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Can it raise entry barriers and abuse
of dominance concerns”**

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Access to Data for Personalized Pricing: Can it raise entry barriers and abuse of dominance concerns? *

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Abstract

This paper offers some insights for competition policy agencies in charge of determining whether the use of data by dominant firms can harm competition and consumers. When the welfare criterion is consumer surplus we show that in markets characterized by sufficiently low entry costs, the ability of the incumbent firm to price discriminate is not enough to exclude the rival from the market. In this case, we show that price discrimination intensifies competition and overall consumer surplus is above its non-discrimination counterpart. In these markets there are no reasons to block price discrimination. In contrast, in markets with intermediate values of entry costs, the incumbent access to data for personalised prices, might act as an important barrier to entry. With no intervention, the entrant would decide to stay out and the incumbent would be able to increase profits at the expense of consumer welfare.

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Keywords: Data-driven strategies, digital markets, price discrimination, competition policy and regulation.

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1 Introduction

Access to user data by large companies in digital markets, especially Amazon, Facebook and Google, has become a major focus of discussion in the competition and antitrust community. The size of these companies is not a problem *per se*, the idea that “big is not bad” is an established rule of competition policy. However, as the amount of information about users and their preferences collected by these businesses grows exponentially there are several types of data-related conducts/strategies that might raise competition and consumer harm concerns.

First, the collection and exploitation of data might raise barriers to entry when new entrants or smaller companies are unable to collect or buy access to the same kind of data as incumbent companies. A recent OECD report on “Consumer data rights and competition” (OECD, 2020a) suggests that foreclosure could potentially occur, especially when a dominant firm has exclusive access to consumer data. For instance, the incumbent could attempt to raise rivals’ costs or barriers to entry by engaging in price discrimination strategies. The Australian Competition and Consumer Commission (ACCC) in its “Digital Platforms Inquiry” (2019) state that “[...]the breadth and depth of user data collected by the incumbent digital platforms provides them with a strong competitive advantage, creating barriers to rivals entering and expanding in relevant markets”. Second, control over exclusive data can generate market power even without classical market dominance, which is why in general a growing importance of situations of “economic dependence” of even large companies on certain platform or service operators can be observed (Bougette et al., 2019). Third, while greater collection and use of personal data allows businesses to improve the quality of their products/services, it also gives them a competitive advantage to implement sophisticated forms of price discrimination, such as personalized pricing. As discussed in the OECD’s 2018 paper on “Personalized Pricing in the Digital Era”, the personalization of prices generally improves efficiency and often results in consumer gains by encouraging businesses to compete more intensively for each consumer (Thisse and Vives, 1988; OECD, 2018). However, in some circumstances, it may result in consumer and competition harm if implemented by businesses with substantial market power (Bourreau and De Streel, 2018; OECD, 2018; OECD, 2020b).

In light of this, the new digital ecosystem has pushed competition and regulation bodies around the globe to take actions to improve and adapt the regulatory frameworks for the digital economy. The 10th Amendment of the German Competition Act, which entered into force on January 19, 2021, is an example of such effort. It addresses abuse of dominance and is

intended to further shape and complete the regulatory framework of competition in the data-driven economy (Budzinski, et al, 2020). Following the Amendment, irrespective of size, a company is considered to have “relative market power”, if another company is dependent on it for its own business strategies. Access to data is introduced as a crucial criterion. The refusal to provide access to such data in exchange for an adequate fee may also constitute an abuse (OECD, 2020b). This suggests that in the digital economy many companies might be exposed to abuse by another company with relative or superior power due to its exclusive access to competition-relevant data.

Although businesses use their personal databases to implement several commercial and marketing strategies, this paper focuses only on the incumbents’ user data as an input for personalized pricing. Amazon, for instance, competes side by side with many retailers which are clearly in an information disadvantage position to design their pricing strategies if they lack access to the required data. While Amazon can set lower prices to those consumers with lower willingness to pay (e.g., those with a preference for the rivals’ products), competitor retailers with no such information have no alternative than charge a “price fits all”.

This paper focus on the following questions: In what circumstances can the incumbent’s exclusive access to user data for personalized prices raise a barrier to entry? Does personalized pricing help the incumbent to sustain its market dominance in case of a competitor entrance? Can the incumbent’s control over data raise abuse of dominance concerns? Does personalized pricing raise consumer harm concerns?

In order to provide an answer to these questions we build a two-period model. The pricing game of our base model is close related to Thisse and Vives (1988). In this model two firms located in the Hotelling line have both access to data on each consumer’s preferences (location) and quote personalized prices accordingly. They show that personalized prices (henceforth PP) benefits consumers and harms industry profits.¹ We depart from Thisse and Vives’ model by assuming that previous to price competition, a potential entrant takes into account that the incumbent has exclusive access to data for pricing, and decides whether to incur the entry cost F , or to stay out. If entry occurs, the new entrant lacks access to data for price discrimination, thus it charges a uniform price (U). Another related paper is Gehrig et al. (2011) who study entry decisions in a market where an incumbent firm engages in history-based price discrimination, while the potential entrant has no data and faces no sunk and fixed costs of entry. They find

¹Esteves, et al (2021) show that personalised prices can harm consumers at the expense of profits if consumer preferences follow a non-uniform distribution.

that dominance for an incumbent firm is invariant on the regimes with price discrimination and uniform pricing. They also show that the potential abuse of market dominance imposed by history-based price discrimination is exploitation, not exclusion. In contrast, we show that the persistence of market dominance for an incumbent firm depends on the price regimes it adopts, i.e. personalized or uniform pricing. Interestingly, our analysis highlights that consumers as a whole are better off under (PP,U) than under (U,U). Thus, as long as entry occurs, the persistence of dominance after entry does not seem to pose consumer harm concerns.

Entry barriers can be introduced in several ways. The traditional approach to entry barriers is to view them as stemming from having fixed and sunk costs of entry. We also take this view. As mentioned, we try to understand whether an incumbent's access to data for personalized prices is a tool to sustain its dominance and exclude new firms from the market.²

Our analysis offers some insights to policy agencies. We show that in markets characterized by sufficiently low entry costs, the incumbent's ability to use its data for price discrimination is not enough to exclude the rival from the market. In this case, although price discrimination helps the incumbent to sustain its dominance, the intensified competition allows overall consumer surplus to be above the non-discrimination counterpart. In these markets there are no reasons for policy intervention. In contrast, for intermediate entry costs, the exclusive access to user data for personalized pricing helps the incumbent to discourage entry in comparison to uniform pricing. With no intervention, the incumbent ability to engage in personalized prices is an effective tool for consumer welfare exploitation and exclusion. Ignoring other effects, personalized pricing would only boost welfare if the demand expansion effect outweighs the consumer surplus extraction effect, and would harm welfare otherwise. When consumer and welfare harm is proved, apart from more extreme remedies such as prohibiting personalized pricing all together, other remedies should be considered. We discuss the possibility of information sharing in exchange of a fee and legal restrictions on the use of data for pricing. Other alternatives can also be considered in order to improve market transparency, empower consumers with control over data, eventually enhancing the ability of consumers to compare prices.³ If remedies are carefully designed, they

²Colangelo and Maggolino (2018) note that "... the collection and aggregation of data, including personal data, by dominant firms entrenches their dominant positions". Rubinfeld and Gal (2017) also argue that a potential new entrant to the market without access to data might face several barriers to entry.

³Following the OECD, 2018 report on "Personalised Pricing" some possible remedies are: (i) requiring the firm to inform consumers that the prices or discounts offered are personalised; (ii) requiring the firm to disclose to consumers how the personalised pricing is calculated, including the personal information that was used to set the price; (iii) requiring the firm to obtain consumers' permission to use their personal data to personalise prices;

may have the effect of reinforcing competition, and therefore reducing the risk of harm associated to personalized pricing by a dominant firm.

The rest of the paper is organized as follows. The model is presented in Section 2. The monopoly benchmark is discussed in Section 3. Section 4 is devoted to the equilibrium analysis. In Section 5 we look at the possibility of information sharing in exchange of a fee. Section 6 is dedicated to the welfare analysis and Section 7 discusses our main policy implications. The Appendix collects the proofs that were omitted from the text.

2 The model

Consider a horizontally differentiated market where an incumbent company has exclusive access to large volumes of user data, which has been collected and analyzed for a long period of time. User data is nowadays recognized as an important input of many business strategies like personalized pricing, targeted advertising, product customization, to name few. As aforementioned, user data can facilitate the implementation of sophisticated forms of price discrimination, such as personalized pricing—the focus of our analysis. Suppose an incumbent dominant platform, say firm A, is challenged by the possibility of entry of a competitor, say firm B, which is in a disadvantaged position with regard to access to user data. Specifically, assume that data is controlled by the incumbent firm. Firm A (B if entry occurs) is located at 0 (1) in the unit interval. There is a population of consumers uniformly distributed in the interval $[0, 1]$, with mass normalized to 1. Each consumer wishes to buy a single unit either from firm A or B and is willing to pay at most v . We will assume that v is sufficiently high so that nobody stays out of the market under competition, i.e., $v \geq \frac{3t}{2}$ (covered market). As usual a consumer located at x incurs total cost $p_A + tx$ if buys from firm A at the price p_A , and incurs total cost $p_B + t(1 - x)$ if buys the unit from B at the price p_B . Since prices and profits are linear in t , under competition to simplify the analysis we normalize $t = 1$.

The timing of the game is as follows. There are two periods. In the first period, firm B decides whether or not to enter in the market incurring the entry cost $F \geq 0$. In the second period, firm A and B (or only firm A, if B stays out) make(s) price decisions. As firm B has no access to consumer data, it can only compete with a uniform pricing policy (henceforth U). In contrast, the incumbent firm has the required data to implement a personalized pricing strategy (henceforth PP). To simplify marginal cost of production is assumed to be equal to zero.

requiring the firm to publish a listed uniform price for all consumers who wish to opt out of personalised pricing.

We will then discuss the implications of a possible remedy through which the incumbent should provide the competitor access to data in exchange of a fee. In this new setting both firms would be able to offer personalized prices.

3 Benchmark: Monopoly

Before proceeding it is useful to begin by considering a monopoly firm (or equivalently, a firm with a super dominant position). If the firm can collect precise data about its consumers, simple economics shows it may increase its profits by offering personalized prices.⁴

Consider first that the incumbent is not allowed to use its data for price discrimination, thus it quotes a uniform price to all consumers. The indifferent consumer between buying its product or not is located at \bar{x} such that $v - \bar{x} - p = 0$. This means that consumers located at $x \leq \bar{x}$ decide to buy, and consumers located at $x > \bar{x}$ stay out of the market, with $\bar{x} = v - p$. Therefore, under uniform pricing the incumbent profit is $\pi = p(v - p)$, with $v - p \leq 1$. We can establish the following proposition.

Proposition 1. *Under uniform pricing when $v \leq 2$ then, at the optimum, the monopolist sets the optimal price $p = \frac{v}{2}$ and its profit is equal to $\pi_M^u = \frac{v^2}{4}$; when $v > 2$ then, the monopolist sets the optimal price $p = v - 1$ and its profit is equal to $\pi_M^u = v - 1$.*

Therefore, as $v \leq 2$, some consumers are left out of the market under uniform pricing. In contrast, if $v > 2$ all consumers are willing to buy the product. In terms of welfare, it follows that when $v \leq 2$:

$$CS_M^u = \int_0^{\frac{v}{2}} \left(v - \frac{v}{2} - x \right) dx = \frac{v^2}{8}, \quad (1)$$

$$W_M^u = \frac{3v^2}{8}. \quad (2)$$

⁴For example, Shiller (2014) estimates the increase in profit if Netflix would introduce personalised prices. According to the author, this would lead to an increase of profit for the company between 0.8% (if it used data on consumer demographics) and 12.2% (if it used the browsing history of its consumers). Dubé and Misra (2017) conducted an experiment on Ziprecruiter, an online recruiting company, comparing the existing uniform price charged by Ziprecruiter, an optimized uniform price and targeted prices. They find that the firm's profits increase by 65% when moving from the existing price to the optimized price, and increase further by 10% when adopting targeted pricing.

In contrast, when $v > 2$:

$$CS_M^u = \int_0^1 (v - (v - 1) - x) dx = \frac{1}{2} \quad (3)$$

$$W_M^u = v - \frac{1}{2} \quad (4)$$

Suppose now that the use of the incumbent's data for personalized pricing is permitted. Then, the incumbent sets a price $p(x)$ to capture all the surplus from each consumer located at x , i.e. $v - p(x) - x = 0$.

Proposition 2. *When the incumbent uses its data for personalized pricing, the optimal price for a consumer located at x is $p(x) = v - x$, for $x \in [0, 1]$, with corresponding profits $\pi_M^{pp} = v - \frac{1}{2}$. Consumer surplus and overall welfare are respectively, $CS_M^{pp} = 0$ and $W_M^{pp} = v - \frac{1}{2}$.*

As said in a monopoly situation, a firm will benefit from personalized pricing. When a firm sets personalized instead of uniform prices, a two opposite effects arise: some consumers with high willingness-to-pay can be worse off (appropriation effect), while some consumers with low willingness-to-pay can be better off (demand expansion effect). The appropriation effect means that moving from uniform pricing to personalized prices, the monopoly firm increases the price charged to consumers with strong preferences (high willingness-to-pay). We will see that under competition this might not occur. These consumers are then worse off with personalized prices. The demand expansion effect arises because as the monopoly firm charges lower personalized prices to consumers with low willingness-to-pay, they can now purchase the good while they could not afford it under uniform pricing. Thus, when v is sufficiently low (i.e., $\frac{3}{2} < v < 2$) in comparison to uniform pricing consumer surplus fall but welfare always increases with personalized pricing due to a demand expansion effect. When $v > 2$ as all consumers can afford the good under uniform pricing, then as expected aggregate consumer surplus and welfare fall when the incumbent uses its data for personalized pricing.

Policy issues: When a super dominant company has access to user data for personalized prices, any intervention to avoid consumer harm might be addressed through a combination of complementary policy tools, including competition and antitrust policy, consumer protection and data protection. Regarding antitrust law, a general *per se* prohibition of personalized prices is usually not justified, however, if it can be proved that consumer surplus and welfare falls with personalized prices in a specific case, the practice can be prohibited by the antitrust rules. Following Bourreau and de Stree (2018) in the European Union, Article 101(1d) TFEU and Article 102(c) TFEU prohibit specifically anti-competitive discriminatory agreement and

abuse of dominant position respectively. In this context, discrimination is defined as “applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage”. Within competition law, personalized pricing may potentially be assessed under abuse of dominance rules, though there are some limitations to the application of competition law in this area.⁵ Antitrust rules are better at condemning exclusionary price personalization than regulating exploitative price personalization. So it is important to consider whether the access to personal data for personalized pricing can help an incumbent to exclude a competitor from the relevant market. We will look at this issue in the next section.

4 Equilibrium analysis

As usual we solve the game working backwards from the second period.

4.1 Second-period (Price decisions)

Consider first the case where firm B enters. If for any reason the incumbent firm cannot use data for personalized pricing (due, for instance, regulation, to legal restrictions, consumers hiding strategies), the pricing game is a replication of the Hotelling model, and both firms quote a uniform pricing (U,U). The equilibrium uniform price is $p_i^{u,u} = 1$, $i = A, B$. Firm A and B’s profits are respectively equal to $\pi_A^{u,u} = \frac{1}{2}$ and $\pi_B^{u,u} = \frac{1}{2} - F$. In this situation all consumers can buy the product (covered market) as long as $v \geq \frac{3}{2}$. Thus, in what follows we impose that restriction on v . If in contrast, firm B stays out, and the incumbent cannot use data for price discrimination then firm A behaves as in Proposition 1.

Consider now the case where the incumbent faces no restrictions in the use of its collected data for personalized pricing. Let $p_i^{p,u}$ represent firm’s i price when firm A charges personalized prices and firm B charges a uniform price. We can establish the following proposition.

Proposition 3.

When the incumbent firm has access to data for personalized pricing and firm B enters, then in equilibrium:

⁵The OECD (2018) states that this limitation arise because (i) rules on abuse of dominance only apply to firms that have substantial market power, which are in fact the circumstances under which personalised pricing can cause more consumer harm; (ii) in several jurisdictions, exploitative abuses are either not prohibited by competition law, or rarely investigated in practice; (iii) it is often unclear whether competition rules against discrimination apply to business-to-consumer relationships.

(i) each firm's price is respectively equal to

$$p_A^{p,u}(x) = \begin{cases} (\frac{3}{2} - 2x) & \text{if } x \leq \frac{3}{4} \\ 0 & \text{if } x \geq \frac{3}{4} \end{cases} \quad (5)$$

$$p_B^{p,u} = \frac{1}{2}. \quad (6)$$

(ii) each firm's profit equals

$$\pi_A^{p,u} = \frac{9}{16}, \quad (7)$$

$$\pi_B^{p,u} = \frac{2}{16} - F. \quad (8)$$

Proof.

See the Appendix.

Therefore, the firm that has access to the data makes higher profits than in the situation without information about consumers ($\pi_A^{p,u} = \frac{9}{16} > \pi_A^{u,u} = \frac{8}{16}$) and the firm without access to data makes clearly lower profits ($\pi_B^{p,u} = \frac{2}{16} - F < \pi_B^{u,u} = \frac{8}{16} - F$).

Look next at the price effects in comparison to (U,U), where both firms charge $p^{u,u} = 1$. Under (PP,U) consumers with preferences in the interval $[0, \frac{1}{4}[$ buy from A at a price higher than 1. In contrast, consumers with preferences in the interval $[\frac{1}{4}, \frac{3}{4}]$ buy from the incumbent at a price lower than 1, the consumer located at $x = \frac{3}{4}$ benefits the most as it pays 0. Finally, consumers located at $[\frac{3}{4}, 1]$ buy from B at price $\frac{1}{2}$ (lower than the uniform price too). In sum, the collection of detailed data for personalized prices even when implemented by a single firm is not necessarily harmful to consumers as a whole. However, there might be winners and losers among consumers. In comparison to the situation where no firm can use consumer data for price discrimination, consumers with low willingness-to-pay or those who buy from the non-discriminating will benefit from personalized pricing. In contrast, consumers with high willingness-to-pay will be hurt.

Can the incumbent sustain its market dominance in case of entry? Our analysis highlights that an incumbent with ability to engage in personalized prices can maintain its market dominance despite entry. Under the uniform pricing policy for both firms, i.e. (U,U), each firm serves 50% of the market at price $p^{u,u} = 1$. The same happens (as we will see in Section 5) if firms in the market have access to the same information about consumers for pricing, the case (PP,PP). But this is not necessarily the case. When the incumbent has access to data, while the entrant does not, in the pricing game the incumbent price discriminates and its rival charges

a uniform price (PP,U). In this situation, the incumbent serves 75% of the market and the entrant 25%. Thus, our analysis highlights that even if entry occurs, the incumbent firm is able to sustain its dominance. In sum, as long as entry occurs, dominance *per se* is not necessarily harmful to consumers as a whole. With the exception of consumers with high willingness to pay for the incumbent’s product (those in the interval $[0, \frac{1}{4}]$) who are exploited, all the others are better off under (PP,U) than under (U,U).

4.2 First-period (Entry decision)

We now turn to period 1, where firm B decides whether or not to enter in the market.

Corollary 1.

If the incumbent firm cannot use its data for personalized prices, firm B enters as long as $F \leq \frac{1}{2}$; otherwise it stays out. In contrast, if the incumbent is able to use its data for personalized pricing, then firm B enters as long as $F \leq \frac{1}{8}$. If $\frac{1}{8} < F \leq \frac{1}{2}$ the incumbent exclusive access to data for personalized pricing acts as a “barrier to entry”.

Our analysis highlights that if user data is commercially valuable, lack substitutes, and is not shared across firms, then in fact the incumbent’s exclusive access to user data for price discrimination purposes can limit the number of viable competitors and create a “data barrier to entry”. In other words, the incumbents’ ability to employ consumer data collected for personalized prices, acts to discourage entry by a rival firm in comparison to uniform pricing. Under personalized prices the dominant firm is able to exclude a rival firm from the market in the range of entry costs that would otherwise lead to entry under uniform pricing, specifically when entry cost belong to the interval $]\frac{1}{8}, \frac{1}{2}]$. This result suggests that the incumbents’ access to data for price discrimination can raise antitrust concerns.⁶ In markets that are relatively well represented by these features, policy intervention plays an important role. Remedies such as imposing a ban on the use of data for personalized prices or mandating some form of information sharing could act to encourage entry and to restore competition in the market.

Personalized Prices and abuse of dominance: Abuse of dominance are any anti-competitive business practices in which a dominant firm may engage in order to maintain or increase its position in the market. In most jurisdictions, qualifying a conduct as an abuse of dominance requires three fundamental conditions to be met: (1) the offender must be dominant in the relevant market; (2) the conduct must fit a generally accepted category of abuse; and

⁶For arguments that Google benefits from a data barrier to entry, see Newman (2014).

(3) the conduct must be shown to have anti-competitive effects that are not counter-balanced by efficiencies. Firstly, the fact that provisions on abuse of dominance only apply to dominant firms is consistent with the idea that, for a firm to be able to unilaterally harm the competitive process, it must have a degree of market power in the relevant market. Secondly, as dominance is in itself not unlawful, but only its abuse, it is necessary to identify an anti-competitive conduct in order to establish an infringement. Antitrust rules are better at condemning exclusionary conducts than exploitative ones. Following Akman (2009) “[E]xclusionary’ abuses refer to those practices of a dominant firm which seek to harm the competitive position of its competitors or to exclude them from the market, whereas ‘exploitative’ abuses can be defined as attempts by a dominant firm to use the opportunities provided by its market strength in order to harm customers directly.”

Our analysis highlights that in some circumstances it might be possible to qualify personalized pricing as an exclusionary abuse, specifically whenever an incumbent firm use its user data and its pricing strategies to target lower prices to customers with a preference for competitors’ products, in an attempt to foreclose the market. When this happens the incumbent is able to maintain its super dominant position with serious harm on competition and consumer welfare. Finally, following the 10th Amendment of the German Competition Act 2021, in assessing market dominance, particular account shall be taken of a company’s access to data and its effects on market entry and competition. Furthermore, the refusal to provide access to such data in exchange for an adequate fee may also constitute an important form of abuse in the digital economy. We look at this issue next.

5 Information sharing

In the case of a company’s exclusive access to competition-relevant data, a critical question relates to the nature of the remedy that could be used to restore competition and offset the harm to consumer welfare. As discussed, this is especially important in markets with intermediate entry costs.

Suppose now that the incumbent can share its user data with the entrant in exchange of a fee, say $f \geq 0$. When both firms have access to data, price discrimination is a dominant strategy

for each player, and the pricing game is similar to Thisse and Vives (1988). Each firm's price is:

$$p_A(x) = \begin{cases} 1 - 2x & \text{if } x \leq \frac{1}{2} \\ 0 & \text{if } x > \frac{1}{2} \end{cases},$$

$$p_B(x) = \begin{cases} 2x - 1 & \text{if } x \geq \frac{1}{2} \\ 0 & \text{if } x < \frac{1}{2} \end{cases}.$$

When both firms have the same information, personalized pricing may actually result in firms competing more aggressively for each individual consumer, increasing the incentive of firms to reduce prices.

The corresponding equilibrium profits are:

$$\pi_A^{p,p} = \frac{1}{4} + f,$$

$$\pi_B^{p,p} = \frac{1}{4} - f - F \text{ with } f + F \leq \frac{1}{4}.$$

Therefore, when both firms have access to data, the incumbent makes lower profits than in the situation where it is the single discriminating firm ($\pi_A^{p,p} = \frac{4}{16} + f < \pi_A^{p,u} = \frac{9}{16}$). If entry occurs and access to data is provided the entrant can make higher profits than without such data ($\pi_B^{p,u} = \frac{2}{16} - F < \pi_B^{p,p} = \frac{4}{16} - f - F$).

Next we look at firm B's entry decisions. If the entrant were able to have access to the incumbent's data costlessly (i.e., $f = 0$), it would decide to enter as long as $F < \frac{1}{4}$ (rather than when $F < \frac{1}{8}$ under no access to data). If a mandatory costlessly data sharing were imposed by way of regulation, the likelihood of restoring competition would be higher. However, a remedy should not act as a sanction. Imposing the incumbent the obligation to share its information for free with competitors might give rise to other problems. First, the incumbent could simply give the competitor access to raw data. It is not clear whether the competitor would gain from this solution. We should take into account that much of the value of data can come from how it is processed, in terms of organization and analytics, which can be costly and take time (Katz, 2019). On the other hand, data can be used by the incumbent to improve quality, product and service innovation, something we are ignoring in this model. Thus, it is important that the remedy does not create disincentives to invest in information technology and analytics across a long period of time.

Consider now the case where $f > 0$. Entry occurs as long as $F \leq \frac{1}{4} - f$. If entry were costless ($F = 0$), the incumbent could receive a fee not higher than $\frac{1}{4}$, and realize a profit equal to $\frac{1}{4} + f \leq \frac{1}{2}$. If the fee reaches the maximum value B would be willing to pay, the incumbent

profit would be equal to $\frac{1}{2}$ and the entrant profit would be null. A remedy like this would help the incumbent to overcome the prisoners' dilemma that arises in Thisse and Vives (1980) when both firms have access to the same piece of information. It would also boost overall consumer surplus. However, would the incumbent decide to refuse a solution like this? Put differently, what is the minimum fee that makes the incumbent willing to share its data with a competitor?

Comparing the worst scenario for the incumbent, which arises when entry occurs, we find that $\pi_A^{p,p} - \pi_A^{p,u} \geq 0$ as long as $f \geq \frac{5}{16}$. The minimum value for the fee would be equal to $\frac{5}{16}$. Even when $F = 0$ the potential entrant cannot support a fee like this. This suggests that if a regulator or competition authority mandates the incumbent to share its data with competitors, they would need to impose a fee, which means that they would also have to be involved in the determination of questions regarding the fee. Other important aspects related to data sharing remedies would be the quantity and quality of datasets, and the interplay between the data sharing remedy and the GDPR.

6 Welfare analysis

This section looks at consumer surplus (CS) and overall welfare (W) under the different market conditions and pricing policies we have analyzed so far. The case of monopoly was already presented in section 3. When firm B enters and the incumbent is not allowed to use its data for price discrimination, both quote the uniform price which is equal to 1 and all consumers buy from the closer firm which is efficient. Consumer surplus and welfare under (U,U) are respectively equal to:

$$CS^{u,u} = 2 \int_0^{\frac{1}{2}} (v - p^{u,u} - x) dx = v - \frac{5}{4}, \quad (9)$$

$$W^{u,u} = \pi_A^{u,u} + \pi_B^{u,u} - F + CS^{u,u} = v - F - \frac{1}{4}. \quad (10)$$

When firm B enters and the incumbent can use its user data for personalized pricing, while its rival quotes a uniform price, consumer surplus and welfare under (PP,U) are respectively equal to:

$$CS^{p,u} = \int_0^{\frac{3}{4}} (v - p_A^{p,u}(x) - x) dx + \int_{\frac{3}{4}}^1 (v - p_B^{p,u} - (1-x)) dx = v - 1, \quad (11)$$

$$W^{p,u} = v - \frac{5}{16} - F. \quad (12)$$

Finally, if in case of entry, competition policy or regulation mandates the incumbent to share its data with the competitor in exchange of a fee f , then both are able to charge personalized prices. Consumer surplus and welfare under (PP,PP) are respectively equal to:

$$CS^{p,p} = 2 \int_0^{\frac{1}{2}} (v - p_A^{p,p}(x) - x) dx = v - \frac{3}{4}, \quad (13)$$

$$W^{p,p} = v - \frac{4}{16} - F. \quad (14)$$

The next table summarizes firms' profits (π_A and π_B), consumer surplus (CS) and welfare (W) under the different market structures and price regimes. The last row of the table presents the case where the incumbent provides the entrant access to its data for pricing in exchange of a fee. The reader should take into account that $v \geq \frac{3}{2}$ and when entry occurs $F \leq \frac{1}{8}$.

Table 1: Profits, consumer surplus and welfare

Pricing	π_A	π_B	Π_{ind}	CS	W
(PP,U)	$\frac{9}{16}$	$\frac{2}{16} - F$	$\frac{11}{16} - F$	$v - 1$	$v - \frac{5}{16} - F$
(U,U)	$\frac{8}{16}$	$\frac{8}{16} - F$	$1 - F$	$v - \frac{5}{4}$	$v - \frac{4}{16} - F$
(PP)	$v - \frac{1}{2}$	—	$v - \frac{1}{2}$	0	$v - \frac{8}{16}$
(U): $\frac{3}{2} < v \leq 2$	$\frac{v^2}{4}$	—	$\frac{v^2}{4}$	$\frac{v^2}{8}$	$\frac{3v^2}{8}$
(U): $v > 2$	$v - 1$	—	$v - 1$	$\frac{1}{2}$	$v - \frac{8}{16}$
(PP,PP)	$\frac{1}{4} + f$	$\frac{4}{16} - f - F$	$\frac{1}{2} - F$	$v - \frac{3}{4}$	$v - \frac{4}{16} - F$

Proposition 5. *Consider the case where access to data is not provided:*

(i) *Consumer surplus is higher when an incumbent firm with access to data, exposed to competition from new entry, is able to engage in personalized prices, than if it does not.*

(ii) *Overall welfare is higher when the incumbent firm is not able to use its data for price discrimination if entry occurs.*

(iii) *If entry does not occur, the use of data by a monopolistic firm for price discrimination harms consumers at the expense of profits when $v > 2$. If $\frac{3}{2} < v < 2$, the use of incumbents' data for price discrimination harms consumers as a whole but boosts profits and welfare due to the demand expansion effect.*

In what follows we discuss the consumer and overall welfare effects. We distinguish three cases taking into account the likelihood of entry. In the first case entry costs are sufficiently low, i.e. $F \leq \frac{1}{8}$, which means that the incumbent's access to data is not enough to block the entry. The second case, the most relevant for policy intervention, entry costs are intermediate,

specifically $\frac{1}{8} < F \leq \frac{1}{2}$. If the incumbent were not able to charge personalized prices, either because it has no data or because price discrimination is for any reason not permitted, the competitor would always decide to enter. In contrast, if the incumbent is able to compete with personalized pricing, then its data/pricing flexibility advantage acts to exclude the rival from the market. In the last case, entry costs are so high that, regardless of any access to data, entry never occurs.

Starting with the first case, the expressions presented in table 1 reveal that $CS^{p,u} - CS^{u,u} > 0$. As explained, personalized pricing favours some consumers, those with preferences in the interval $[\frac{1}{4}, 1]$, while leaves others worse-off, those with preferences in the interval $[0, \frac{1}{4}]$. In contrast, in markets where entry is costless or cheap, although access to data for the personalization is good for aggregate consumer welfare, it is harmful for overall welfare, as $W^{p,u} - W^{u,u} < 0$. This is basically due to more inefficient shopping. Under uniform pricing consumers always buy from their preferred firm, which is efficient. Under (PP,U) consumers with preferences in the interval $]\frac{1}{2}, \frac{3}{4}[$ buy from the less preferred firm under discrimination (i.e., from the incumbent), which is less efficient than buying from B.

Look next at the second case where $F \in]\frac{1}{8}, \frac{1}{2}]$. The incumbents' ability to employ consumer data collected for personalized prices, acts to discourage entry by a rival firm in comparison to uniform pricing. This harms consumers but also welfare when price discrimination has no demand expansion effect. The same welfare effects are produced when F is high.

Finally, consider next the welfare effects associated to a policy intervention that mandates the incumbent to share its data with the entrant in exchange of a fee. Our analysis reveals that when entry occurs consumer, then $CS^{p,p} > CS^{p,u} > CS^{u,u}$. Thus, conditional on entry, consumer surplus is in fact maximized when both firms are able to use data for personalized prices. In markets with sufficiently low entry costs, i.e., $F < \frac{1}{8}$, any restriction on the use of data for price discrimination would cause consumer harm. If the criterion is aggregate welfare we conclude that $W^{p,p} = W^{u,u} > W^{p,u}$. Thus, an information sharing remedy would have the same effect on welfare than not permitting the use of data for personalized prices.

Following the welfare analysis, the next section presents the main policy implications of our analysis.

7 Policy implications and final remarks

As aforementioned the 10th Amendment of the German Competition Act which entered into force on January, 19 2021, addresses abuse of dominance and is intended to further shape and complete the regulatory framework of competition in the data-driven economy. Following the Amendment, market power might arise from the fact that a company is dependent for its own business strategies, like pricing, on access to data controlled by another company. In our model user data is a key input for the implementation of sophisticated price discrimination strategies, such as personalized pricing. Amazon, for instance, competes side by side with many retailers which are clearly in an information disadvantage position to design their pricing strategies. The refusal to provide access to such data in exchange for instance of an adequate fee may also constitute an abuse. This suggests that in the digital economy many companies may be expose to abuse by another company with relative or superior power due to its exclusive access to competition-relevant data. Further, the OECD (2020a) suggests that foreclosure could potentially occur when a dominant firm has exclusive access to consumer data. The same concerns are raised by ACCC (2019) which states that the incumbent could attempt to raise rivals' costs or barriers to entry by engaging in price discrimination strategies.

Our analysis has tried to shed some light on these concerns. It is important to note that policy intervention may depend on the legal standard or general mission of the competition law in a specific jurisdiction. According to a survey by the ICN (2011), in 89% of the jurisdictions consumer welfare is the primary goal or one of the goals of competition law, but there are other countries where the standard is total welfare.⁷ As is referred in the OECD (2018) report “[A]mong those countries where consumer welfare is one of the goals, some also have the institutional role of promoting efficiency (not necessarily passed through to consumers), potentially requiring the respective competition authorities to balance a trade-off between total and consumer welfare.”

Before proceeding, when personalized pricing does not reflect different marginal costs of serving different consumers, as is the case in our model, competition authorities may consider following the next steps in order to determine whether such conduct is abusive. First, it is important to exist dominance. While personalized pricing can be observed in markets that are relatively competitive, there is a higher risk of exploitation when a firm has substantial market

⁷For instance, overall welfare is the standard welfare criterion in Australia, Canada, New Zealand and Norway, to name few.

power in the relevant market. In fact, establishing dominance is a legal requirement in most jurisdictions to apply rules on abuse of dominance. Second, an infringement should only be established if there is evidence of harm. As discussed, different authorities may give a different weight to consumer welfare and total welfare, depending on the antitrust standard of a particular jurisdiction. Even if personalized pricing harms consumers by increasing average prices, this does not necessarily merit an antitrust intervention, as those effects may be temporary and likely to be resolved by the market (this would be the case if the entrant were able to get data across time). In contrast, an intervention may be needed when the existence of barriers to entry extend the negative effects over time. Finally, identifying the source of the personalized pricing can be useful to define the appropriate remedies. As said, price discrimination can be facilitated by many factors, such as data collection, lack of price transparency, to name few.

Next we highlight under what market conditions personalized pricing by a dominant firm is assessed to have negative and persistent negative effects on consumers and competition. We first discuss the case where the incumbent access to data for personalized pricing cannot block entry.

Data access raises no barrier to entry: in markets where the likelihood of entry is high due to sufficiently low entry costs (i.e., $0 \leq F \leq \frac{1}{8}$), consumers are clearly better off in comparison to a monopoly market. As expected if entry occurs, competition boosts consumer surplus. Consider first the case where the incumbent is not allowed to use its consumer data for price discrimination. In this situation, both firms compete with uniform prices, (U,U), and each serves 50% of the market. The incumbent loses its dominance. In contrast, if no policy restriction is imposed on the use of data by the incumbent for pricing, it can set personalized prices while the entrant sets a uniform price, (PP,U). In this scenario, we conclude that price discrimination helps the incumbent to sustain its dominance, by serving 75% of the market. Our results are in sharp contrast with Gehrig, et al (2011) who find that dominance for an incumbent firm is invariant on the regimes with price discrimination (behavior-based price discrimination) and uniform pricing. In our setting, the persistence of market dominance does depend on the price regimes for the incumbent, i.e., personalized or uniform pricing. More interestingly, Proposition 5 highlights that consumers as a whole are better off under (PP,U) than under (U,U). Thus, the persistence of dominance after entry does not seem to pose aggregate consumer harm concerns. Price discrimination intensifies competition between duopolists and boosts overall consumer surplus. Although it is true that personalized pricing favours some consumers while leaving others worse-off, the analysis of the effects should be based on consumer welfare as a

whole, and not on the harm imposed on a subgroup of individuals. This suggests that apart from other concerns related, for instance, to privacy and fairness issues, which beyond the goals of this model, competition authorities that prioritize the promotion of consumer welfare have no good reasons to prohibit the use of data by an incumbent in the case of entry.

Finally, competition authorities that give more weight to total welfare may find personalized pricing to be harmful, and so they might be opened to consider policy restrictions on the use of data for pricing by a dominant firm. It is interesting to note that this trade-off between consumer welfare and total welfare is very specific to personalized pricing (the same happens in merger review), not being commonly observed in other types of abuse that generally affect consumer welfare and total welfare in a similar way.

Data access raises a barrier to entry: As aforementioned, in terms of policy intervention, the most relevant markets are those exhibiting intermediate entry costs, specifically $\frac{1}{8} < F \leq \frac{1}{2}$. If the incumbent were not able to charge personalized prices, either because it has no data or because price discrimination is for any reason not permitted, the competitor would always decide to enter. In contrast, if the incumbent is able to compete with personalized pricing, then its data/pricing flexibility advantage acts to exclude the rival from the market. Without any policy intervention to restore competition in the relevant market, the incumbents' exclusive access to data for price discrimination, acts as a "data barrier to entry". Firm B decides to stay out of the market, and firm A is able to sustain its monopoly position and capture all consumer surplus. In this scenario the potential abuse associated with PP by a dominant firm is *exploitation with exclusion*.

In markets like this a critical question relates to the nature of the remedy that can offset consumer harm and restore competition. In such a situation, a competition authority might restore the level of competition that would otherwise exist by (i) not permitting the incumbent to use data for pricing (U,U) and (ii) by mandating the incumbent to grant some form of access to its data to the entrant (P,P).

We saw that a remedy restricting the use of data for personalized prices would restore competition at (U,U) at the benefit consumers and overall welfare. Another possible remedy, with some associated problems, would be to mandate the incumbent to grant some form of access to its data to the entrant. When all competing firms have access to the same information about consumers' tastes and preferences, the intensity of competition increases, with a positive impact on consumer welfare, which reaches its maximum value at (PP,PP) and on social surplus. However, if authorities decide to impose an information data sharing remedy, and if this is done

in exchange of a fee, our analysis suggests that the fee the entrant can support is below the level the incumbent is willing to share its data. Thus, if a regulator or competition authority mandates the incumbent to share its data with competitors, they would need to impose a fee, which means that regulators would also have to be involved in the determination of questions regarding the value of the fee and other aspects such as monitor the quantity and quality of data shared. This would require antitrust courts to act as central planners, identifying the proper price and other terms of dealing and monitoring such activity. Competition authorities and antitrust courts are not best placed for such tasks. Additionally, an information sharing remedy needs to comply with the principles and rules of the GDPR. In view of that, a remedy restricting the use of data for price discrimination purposes could be a more effective remedy to restore competition and offset consumer harm.

Finally, the risk of consumer harm from personalized pricing by a dominant firm might be addressed through a combination of complementary policy tools, including competition policy, consumer protection and data protection, as well as anti-discrimination laws. Effective enforcement may therefore require the coordination of competition, consumer and data protection authorities. Apart from more extreme remedies such as prohibiting personalized pricing all together, some alternatives for future consideration in line of OECD (2018) are (i) requiring the firm to inform consumers that the prices or discounts offered are personalized; (ii) requiring the firm to obtain consumers' permission to use their personal data to personalize prices; (iii) requiring the firm to publish a listed uniform price for all consumers who wish to opt out of personalized pricing. If remedies are carefully designed, they can be an effective tool to avoid entry barriers and abuse of dominance linked to the access of personal data in digital markets.

Appendix

This appendix collects the proofs that were omitted from the text.

Proof of Proposition 3: Given firm B's uniform price P_B the indifferent consumer between buying from A and B is located at

$$P_A(x) = P_B + (1 - 2x). \quad (15)$$

As we assume $c = 0$ the lowest price firm A is willing to charge to a more distant consumer is equal to 0. Therefore, the consumer who is indifferent between buying from A at the lowest price and from B at price P_B is located at x such that

$$v - x = v - P_B - (1 - x)$$

This yields

$$x = \frac{1}{2} + \frac{P_B}{2}.$$

Therefore, firm A's demand is x while firm B's demand is $1-x$. It is now possible to determine firm B's profit which is equal to

$$\pi_B = P_B \left(\frac{1}{2} - \frac{P_B}{2} \right).$$

From the FOC for the profit maximization with respect to P_B we obtain that $P_B = \frac{1}{2}$. Thus, in equilibrium, firm B quotes $P_B^* = \frac{1}{2}$ and serves all consumers in the interval $[\frac{3}{4}, 1]$. Firm A serves all consumers in the remaining interval, i.e., those consumers who belong to the interval $[0, \frac{3}{4}]$. Substituting P_B by $\frac{1}{2}$ in $P_A(x)$ we find that:

$$P_A^*(x) = \begin{cases} (\frac{3}{2} - 2x) & \text{if } x \leq \frac{3}{4} \\ 0 & \text{if } x \geq \frac{3}{4} \end{cases}$$

It is now straightforward to determine each firm's profits. Firm B's profit is

$$\pi_B = \frac{1}{2} \left(\frac{1}{4} \right) - F = \frac{1}{8} - F$$

while firm A's profit is

$$\pi_A = \int_0^{\frac{3}{4}} (\frac{3}{2} - 2x) dx = \frac{9}{16}. \blacksquare$$

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