according to their willingness to pay. They may rank consumers equally or differently.** Firms will rank consumers similarly if they discriminate consumers according to their income, for example, since in general and all else constant, high income groups have a higher willingness to pay. On the other hand, firms rank consumers differently if they discriminate consumers, for example, according to their brand preferences, in a context of horizontal differentiation. Price discrimination may have different effects on the market, depending on whether firms rank consumers similarly or differently. These two simplified scenarios are discussed below.
240. **In a hypothetical scenario where firms rank consumer groups differently, competition may be intensified following the introduction of direct price discrimination, as firms try to poach customers from each other.** If firms are not able to price discriminate consumer groups, each firm may focus on its high willingness to pay consumer group. In this case, each firm sets a high single price, which nonetheless appeals to its high willingness to pay consumer group but not to its low willingness to pay consumer group. As a result, there is less competition as firms do not contest the same consumer groups. However, once they are able to apply different prices to each group, they may decrease prices for their low willingness to pay group without reducing prices (and profit margins) for the high willingness to pay consumer group. If several firms in the market adopt this strategy, there is more competition for all consumers in the market, as firms try to poach customers from each other – **poaching effect**. As such, competition may be intensified and prices may decrease for all consumers in the market, thereby increasing consumer surplus¹⁸².
241. **On the other hand, in a hypothetical scenario where firms rank consumer groups similarly, the ability to price discriminate should not significantly change the competitive conditions in the market.** Regardless of the pricing strategy, firms value the same consumers, meaning that they have incentives to increase prices for the same high willingness to pay consumer group and to reduce prices for the same low willingness to pay consumer group. The effect on consumer surplus would be ambiguous as when firms increase prices to their high willingness to pay consumer group, they appropriate part of the consumer surplus; but they increase the number of transactions in the market if they reduce prices to the low willingness to pay consumer group (expansion effect).
242. **Lastly, it should be noted that, in the analysis of mergers which would join (two or more) databases, it may be pertinent to assess the impact of the merger on the ability of the resulting firm to extract consumer surplus.** The firm may move along the sliding scale of price discrimination, which could entail effects on consumer welfare. In

¹⁸¹ *Vide* Corts (1998).

¹⁸² This is the result in Thisse & Vives (1988) and one of the possible results in Corts (1998).

these cases, the resulting firm may be able to appropriate the efficiencies generated by the merger or, possibly, reduce consumer surplus.

3.4. Pricing and monitoring algorithms as facilitators of collusion

- 243. **Despite the benefits big data and algorithms may bring to the market, their increasingly frequent use may facilitate collusive strategies, explicit or tacit**, in the market. A more diffused usage of monitoring and pricing algorithms may increase market transparency and the frequency of interaction between competing firms.
- 244. **As a result, concerns have been raised regarding the digital economy and the risk of algorithmic collusion (e.g., OECD, 2017)**. Algorithms may, on the one hand, be used as facilitators of collusion to implement explicit collusive agreements that are also seen in traditional markets and, on the other hand, they may enable new forms of coordination between firms.
- 245. **These concerns are more relevant in the context of algorithms that set uniform prices**, since price discrimination, namely personalised pricing, may make coordination harder for firms, as it increases the complexity of pricing policies and reduces market transparency.

Algorithms as facilitators of explicit collusion and pre-existing vertical agreements

- 246. **Pricing and monitoring algorithms may promote or strengthen explicit collusion, namely its frequency, duration and extent, as they strengthen the conditions of internal and external sustainability of explicit collusive agreements¹⁸³**.
- 247. **This will be the case if algorithms play an instrumental role in the implementation of an existing explicit collusive agreement between competing firms**. Monitoring algorithms may improve firms' ability to detect deviations from the terms explicitly agreed by competitors. Pricing algorithms, in turn, may ensure that firms react more quickly to deviations from the collusive terms agreed beforehand. For this reason, algorithms may facilitate the implementation of collusive agreements, e.g., on prices, over time.
- 248. **These tools may enable firms to overcome the difficulties associated with the implementation of coordinated strategies** resulting from, for example, demand fluctuations, the volatility of input costs, and others; hence ensuring strategic alignments are more stable.
- 249. **Cases where algorithms are instrumental to implement an explicit agreement between competitors in the market fall under a horizontal agreement** in breach of article 9 of the Portuguese Competition Act and, if applicable, of article 101 of the Treaty on the Functioning of the European Union (TFEU).

¹⁸³ Classified as "messenger algorithms" in the taxonomy adopted in Ezrachi & Stucke (2016).

250. In this regard, it is relevant to refer the Topkins (DOJ, 2015)¹⁸⁴ and Trod (DOJ, 2016¹⁸⁵ and CMA, 2016¹⁸⁶) cases (*vide* Box 8), in which some poster sellers on Amazon’s marketplace used a pricing algorithm to implement an explicit collusive agreement. These cases illustrate the role algorithms may play in aiding firms and as facilitators in the implementation of collusive agreements between competitors in the market.
251. The Trod case, in particular, shows how the features and settings of pricing algorithms, discussed in paragraph 213 et seq., were exploited to aid the implementation of a collusive agreement. The evidence presented by the CMA includes an e-mail exchange between workers of one of the firms, in which they state:
- “(...) but you need to reciprocate and switch off the rep-pricing against our products for us to move forward (...)”¹⁸⁷.
 - “Trod (Buy 4 Less) have agreed not to undercut us on Amazon and I have agreed to reciprocate. We will therefore be aiming to be the same price wherever possible, put prices up and share the sales (...)”.
 - “Logistically it is going to be difficult to follow the pricing effectively on a daily basis so I am looking into re-pricing [so]ftware...”¹⁸⁸.
252. **Monitoring and pricing algorithms may also be used to implement vertical agreements, namely, RPM (Resale Price Maintenance) agreements.** This type of agreements breaches, by object, article 9 of the Portuguese Competition Act and, if applicable, article 101 of the TFUE¹⁸⁹. Monitoring algorithms may be used to detect deviations from an explicit vertical agreement which pre-determines fixed or minimum resale prices.
253. Additionally, if suppliers put pressure on retailers to follow “recommended” prices, monitoring algorithms may be used by suppliers to detect whether retailers deviate from these prices¹⁹⁰. In this context, the “recommended” prices strategy may be a RPM agreement.
254. Lastly, if pricing algorithms are used by competing retailers outside a RPM agreement, they may broaden the impact of RPM agreements on the market. In particular, if retailers outside the RPM agreement set their prices as a function of the price of the retailers covered by the agreement, they will mirror the price set by the suppliers.

¹⁸⁴ Plea Agreement, delivered by a United States District Court, on 30 April 2015, in the case United States v. David Topkins, available [here](#). David Topkins was accused by the DOJ of participating in a horizontal price fixing agreement (alongside other co-conspirators), for breaching US competition law (Section 1 of the Sherman Act). Topkins confessed to the accusation, agreed to pay a fine and to continue to cooperate with the DOJ’s investigations in the e-commerce sector. The press release of the decision is available [here](#).

¹⁸⁵ Plea Agreement, delivered by a United States District Court, on 11 August 2016, in the case United States v. Daniel William Aston and Trod Limited, available [here](#). The DOJ accused the firm Trod Limit of participating in a horizontal price fixing agreement. Press release available [here](#).

¹⁸⁶ Decision of the CMA, on 12 August 2016, in the Case 50223 – Trod and GBE (Online sales of posters and frames), available [here](#). This decision fined Trod for participating in a horizontal price fixing agreement, which breached the UK competition law.

¹⁸⁷ *Vide* decision of the CMA, on 12 August 2016, in the Case 50223, pp. 22.

¹⁸⁸ *Ibid* pp. 23.

¹⁸⁹ European Commission (2017b).

¹⁹⁰ Suppliers may compel retailers to adopt “recommended” prices by limiting discounts, delaying supplies, severing contracts or expelling retailers from their distribution network. *Vide* European Commission (2017a, pp. 172).

Box 8. Decisional practice and jurisprudence regarding the breach of competition law due to the use of algorithms

	USA Section 1, Sherman Act	EU Members States	EU Article 101 of the TFUE
Horizontal price fixing agreements	Pricing algorithm <ul style="list-style-type: none"> • <i>U.S. v. Airline Tariff Publishing Company, et al.</i> (1994) • <i>U.S. v. David Topkins</i> (2015) • <i>U.S. v. Daniel William Aston and Trod Limited</i> (2016) 	Pricing algorithm <ul style="list-style-type: none"> • <i>Lithuania: Case No A-97-858/2016</i> – Eturas (2016) • <i>United Kingdom: Case 50223</i> – Trod and GBE (2016) 	Pricing algorithm <ul style="list-style-type: none"> • C-74/14 – Eturas and others. (preliminary ruling) (2016)
Vertical RPM agreements			Monitoring algorithm as facilitator <ul style="list-style-type: none"> • AT. 40469 (<i>Denon & Marantz</i>) (2018) • AT. 40181 (<i>Philips</i>) (2018) • AT. 40182 (<i>Pioneer</i>) (2018) • AT. 40465 (<i>Asus</i>) (2018)

Simple-rule pricing algorithms (predictable agent¹⁹¹)

255. **In the digital economy, data availability promotes transparency and may reduce the unpredictability and uncertainty of firms regarding the strategic behaviour of their competitors**, as well as other aspects of the market. In addition, the digital context in which firms operate may increase their efforts towards systematically and automatically monitor their competitors, as well as increase how frequently firms decide on strategic variables, such as prices.
256. **The pricing strategies implemented in simple-rule pricing algorithms may generate patterns of decision that are predictable (“decipherable”) by competitors**. As illustrated above, pricing algorithms, when used in tandem with a monitoring algorithm, may be programmed to match competitors’ prices. If a seller (A) configures her pricing algorithm to match the price of a competitor (B), the latter may infer the strategy of its rival, given that every time B changes her price, A does the same. In this scenario, B may no longer have an incentive to make discounts, for example.
257. **Increased transparency and speed of price adjustments, in a context of widespread use of simple-rule pricing algorithms, may reduce firms’ incentives for undercutting and result in higher prices for consumers**. This is illustrated in the case where a seller configures her pricing algorithm to set a price lower than the lowest price in the market. If a single competitor follows the same strategy, the price of the seller may decrease significantly in a short period of time, given the speed of adjustments – *i.e.*, it creates a price war. As a result, that seller may “learn” that she risks a price war if she configures pricing algorithms to undercut other vendors.
258. **Algorithms may be programmed to detect and avoid price wars** (*cfr.* Figure 14), using the frequency and/or magnitude of price changes. In these cases, algorithms may be configured to change pricing regimes. They may, for example, stop adjusting to competitors’ strategic reactions.

¹⁹¹ This scenario is classified as “predictable agent” in the taxonomy adopted in Ezrachi & Stucke (2016, pp. 56-71).

259. **Firms may resort to pricing algorithms to explicitly coordinate their prices.** Whenever pricing algorithms are used by competing firms in the market to coordinate parameters of their pricing strategies, for example, by agreeing to reciprocate in matching strategies, to react in a parallel fashion to changes in the market, or to avoid price wars, that may be a horizontal agreement harmful to competition. This type of explicit agreement may decrease the need for firms to communicate to readjust the terms of coordination in response to changes in market conditions¹⁹².
260. **Firms may also resort to pricing algorithms to signal their intentions on pricing strategies to their competitors.** In particular, the lower response time in the context of pricing and monitoring algorithms may allow firms to negotiate in the market via quick interactions and then establish their prices in the market¹⁹³.
261. **Signalling and communication in the market may be a concerted practice between competitors,** to the extent they aim to eliminate effective competition in the market and introduce interdependence between the strategies of competing firms.
262. **The use of pricing algorithms may also increase the frequency of interaction between firms, which, besides reducing the delay for retaliations against deviations from collusive equilibria, provides more information to firms about their competitors' strategic behaviour.** Depending on the available resources and the terms of service of marketplaces, the time span between pricing decisions may be arbitrarily short¹⁹⁴. In the United States, among the major retailers, there is evidence suggesting there has been an increase on the frequency of price changes as a result of entry of e-commerce platforms in the market¹⁹⁵.
263. **In what regards potential fora of communication, firms may communicate and disclose information on the implications of adopting different strategies when using pricing algorithms** in marketplace forums, specialised e-commerce pages, newspapers and magazines on management, video-sharing platforms or social networks. This information may include, for example, the impact on profits of adopting certain strategies within the pricing algorithm. Sellers in marketplaces may, for example, disclose that profit margins decrease when algorithms are configured/set to undercut competitors, if the latter do the same. On this point, *vide* Box 9 for examples of communications where market operators highlight the losses that may result from undercutting strategies.

¹⁹² *Vide*, for example, OCDE (2017, pp. 28).

¹⁹³ *Vide* OCDE (2017, pp. 30) on signalling algorithms, including the example of the United States v. Airline Tariff Publishing Co., 1994-2 case.

¹⁹⁴ See a [demonstration video](#) of a pricing algorithm for third-party sellers on Amazon, Sellery, in which the price of a product is updated within a minute of the price change of a competing product. See, in addition, [this document](#) about the pricing algorithm for third-party sellers on Amazon, RepricerExpress, which states that information on prices is sent to Amazon every 5-15 minutes.

¹⁹⁵ Cavallo (2018) indicates that the prices of goods sold on Amazon last for 20% less than the price of goods not sold on Amazon.

Box 9. Examples of exchanges in marketplace forums, where market operators highlight the losses that may result from competition

A. Publication “A race to the bottom – EVERYONE LOSES. Please read”

“I am here to teach you all some things.

*Something that has ticked me off for quite some time. Something that should be second nature to everyone. Something that everyone here should have known the second they started, but has failed to learn.**

*The race to the bottom is a race that EVERYONE loses. **STOP REPRICING YOUR STUFF INTO OBLIVION.***

What do I mean? I mean when you reprice your product to a penny below the next person. Then that person reprices his price to a penny below you. Then the next 5 guys all do the same thing, then you log in one day and see that you’re 10 cents above everyone else, so you drop your price 11 cents and the cycle begins all over again...

*This happens until SOMEONE realizes they’re pointlessly losing \$1 per unit and stops, then the next guy realizes he’s losing \$1.01. Then the next guy realizes he’s losing \$1.10... But guess what. **NONE** of you will reprice UPWARDS to recover that lost dollar because you worry the next guy won’t do the same - which he probably won’t because he’s fearing the same thing as you.*

*So **why the repricing? It’s because these novice sellers** (even you dorks that have been here for YEARS do this, so you’re still novice in my book) think that by repricing a penny below the lowest person will magically make your sales sky rocket. I have news for you. It **WON’T.** (...)*

*So please people, remember these two points when you do competitive repricing. Consider these following alternatives to **penny wars**:*

***MATCH the lowest person’s price rather than attempting to undercut them. Undercutting is a win for no one other than the buyer,** who will save a few pennies on your price, but you’ll lose hundreds because you have 800 of them in stock”. (emphasis added).*

Source: noober0x, March 2015; [Amazon Services Sellers Forums](#), accessed on 3 June 2019.

B. Publication “Repricers and their perils”

“This is just a rant.

*So there is a new seller on some of my best selling listings and he is FBA and has the repricer set to undercut. Other’s have set to match. So this guys undercuts and others match. Result: **very fast march to bottom!** I know very well their price points and **am shocked to see sellers being so irresponsible.** This seller is new, I get it but the other more experienced sellers also seem to have no bottom price. On listings where there are good number of FBA sellers, now it is going to take months for it all to clear out. I can set 10% lower and they will come down fast, but I do not want to keep doing it as I do not want to risk any policy violation! I have heard of how repricers are dangerous and can set ur price to a penny, but I feel the most dangerous aspect of repricers is their use by people who do not know their margins!*

I know that talking pricing is illegal and will not do so. But can I contact this crazy seller and just tell him this:

“Hello,

*I see u have a repricer on that undercuts the lowest FBA offer. When u undercut, the others match, and then u again undercut and so on. **The result is loss of profitability for everyone. Now your price is your choice and this message is in no way an attempt to fix pricing.** You set your price to whatever you like but I just wanted to send you a message on what I observed on the listings you are on and share my thoughts with you.”*

Please advise me if it will be OK to send such a message or is it considered an attempt at price fixing. (...).” (emphasis added).

Source: sellsome, March 2016; [Amazon Services Sellers Forums](#), accessed on 3 June 2019.

Common algorithms / Hub and spoke

264. **Using commons algorithms may significantly increase market transparency**, as each firm knows the how its software functions and, as such, may know the decision-making process of their competitors.
265. This scenario may occur, namely, in a context where firms acquire their **pricing algorithms from the same third-party, e.g., the same provider of pricing algorithms**, or if there is a pricing algorithm deemed as standard in a particular industry. Firms may also use the same algorithms if they are available in open source in the market.
266. **The use of common algorithms with the intent of coordinating market strategies raises competitive concerns under article 9 of the Portuguese Competition Act.** In these cases, the collusion between market operators may occur in the context of a

hub-and-spoke system¹⁹⁶, where spokes coordinate their pricing strategies in the market through a common provider of algorithms – the hub. In a hub-and-spoke scenario, firms may also outsource joint profit maximization to a third party. In this case, when setting prices, the hub may combine strategic information from several firms and internalise the impact that price changes would have on competitors.

267. **Third-party providers of pricing algorithms may promote collusive hub-and-spoke arrangements** by, for example, disclosing their list of clients on their webpages or on their promotional material, or even by presenting this fact as a plus of its product/service. In addition, they may advertise that their pricing algorithm prevents price wars.
268. Additionally, the risk of collusion resulting from common algorithms (or hub-and-spoke) has been referred to as more serious in comparison with other theories of harm associated with algorithms, such as those related to self-learning algorithms¹⁹⁷.
269. As such, resorting to the same algorithm or the same third-party provider of pricing algorithms will be viewed with suspicion by the AdC, when done by competing firms in the same relevant market. This will be particularly the case in markets more susceptible to coordinated behaviour, to extent that the choice by competitors of using a common algorithm may be conscious and deliberate.

Self-learning algorithms

270. In this context, self-learning algorithms are algorithms that resort to machine learning techniques to set prices, considering past experiences. One of the types of self-learning algorithms that has been under discussion in the literature are **reinforcement learning algorithms** (cfr. paragraph 220). These algorithms have an objective function defined exogenously (e.g., profit maximization) and adjust automatically over time in a learning process of trial and error, considering the outcome of the algorithm in comparison with the objective function. This learning process aims to reduce the difference between actual market outcomes and the pre-defined objective function.
271. **There is some evidence that reinforcement learning algorithms may be able to achieve collusive equilibria.** Calvano et al. (2019) seek to test the behaviour of one of these algorithms in the context of an oligopoly model of repeated price competition. The algorithm they use, Q-learning¹⁹⁸, improves by trial and error, does not include specific instructions for collusion or to communicate with other algorithms, nor specific prior knowledge of the environment in which they operate, except for a profit maximization objective function. However, in their simulations, the authors find that when these algorithms interact in the market, they are able to learn and implement collusive strategies. The authors also test specifications in which they induce one of the algorithms to deviate from the collusive equilibrium for one period, by reducing price. This generates a retaliation response by other algorithms. Nonetheless, in the subsequent periods, algorithms converge back to the collusive equilibrium. Following a different specification using a Q-learning algorithm, Klein (2019) also finds that algorithms can learn collusive strategies.
272. **One of the questions under discussed regarding algorithms is the possibility of learning and converging to collusive equilibria without active human intervention in**

¹⁹⁶ This scenario is classified as “hub and spoke” in the taxonomy adopted in Ezrachi & Stucke (2016, pp. 56-71).

¹⁹⁷ Vide CMA (2019).

¹⁹⁸ Q-learning is a type of reinforcement learning algorithm that, due to their simplicity and ease of use, has been applied in varied contexts (e.g., robotic control or videogames), namely for dynamic pricing (e.g., to set the prices for airlines or to bid in electricity markets, e.g., Itto & Petit, 2017).

that direction. The evidence discussed above, even if developed in stylised contexts, suggests that this is a possibility. Therefore, even though there is still no empirical evidence of these phenomena, it is not possible to exclude that, in the future, this issues gains added relevance¹⁹⁹.

273. On this point, Harrington (2017) argues that even though collusion is usually understood as the ability to charge supracompetitive prices, this rather corresponds to the outcome of collusion. Instead, collusion is a scenario where competitors incorporate *“a reward-punishment scheme which rewards a firm for abiding by the supracompetitive outcome and punishes it for departing from it”*.
274. Still in the context of this debate, and on the role of human intervention in pricing algorithms, it is important to note the position of the EC that **“companies can’t escape responsibility for collusion by hiding behind a computer program”**²⁰⁰, indicating that economic agents are responsible for the algorithms they choose to set their prices.
275. For this reason, firms may be required to test and verify the algorithms they use, to ensure they are compliant with competition law.

3.5. Selection algorithms

276. **The large number of goods/services available in the market may make the process of choosing products costly for consumers.** As a result, consumers may not know all the products available in the market or be able to consider all available products in their consideration set, when making a decision²⁰¹.
277. **In this context, firms may resort to automatic systems (i.e., algorithms) that facilitate the discovery of their products or streamline the decision process of consumers,** namely systems that select bundles of products for customers or give salience to some available products. In this document, these automatic systems will be referred to as **selection algorithms**²⁰².
278. **Therefore, in this document, a selection algorithm is considered to be any algorithm which conditions the exhibit of products to specific consumer or consumer groups.** Hence, the same products are exhibited with different probabilities to different consumers. A product may also never be exhibited, a scenario where the consumer may not realise it exists. The selection of products is typically opposed to cases where products are uniformly exhibited, where the same products are equally shown to all consumers, such as in physical product catalogues.
279. **Selection algorithms may not only determine which products are exhibited (i.e., if products are shown or not), but also the salience of exhibited products (i.e., how products are exhibited).** Salience refers to any aspect that affects the probability that a product captures the attention of a consumer and enters her consideration set.
280. **The criteria of product selection are based on the data gathered by platforms when they monitor their users**²⁰³. The data gathered may be used to develop proxies that indicate the interest or the willingness to pay of consumers for available products. These proxies are specific to each type of platform. A marketplace, for example, may uses search entry inputs by consumers when they search for products, or their

¹⁹⁹ Vide, for example, Ezrachi & Stucke (2016) and Harrington (2017).

²⁰⁰ European Commissioner for Competition, Margrethe Vestager, [“Algorithms and Collusion”](#), speech on 16 Mars 2017, Berlin.

²⁰¹ Vide “consideration set” in Elliaz & Spiegler (2011).

²⁰² These systems that promote product discovery and streamline consumers’ decisions fall under what Dinerstein et al. (2018) call “platform design”.

²⁰³ Vide section 2.3.2 on user characterisation in multi-sided platforms.

purchase history. A video streaming platform may focus on which content is viewed, view duration or on user ratings²⁰⁴.

- 281. **In this context, data is an important input in selection algorithms and its volume and variety may be crucial to ensure their quality, i.e.,** to ensure they are able to form high-value product-consumer pairs.
- 282. **Selection algorithms may create value for consumers to the extent they allow for or aid product discovery.** Selection algorithms allow consumers to find products already in their consideration set, as in the case of a consumer looking for a specific book or piece of clothing on a platform. Moreover, selection algorithms may allow users to discover new products, until then outside their consideration set. An example is the discovery of new music in audio streaming platforms.
- 283. **By facilitating product discovery, selection algorithms also allow firms to offer more personalised products to consumers.** In particular, firms may intensify differentiation strategies and focus on market niches^{205,206}.

3.5.1. Types of selection algorithms

- 284. Selection algorithms may be used in a varied range of online services, namely product recommendation systems, online digital advertising and search services.
- 285. **In recommendation systems, platforms exhibit products to the consumer with the greatest interest or willingness to pay,** in order to implement strategies of cross-selling or sell similar products. Moreover, recommendation systems may be used to capture to capture user attention²⁰⁷. Recommendation systems may be implemented directly on platforms or be associated with newsletters subscribed by consumers.
- 286. **Product-consumer pairs in recommendation systems may be formed according to the characteristics of the products being sold and/or the characteristics of the users.** Content filtering recommendation systems²⁰⁸ recommend to users products that are similar to other products they have positively rated²⁰⁹ before. Conversely, collaborative filtering recommendation systems²¹⁰ recommend products to users based on the positive ratings of similar users. In this case, users may be considered to be similar if they have similar ratings for other products and/or through audience analysis²¹¹.
- 287. **In online digital advertising, platforms may also exhibit products to the consumers with the greatest interest or willingness to pay – targeted advertising –, but they require a compensation from the advertiser side of the platform.** Targeted advertising allows firms to focus their advertising efforts on the consumers who have

²⁰⁴ Vide [an article by Netflix](#), which presents some of the factors considered in the recommendation system used by the firm.

²⁰⁵ Differentiation strategies may also be viable due to the digital context in which selection algorithms operate. An online store, in contrast with a physical store, allows for efficiencies in stock management. Additionally, some services may be digitally distributed.

²⁰⁶ Brynjolfsson et al. (2003, 2011).

²⁰⁷ Cfr. subsection on attention markets in section 2.4.3.

²⁰⁸ Burke (2007).

²⁰⁹ These ratings may be explicit (e.g., clicking on a “like” button) or implicit (e.g., view duration for a video).

²¹⁰ Burke (2007).

²¹¹ See some documents detailing the recommendation systems used on YouTube, Covington et al. (2016); on Amazon, Linden et al. (2003) and Smith & Linden (2017); or on Netflix, Gomez-Urbe & Hunt (2015).

the highest preference for their products, without having to simultaneously advertise to more price sensitive consumers²¹².

288. **Online advertising may be divided into display advertising, search advertising and classified advertising.** Display advertising includes adverts in graphical or audio-visual format that may appear in news pages, video-sharing platforms or social networks. Search advertising refers to the adverts that appear on search results pages, and depend on the search entry input by users. Classified advertising, in turn, is associated with classified advertising platforms, where users can publish adverts to sell, for example, used products²¹³.
289. At the EU level, in 2015, expenses on online advertising surpassed expenses on TV adverts, in the advertising market. Conversely, in Portugal, in 2016, online advertising was only 40% of the expenses in TV advertising, and accounted for 23% of total expenses on advertising. The online advertising market grew by 28% in Portugal in 2016, placing Portugal among the 10 countries in the EU where it grew the most. However, Portugal remains one of the 5 EU markets where the share of TV advertising is the largest²¹⁴.
290. **Search engines exhibit products to users based on the search entries and on the search settings they input in search engines, online catalogue systems and search results pages.** These last two, in particular, allow users to filter products according to pre-defined categories; or to order results, in increasing or decreasing order, according to price, name (i.e., alphabetical order) or the date the product was made available. Search services include both general search engines but also specific search engines associated, for example, with e-commerce platforms or marketplaces. Among search services, one may also include the searching features in personal virtual assistants (e.g., Siri or Alexa).
291. **The order of search results in search engines may be determined by a plethora of factors**²¹⁵, which may be associated with learning-to-rank techniques²¹⁶. The most clicked or skipped results by users may be, for example, respectively promoted or disregarded in future searches. In addition, search engines may compare the content of the products or webpages to be searched with the search entries input by the user, which may be associated with natural language processing algorithms²¹⁷.
292. **The same platform may implement different selection algorithms at the same time.** A marketplace may, for example, incorporate digital advertising into its product recommendation system, if it offers, alongside its recommendations, a “featured products” service to sellers. Moreover, as described above, digital advertising may be associated with search engines – i.e., search advertising. Therefore, search engines

²¹² In digital advertising it is possible to exhibit different adverts to users that are consuming the same content. This contrasts digital advertising with traditional advertising in mass media, such as television or radio, where the same advert is exhibited to all consumers. *Vide* Iyer et al. (2005).

²¹³ *Vide* ACCC (2019, pp. 54-55). See, in addition, that, in Australia, search advertising accounts for the largest share of online digital advertising, followed by display advertising and classified advertising, in this order.

²¹⁴ European Audiovisual Observatory (2017).

²¹⁵ See, as an illustration, [a possible list of factors considered by Google in its search engine](#), made by a firm specialised in Search Engine Optimization (SEO). It should be noted, however, that many of the factors presented on this list are of a speculative nature, as the detailed functioning of Google’s search algorithms is not publicly known. Nonetheless, [Google discloses, in general terms, some of the factors it considers to order search results](#).

²¹⁶ Learning-to-rank refers to models that create rankings of objects, such as products or webpages, using machine learning techniques. *Vide* Liu, T. Y. (2011) or [an implementation being developed by Google](#).

²¹⁷ These algorithms are able to process and analyse text written in the way humans naturally communicate with each other. They are used in search engines to, for example, answer questions explicitly placed by users or to include synonyms or words related to the terms searched by the user. *Vide* Bird et al. (2009).

may exhibit, for example, adverts on top of their search results pages, based on the search entry inputs by the user.

293. The effectiveness of selection algorithms may be evaluated through randomised experiments on apps or websites – A/B testing. These tests randomly show users variants of some element or feature of an app/website, which may include specific parametrisations or specifications of selection algorithms. These variants are then compared according to some relevant pre-defined measure²¹⁸, such as the number of clicks or the volume of sales of a given product.
294. **The development and implementation of selection algorithms may be subcontracted to third-parties.** These firms may also gather data directly on the apps and websites where they implement their algorithms. See, as an illustrations, firms such as Algolia, for search services²¹⁹; or Target2Sell, for recommendation systems²²⁰.

3.5.2. Implications for competition

295. **Selection algorithms may increase the number and variety²²¹ of products considered by consumers, as they facilitate the discovery of new products.** For this reason, they may intensify competition, reduce barriers to entry, decrease firms' market power and allow consumers to have access to products more adjusted to their preferences²²². When users join audio streaming platforms, for example, the number and diversity of music they hear may increase. This may fragment the market and promote the entry of new artists or publishers²²³.
296. **These algorithms establish a touchpoint between consumers and the products available in the market. This may change how firms strategically interact in the market,** namely via increased consumer segmentation. By determining which products are exhibited to consumers or the salience of exhibited products, selection algorithms may affect which products are considered by consumers when they are choosing what to buy and, thus, change their decision in comparison with a scenario where they would have considered all available products.
297. **In search services, the relative position of the products exhibited in a list of products, namely their order²²⁴, may affect product salience and hence divert consumers from some products to others.** In a search results list, for example, users have a tendency to click on the results that appear first, even if they are less relevant²²⁵. According to results from the Special Eurobarometer about online platforms by the EC (2016), 75% of the respondents in Portugal have agreed that the order in which search results are displayed affect their behaviour as consumers – the highest value in the EU. As such, consumers tend to browse webpages following a “F” pattern – *vide* Figure 16²²⁶. For

²¹⁸ There exist also “multi-armed bandits”, in which the randomized experiment may use more variants and be conducted “online”, meaning that the worst performing variants are eliminated from the pool of variants throughout the experiment. *Vide* Scott (2015).

²¹⁹ *Vide* <https://www.algolia.com/>

²²⁰ *Vide* <http://www.target2sell.com/>

²²¹ *Cfr.* footnote no. 206

²²² See, for example, Goeree (2008) who finds, in the market of personal computers that profit margins would be a quarter of the prevailing profit margins in the market, if consumers considered all available products. See, also, Hendricks & Sorensen (2009), who find, in the market for music albums, that if consumers considered all available products, the sale distribution of music albums would be less asymmetric.

²²³ Datta et al. (2018).

²²⁴ The order of exhibited products may refer to a vertical and/or a horizontal order.

²²⁵ Pan et al. (2007)

²²⁶ Consequently, the first lines of text in a webpage, read from left to right, are the most read. For the following lines, users tend to focus on the first words of each line.

this reason, when a consumer is looking for a non-differentiated good, the product that appears first may be bought because of its favourable relative position.

298. **Therefore, a selection algorithm may be the decisive factor behind the choice of a consumer.** The relative position of products may be a relevant variable from the point of view of competition, even if consumers may configure how search results are ordered, since consumers have a tendency to keep default options²²⁷.

Figure 16: “F” pattern – Heatmap of the distribution of the locations users look at in search results pages



Source: [Nielsen Norman Group](#)

299. **In audience-providing platforms, the relative position of digital advertising relative to the relevant content of the platform (e.g., news or the feed of a social network) may also change the salience of exhibited products²²⁸.** In a social network, for example, users want to see their feed of publications from other users, such as family members, friends or celebrities. A social network may exhibit adverts directly on the user feed, alongside these publications, or, for example, on the side of the page. In this context, the advert with greater salience should be the one closest and/or integrated with the content that most interests consumers. In turn, in a video-sharing platform, adverts may be in audio-visual format and exhibited at the beginning or during a video, stopping it; or be static images (banners) next to the video. In this case, the advert integrated with the video should be the most salient.

²²⁷ Vide subsection of switching costs in section 2.4.2.

²²⁸ Vide Goldfarb & Tucker (2011).

Figure 17: Advert exhibited in the beginning of a video (on the left) and advert in banner format (on the upper-right) – Detail from the platform YouTube



Source: YouTube

300. Best-selling lists may strengthen the popularity of already popular products, as they are highlighted – a bandwagon effect. As a result, these tools may create barriers to entry to new products in the market. Nonetheless, best-selling lists allow for product discovery²²⁹.
301. **Because selection algorithms establish a touchpoint between consumers and available products, they may create bottlenecks which confer a competitive advantage to certain products at the expense of others, given that they are easier to discover, or more salient.** These bottlenecks may be exacerbated to the extent these product recommendation, digital advertising or search services are concentrated in a small number of firms. This may be the case in contexts where specialised firms are hired to provide these services, or if they are integrated in the ecosystem of a multi-sided platform.
302. **Selection algorithms may be used to leverage market power between goods and services integrated in the same ecosystem.** If a good/service in an ecosystem incorporate selection algorithms by using, for example, a search engine or a recommendation system, the platform may highlight other products from its own ecosystem, at the expense of competing products. This ability to divert consumers to its own products using selection algorithms will depend on the market position of the products where these algorithms are implemented²³⁰. The advantages resulting from a favourable position of a good or service relative to others competing products was addressed by the EC in Google Search (Shopping)²³¹ and Google Search (AdSense)²³² cases – *vide* Box 2 for details on these cases.
303. **Similarly, selection algorithms may be used to leverage market power in a vertically integrated platform.** A firm with market power in product discovery services, upstream, may favour its downstream market, by diverting consumers from competing products to its own products.

²²⁹ E.g., Aguiar & Waldfogel (2018) estimate the impact of adding a song to the “Today’s Top Hits” playlist on the number of plays on Spotify.

²³⁰ *Vide* “self-preferencing” in the Cr  mer et al. Report (2019, pp. 65-66).

²³¹ *Vide* section 7.2 in Google Search (Shopping), COMP/AT.39740, 27 June 2017, EC.

²³² *Vide* “premium placement” in Google Search (AdSense), COMP/AT.40411, 20 march 2019, EC.

304. **These self-preferencing strategies introduce barriers to entry and expansion for competitors and may, in certain circumstances, be considered an abuse of dominant position.**
305. **In addition, the ability to divert consumers from some products to others, based on their interest or willingness to pay, may soften price competition in the market.** A firm that advertises its products in this context knows, beforehand, that its products will only be exhibited to consumers who are less price sensitive, due to greater market segmentation. As such, firms may set higher prices *ex-ante*, even if uniform prices, to take advantage of the expected low sensitivity to price of its group of potential consumers²³³.
306. In 14 February 2019, the European Parliament, the European Council and the European Commission reached an agreement on a Proposal for a Regulation of the European Parliament and of the Council on promoting fairness and transparency for business users of online intermediation services. The purpose of this regulation is to ensure fairness and transparency for business users of online platforms, tackling the legal uncertainty that may arise from new technologies and limiting harmful commercial practices between platforms²³⁴.

²³³ *Vide* Roy (2000), Iyer et al. (2005), Galeotti & Moraga-González (2008) and de Cornière (2016).

²³⁴ European Commission, Proposal for a Regulation of the European Parliament and of the Council on promoting fairness and transparency for business users of online intermediation services, COM(2018) 238 final, 26 April 2018

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