Data-driven Envelopment with Privacy-Policy Tying*

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Abstract

We present a theory of monopoly protection by means of entry in adjacent markets that have a common customer base (i.e., envelopment). A firm dominant in its market enters a data-rich secondary market and engages in predatory pricing and privacy-policy tying. We define the latter as conditioning service provision to the subscription of a privacy-policy that allows bundling of user data across all sources. Acquiring data from the secondary market confers an advantage in the data-intensive primary market that shields the dominant firm from entry, thus harming consumers. We discuss potential remedies, including data unbundling and portability.

Keywords: Entry-deterrence, Predatory pricing, Platform Envelopment, Data, Privacy-policy Tying

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1 Introduction

We present a theory of entry deterrence in digital markets. A *dominant* firm preemptively enters a *data-rich secondary market* and gains customers by offering below-cost products in order to build a data advantage that deters entry in its monopolized *data-intensive primary market*.[1] The bundling of user data increases profits in the primary market and, as a result, also turns firms operating in the secondary market into potential entrants. Then, acquiring control of data from the secondary market entrenches the dominant firm's position in the primary market and protects it from entry.

This foreclosure motive represents an incentive to ecosystem building by big tech companies, especially those that monetize user attention through advertising. As opposed to traditional bundling of complement products (e.g., Whinston (1990) and Carlton and Waldman (2002)), our theory relies on tying of data collected in unrelated markets to motivate entry by dominant platforms into markets serving an overlapping customer base, a strategy popularized as *platform envelopment* by Eisenmann et al. (2011).[2]

The goal of *combining data across markets* may have been a leading force behind a number of crucial acquisitions performed in recent years, primarily by Google and Facebook. These two firms jointly lead the USD 500 billion a year digital advertising market and rely on data to improve their services and delivery of advertising. We mention three landmark cases next, but the list is not exhaustive.

- In 2005 Google acquired Android, a company developing an operating system (OS) for mobile phones, for $50 million. In 2007 Google launched its OS, licensing it for free to mobile phone producers. Acquiring a start-up was the natural way for Google to enter the mobile (licensable) OS market, at a time when Microsoft was a competitor in that market. In time, Google secured control of the mobile OS market and became able to track location of its users, which is crucial to provide good search results and advertising. Arguably, the acquisition of Android curbed the growth of Bing, an entrant search engine by Microsoft that also had the prospect of gaining access to location data.
- In 2008 Google acquired DoubleClick, a company providing ad-serving services to websites, for $3.2 billion. The transaction was cleared by the European Commission (EC) and the Federal Trade Commission (FTC), on the grounds that Google and DoubleClick were not competitors. However, as many commentators noted, acquiring the leading (display) ad-serving company allowed Google to track the browsing activities of its users outside of its walled garden and, in turn, improve its own search-advertising capabilities and consolidate its dominant position.[3]

[1] A data-rich business is one that allows the harvesting of extensive datasets on user behaviour; a data-intensive one centers around the exploitation of data. These definitions are, of course, not mutually exclusive.

[2] This motive complements those highlighted in the literature on conglomeration, such as complementarity and economies of scope. See Bourreau and de Streel (2019) for a recent survey that focuses on digital conglomerates and Condorelli and Padilla (2020) for a discussion of envelopment strategies by digital platforms.

[3] For example, the following statement was made in a US Senate hearing about the merger in 2007 (J-110-25) "Google collects an enormous amount of information on computer users' search history and Internet preferences. DoubleClick also collects a vast amount of information regarding consumers' Internet preferences. While DoubleClick

- In 2021 Google acquired Fitbit for $2.1 billion. Fitbit produces wearable devices that tracks a number of health indicators of its users. Complaints were raised about the possibility of Google using Fitbit's data to improve its targeted search advertising. The EC and FTC ultimately cleared the deal, but Google committed not to use Fitbit's data for advertising.

Empirical evidence confirming our hypothesis that many big-tech acquisitions were data-driven has been published by Affeldt and Kesler (2021). Web-scraping the Google Play Store, they examined 400 acquisitions carried out in the last ten years by big tech companies. They show that about half of the acquired applications have been discontinued. Regarding those that are continued, which tend to be those most privacy-intrusive, they observe that "the monetization strategy seems to change as apps become free of charge but request more privacy-sensitive permissions."

In practice, bundling of user data is often achieved by mean of *privacy-policy tying*. Privacy policies are legal documents describing how user data are handled and shared by companies that collect them while providing their services. In most cases, they are embedded into terms of service, so that when users accept the latter, they have also accepted the former. Typically, these policies allow firms to collect and combine user data from their various, often unrelated, services as well as multiple third-party sources. To give an idea, Facebook collects information from "Facebook (including the Facebook mobile app and in-app browser), Messenger, Instagram (including apps like Direct and Boomerang), Portal-branded devices, Bonfire, Facebook Mentions, Spark AR Studio, Audience Network, NPE Team apps and any other features, apps, technologies, software, products, or services offered by Facebook Inc. or Facebook Ireland Limited under our Data Policy. The Facebook Products also include Facebook Business Tools, which are tools used by website owners and publishers, app developers, business partners (including advertisers) and their customers to support business services and exchange information with Facebook, such as social plug-ins (like the "Like" or "Share" button) and our SDKs and APIs." [4]

Our theory relies on two key drivers. The first is the hypothesis that there exists an advantage in serving a primary market which is conferred by controlling data collected in a secondary market. As we shall illustrate later, this advantage can take several forms: it may increase the willingness to pay of users; it may reduce the cost of providing services; it may reduce information asymmetries in a way that increases profit (e.g., via price discrimination). In our model, this *data advantage* turns incumbents in this secondary market into threats for the dominant firm in the primary market. Crucially for our conclusion, entry in the primary market must be feasible *if and only if* a data advantage in the secondary market is accrued by the entrant and not by the monopolist.

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assures us today that this information is shared with no one other than the advertiser or the website carrying the advertising, what will happen to this treasure trove of consumer data once Google gains control of DoubleClick?".

[4] See Facebook's Data Policy, dated April 19, 2018, available at `https://facebook/policy.php` (Downloaded on 27 March 2020). Google is another relevant example. Google collect information about (a) the apps, browsers, and devices used to access Google services; (b) users' activity in Google services, including search terms, watched videos, views and interactions with content and ads, voice and audio information, purchase activity, activity on third-party sites and apps that use our services, Chrome browsing history, phone number, calling-party number, receiving-party number, forwarding numbers, time and date of calls and messages, duration of calls, routing information, and types of calls; (c) location, etc. See Google's Privacy and Terms, dated October 15, 2019, available at `https://policies.google.com/privacy?hl=en-US#infocollect` (Downloaded on 27 March 2020).

Our leading example is that of an advertising platform which monetises user attention. For instance, in suggesting purchases to users, a search engine benefits greatly from having data on the brick and mortar shops they have just recently visited, which may be collected by a different application requiring granular location data to function (e.g., as hinted, a mobile phone operating system). Likewise, a social network may expand faster if it knows the identities of its users' friends, which may be obtained via a messaging application where users store their contacts. Such data, of course, would also benefit greatly new entrants in search or social networking, to the point that their availability might be essential for successful entry. The diagram below illustrates this environment.

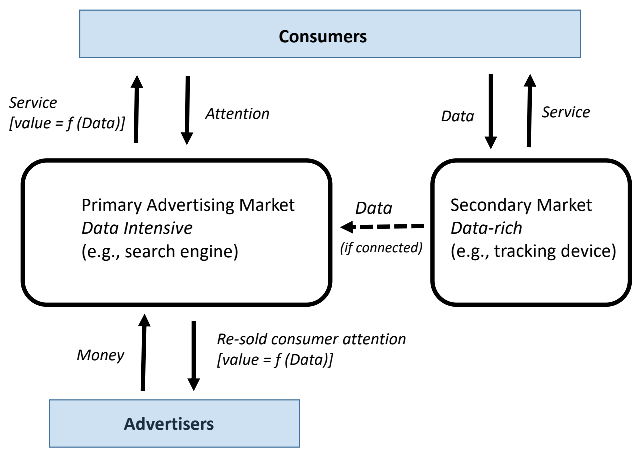


Figure 1: Diagram of the Environment

Beyond casual observation, a revealed preference argument suggests that accumulating data about consumers increases advertising returns, given the great effort such advertising platforms go through in order to acquire, compile and store such data. Indeed, the same conclusion is reached by more in-depth industry studies. For instance, in its 2020 "Online platforms and digital advertising market study" (Appendix F), the CMA argues that "Data gives platforms a competitive advantage in the provision of digital advertising. [...] For these purposes, detailed data on consumers' demographics, interests, preferences and behaviours is most valuable in terms of profiling consumers, predicting consumers' potential response to advertising and tailoring advertising messages."[5]

The second driver is an initial exogenous asymmetry, as the dominant firm in the primary market is endowed with a *first-mover advantage* over potential entrants in its own primary market. This more traditional advantage, which is a common hypothesis in theories of strategic entry deterrence, may be conferred by dominance in the primary market, sheer size or availability of resource, as in the case of Google and Facebook or other big-tech. For instance, leaked emails indicate that Mark Zuckerberg, CEO of Facebook, was extremely concerned about the growth of Tinder, which exploited Facebook data in addition to collecting its own data. Facebook subsequently entered the dating space with its own service, at a point in time were Tinder did not have the know-how to expand into a full fledged social network, an attempt that it did later with Tinder Social.[6]

[5]For a more cautious view on the value of user data for advertising see Lambrecht and Tucker (2017).

[6]Zuckerberg wrote "Tinder's growth is especially alarming to me because their product is built completely on Facebook data, and it's much better than anything we've built for recommendations using the same corpus." (Forbes

Then, our story goes, by preemptively entering the secondary market and conquering it by means of below-cost prices (e.g., by offering a free product in line with evidence from Affeldt and Kesler (2021)), the dominant firm may be able to deter entry in the primary market, even from *more efficient* firms already operating in the secondary market. Although the dominant firm sustains a loss to outbid other firms in the secondary market, the strategy is likely to be profitable if it deters entry in the primary. In fact, the dominant firm is willing to outbid the secondary market's incumbent because it stands to lose monopolistic profits if entry in the primary market takes place. On the other hand, a firm's incentive to retain control of the secondary market and then enter the primary market is diluted by the expectation of competitive prices following entry in the latter. The positive wedge between the value of retaining a monopoly and the value of entering, also known in the literature as *efficiency effect*, makes the exclusionary strategy profitable for the monopolist.[7]

Our theory echoes growing concerns that data accumulation by big tech companies may erect barriers to entry into digital markets that harm consumers.[8] Indeed, our results also illustrate that if *additional* competition in the primary market is substantially more valuable to consumers than it is in the secondary market, then the exclusionary conduct we describe harms not only competitors but also consumers, compared to the counter-factual scenario in which entry in the secondary market is blocked. As an example, consider the DoubleClick and Fitbit deals mentioned above. Conceivably, consumers are worse-off from a monopoly in web-search than they are from a monopoly in the intermediation of display advertising or in the market for tracking bracelets. We stress that this observation could be reversed if the primary market exhibited, say, strong network effects that made it invariably prone to tipping to monopoly even with entry.

In light of the above, if pricing in the secondary market is below-cost (i.e., entry can't be justified by commercial reasons), our results can be used to construct an antitrust *theory of harm* against privacy-policy tying (i.e., a potential abuse of dominance) or against a data-driven merger of firms operating in apparently unrelated markets. Steps in this direction have been taken by the CMA and the EC. In 2022, a deal between Facebook and Kustomer, a customer relationship management company, received the green light but the CMA investigated the possibility that "the Merger would raise barriers to entry and expansion by increasing Facebook's data advantage in online display advertising, leading to reduced competition in that market".[9] In its Google/Fitbit decision, the EC stated that "although pre-Transaction Fitbit is not competing in the same markets as Google, "the transaction would give Google control over an important asset, the Fitbit data, that would further

reporting on leaked emails, see `https://bit.ly/2TVr5X8`)

[7]Fudenberg and Tirole (2013) first used the term "efficiency effect" referring to a monopolist as being more *efficient in extracting profits*, assuming all firms have the same technology. This effect, typically assumed positive in light of the argument just offered, is key in models of innovation attempting to explain the persistence of monopoly. In contrast to the "Arrow effect", it suggests that a monopolist's incentive to innovate may exceed that of potential competitors, if successful innovation triggers entry. See footnote 19 for cases when the efficiency effect may be negative.

[8]This has been emphasized in a number of recent reports, including the UK Furman Report "Unlocking Digital Competition" (see 1.71), Crémer et al. (2019) (see 5.IV) prepared for the European Commission and the Final report of the Stigler Committee on Digital Platforms (see II.a.ii.1).

[9]See "Theory of Harm 1" in the summary of the CMA decision on "Anticipated acquisition by Facebook, Inc. of Kustomer, Inc." ME/6920/20.

strengthen Google's dominance in the markets for the supply of online search advertising"[10]

Within the scope of our model, we also perform some simple policy analyses, by comparing the exclusionary equilibrium outcome with the outcomes that would arise from various policies under the same assumptions. Primarily, we consider imposing a *prohibition to tying of the privacy policy* and *enforcing portability of user data*. Versions of these two policies are currently part of a proposed EU Digital Markets Act (DMA), which imposes a set of obligations on larger firms operating core platform services, such as Google and Facebook, who are identified as gatekeepers.[11]

Our results highlight that, in order to evaluate the effect of such policies, a key element to assess is whether a data advantage accrued by serving some secondary market is essential for entry in the primary market or not. We say that a *data advantage is essential for competition* in the primary market if entry does not take place *unless* the new entrant holds the secondary-market data in an exclusive fashion. As we elaborate later on, we believe that having access to user location data might be essential for competition in the search market. That is, having had exclusive access to tracking the location of consumers might have allowed profitable entry into the search market, but only at a time when Google did not have such access as well, which it gained through Android.

When data is *not* essential for competition, both a prohibition to tying of the privacy policy and enforcing portability of user data are effective in preventing the dominant platform in the primary market from implementing its exclusionary strategy. However, we show that when data *is* essential for competition these two policies may backfire, if imposed also on potential entrants, because they make it impossible for such entrants to gain exclusive access to data. In particular, a generalized prohibition to privacy-policy tying makes the entrant unable to bundle data, while portability implies that users can migrate their data to the dominant operator if they wish so after the new entrant has made the investment to enter. In both cases the entrant in the primary market is left with no advantage over the incumbent and loses incentives to enter. The end result is that consumers will be worse off than under the exclusionary equilibrium, as they will be left with a monopoly in both the primary and secondary markets. Importantly, the above suggests that imposing such restrictions *only* on the primary-market incumbent will be preferable.

Finally, we look at the possibility of allowing firms to trade data. As one would expect, free trading of data between firms eliminates some of the strategic externalities that arise from competition. Ultimately, allowing data trading will either have no effect, or otherwise it will allow the dominant firm in the primary market to buy data from the potential entrant, thus preventing entry into the primary market without the need to compete in the secondary. When the latter happens, consumers are worse off than in the exclusionary equilibrium due to the double monopoly.

In a separate section, we analyse the case in which entry in the secondary market, and therefore acquisition of data, is obtained by merging with or acquiring an already successful firm operating in the secondary market.[12] As we have discussed early on, we believe this has been a common

[10]See Commission Decision of 17.12.2020 on Case M.9660 – GOOGLE/FITBIT, page 98.

[11]The DMA (COM/2020/842) is awaiting approval by the European parliament before entering into force.

[12]This needs to be distinguished from acquisitions that have the purpose of eliminating future competition, also called "killer acquisitions". Some recent contributions include Motta and Peitz (2020), Kamepalli et al. (2019) and Cunningham et al. (2019)). Here, the acquiring firm has no incentive to shut down the target firm.

phenomenon in recent years. In our framework, an acquisition has similar effects as a data-selling agreement discussed in the previous paragraph and allows firms to internalize their strategic externalities. In fact, it is always more profitable than entry for both the target firm in the secondary market and the dominant firm in the primary market, insofar as the purchase price is kept low enough by the target's shareholders realizing that refusing to sell will trigger entry. This observation suggests that some acquisitions may take place under the threat of predation we describe. When this happens, consumer surplus is even lower than with preemptive entry, as there will be no competition for the data advantage and consumers will end up with a monopoly in both markets. This indicates that competition authorities should be especially vigilant about data-driven acquisitions by big tech companies, even when firms do not *prima facie* compete in the same market.

The rest of the paper is structured as follows. In the next section we discuss the relevant literature. In sections 3 and 5 we formalize our theory. In between, section 4 provides a microfoundation for the primary market that highlights the role played by data on welfare outcomes. Section 6 contains the policy analysis and section 7 discusses mergers and acquisitions.

2 Related literature

Our work contributes primarily to the literature on strategic entry deterrence, which we informally describe as strategic behaviour that is expected to be profitable only if it successfully prevents entry. The literature is quite vast but can be broadly subdivided into two strands. One strand emphasizes asymmetric information and, in particular, how an incumbent can persuade potential entrants that competition will be though (e.g., see Kreps and Wilson (1982) and Milgrom and Roberts (1982)).

Another, to which our paper is closely connected, focuses on the ability of a dominant firm to neutralize incentives to enter by gaining an advantage (or denying it to others) that reduces the profit competitors may expect from entering the market. Following the taxonomy offered in Fudenberg and Tirole (1984), in our paper, the monopolist attempts to turn itself into a "top-dog" to deter entry. The literature has mostly focused on investment in capacity (e.g., Spence (1977)), learning by doing (e.g., Spence (1981)) and R&D (e.g., Gilbert and Newbery (1982)). This last piece is especially related to our work. Gilbert and Newbery (1982) showed how a monopolist might be inclined to sustain large R&D expenses, perhaps creating a "patent thicket", to prevent innovation by potential entrants, thereby preserving monopoly profits. In Gilbert and Newbery (1982) we see the efficiency effect at play for the first time in the literature. That is, preemptively investing in *R&D* is potentially able to deter entry in a market that requires an innovation, because the monopolist stands to lose a monopoly while the new entrant only expects competitive profits.

A seminal contribution to this second strand of the entry deterrence literature is Carlton and Waldman (2002) (CW). They consider a model where some firm is initially dominant in two markets, but a competitor can enter the secondary market in period one and both markets in period two only. For the case in which the products in the secondary and primary market are perfect complements, they show how tying can reduce incentives to enter. In particular, by committing to tying two products that have no value unless consumed together, the dominant firm forecloses the secondary market in the first period and forces the potential entrant to either enter both markets in period two or none at all. Then, in a version of their theory, entry is deterred because operating in one period only is not sufficient to cover entry costs. In another, in which the bundled products enjoy network externalities, foreclosure operates by preventing competitors to acquire critical mass in the secondary market in period one, which makes it harder to compete in the primary market, regardless of entry cost. Either way, in CW the focus is on strategic tying of complementary products, while we analyse data tying in unrelated markets.[13]

Within the research spurred by CW, the most closely related paper is Fumagalli and Motta (2013) (FM). They formalize the general idea that an incumbency advantage, accrued in serving incremental customers, may allow a firm with market power to prey on, or deter entry by a firm who would be more efficient at scale. In particular, repackaged to fit our context, their main assumption is that a dominant firm has an efficiency advantage in serving either the primary or the secondary market in isolation, but the potential entrant would be more efficient in serving both markets. Then, if the dominant firm is able to engage in aggressive pricing in the secondary market before competing in the primary one, it could be able to deny scale to other firms. By facing a smaller and less aggressive competitor in a single market, the incumbent is able to recoup its losses.

There are important analogies between CW, FM and our paper. In particular, the general strategic force that shapes behaviour is fundamentally equivalent. That is, the dominant firm is willing to temporarily sustain losses, either by reducing its profit in the primary market (as in CW) or by pricing below cost to consumers in the secondary market (as in FM and our paper), in order to later on prevent effective competition in the primary market.[14] However, the specific incentives are different and our model is not a special case of either. In our case, the two firms might be equally efficient in serving both markets. It's the first-mover advantage that creates an asymmetry.

Last but not least, a similar view of data, as generating efficiency or value advantages in unrelated markets, is explored in Prufer and Schottmuller (2020), Farboodi et al. (2019) Hagiu and Wright (2020) and de Cornière and Taylor (2020). The first three papers focus on long-run competitive dynamics, taking place in a single market, generated by data-enabled learning (i.e., firms that improve their products by dynamically learning about their customers). In contrast, we focus on pooling of information from unrelated markets and its potential foreclosing effects. Moreover, the decision to acquire data is endogenous in our paper. Finally, like us, de Cornière and Taylor (2020) model data as producing a shift in the per-consumer revenue obtained by firms. They define them as "unilaterally pro-competitive" (anti-competitive) if more data induce firms to offer a higher (lower) level of utility to consumers, *ceteris paribus*. In contrast to us, they analyse mergers and show how equilibrium utility of consumers is affected by mergers between firms, depending on whether the data are pro or anti-competitive. Beyond the works mentioned here, there is a lively literature that emphasizes the importance of data in digital markets. For a review see Acquisti et al. (2016).

[13] A related argument, that also rationalizes tying of complementary products, is developed by Choi and Stefanadis (2001). In their model, firms need to engage in successful R&D to enter a market. By tying two products, the incumbent makes it riskier (and costlier) for a competitor to attempt entry.

[14] This is reminiscent of the classic analysis in Cabral and Riordan (1994), where superior efficiency is conferred by a larger scale due to learning by doing.

3 Model: A two-period data-driven preemption game

There are two profit-maximizing firms A and B. At the outset, both A and B are monopolists in their respective markets, the primary market, $\mathcal{P}$, and the secondary, $\mathcal{S}$. Firms A and B play the following two-period entry-game. In the first period, A decides whether to enter $\mathcal{S}$. After the entry decision, competition (or lack of it) determines outcomes in both markets. In the second period, B decides whether to enter $\mathcal{P}$. Then, as in the previous period, outcomes in both markets are determined. At the end of second period, the game ends. We assume that there are non-negative fixed costs of entry in market $\mathcal{P}$ and $\mathcal{S}$, namely f_P and f_S.[15] To facilitate application of the analysis to a more realistic multiple-period environment, we rescale *fixed costs* and what we *interpret* as one-period-only profits, that is *first-period profits in* $\mathcal{P}$ and *second-period profits in* $\mathcal{S}$, by a factor of $1-\beta$, with $\beta \in [0,1]$ representing a common discount factor. As β grows, costs and profits we deem sustained for one period only become less relevant. The reader interested in the long-term horizon should assume $\beta = 1$, while the reader interested in the two-period game should assume $\beta = 0$.

Both the *first-mover advantage* of A and its *market power* are essential assumptions. However, they are natural hypotheses in the set of situations we aim to model. Online advertising markets are currently lead by two mature platforms, Facebook whose primary market is social-networking and Google whose primary market is search. These big conglomerates have continuously expanded in adjacent markets, which are populated by firms often incapable, in their startup phase, of challenging them in their search and social networking primary markets. Instead, our analysis easily extends to the case of competition in $\mathcal{S}$ and the restriction to two periods is for simplicity.

To close the model, we describe next how competition operates in the two markets in both periods. A key feature of our setup to keep in mind is that profits in $\mathcal{P}$ in the second period depend *both* on the entry decision of B *and* on the outcome of competition in $\mathcal{S}$ in the first period. In particular, the profit of a firm in $\mathcal{P}$ in the second period is larger if such a firm holds a *data advantage*, which is conferred by serving consumers, the more the better, in $\mathcal{S}$ in the first period.

Secondary Market. We assume it is populated by a unit-mass of consumers with a constant value, v_S, for a product which both firms produce identically. When two firms are in the market, they engage in Bertrand price-competition. Remarkably, in our environment, a Bertrand price-offer could also be negative, thus representing a positive transfer to consumers, which may be interpreted as taking the form of additional product quality or features. We focus on the case where firms are *not* capacity-constrained and have heterogeneous but constant marginal cost, c_S^i for $i \in \{A, B\}$, with $0 < c_S^i < v_S$. These assumptions impose useful structure to our analysis but are mainly made for simplicity of exposition. In particular, as a result of Bertrand competition, the market will be, *generically*, fully served by the single firm who is able to offer the best deal to consumers. Hence, barring zero-measure ties and policy interventions that will be discussed later, we can model the advantage provided by data in the primary market as being either held by A or by B.[16]

[15] In contrast to FM, as long as $f_P \leq f_S$ (i.e., entry into the primary market is less costly than entry into the secondary one), the monopolist need not enjoy any specific asymmetric cost advantage.

[16] This assumption would not hold if consumers tended to effectively multi-home in the secondary market and split their consumption equally across existing firms.

Importantly, we will maintain that in the secondary market consumers buy from the firm who offer the lowest price (or highest transfer). However, while it is clear that atomistic consumers will not internalize their collective impact on market structure, it may be argued that they may sometimes internalize the effect that buying from one firm or the other will have on the deal they will receive in the primary market and on their privacy. Nonetheless, we suggest several ways to rationalize our assumption in our setup. First and of easiest interpretation, the primary and secondary markets might serve two different consumer pools, but learning about consumers in the secondary market is informative about consumers in the primary. For example, consider two geographically separated market with similar populations of consumers. Second, the same atomistic consumers might patronize both markets but any of the following applies. One, even if consumers refuse to buy in the secondary market, with the aim of preventing the firm in the primary market to combine their data, the relevant information they would like to protect could still be inferred using the data collected from close-enough consumers.[17] Two, consumers might be myopic and not able to recognize the cross-market externality implied by the tying of the privacy policies.[18]

If B remains a monopolist in the secondary market, it extracts all value from consumers and we can denote its profit, $v_S - c_S^B$, with $\Pi_S^B(m)$. (We stress that notation format $\Pi_i^j(k)$ will be used to denote payoff levels throughout the paper, with the subscript standing for the market, $\mathcal{P}$ or $\mathcal{S}$, the superscript standing for the firm, A or B, and the argument in brackets representing the mode of competition, m for monopoly and c for competition.) However, since the outcome of competition in $\mathcal{S}$ determines who holds the data advantage in the future, if entry takes place, profits from competition in the secondary market are endogenous and do not *only* depend on production cost. This is a central aspect of the equilibrium analysis in the next section. Nonetheless, to simplify the interpretation of our main result, let's denote with $\Pi_S^i(c)$ the profit that firm i would obtain if *one-shot* Bertrand competition took place with firms having marginal costs c_S^A and c_S^B. That is, $\Pi_S^i(c) = \max\{0, c_S^j - c_S^i\}$, where j represents the firm other than $i \in \{A, B\}$.

Primary Market. Since behaviour in the primary market does not spill-over other markets, we can treat outcomes in reduced form. This simplifies modelling and, arguably, makes the analysis more applicable. In particular, we denote with $\Pi_P^i(c^+)$ and $\Pi_P^j(c^-)$ the competitive profits of i and j in the primary market when i is the only firm with a data advantage. We indicate with $\Pi_P^A(m^+)$ and $\Pi_P^A(m)$ the monopoly profit of A with and without the advantage. Naturally, we maintain that $\Pi_P^A(m^+) > \Pi_P^A(m)$ and $\Pi_P^i(c^+) > \Pi_P^j(c^-)$ for each $i, j \in \{B, A\}$. That is, obtaining data improves the profitability of a monopolist and provides an advantage in case of competition.

[17] A basic externality problem arises because data acquired from a set of consumers can be used to gain information about other consumers with similar characteristics. For instance, the location of a person might be identified from the location of its closest contacts. This has been discussed in the legal literature (see Fairfield and Engel (2015)) and in economics (see Acemoglu et al. (2019), Bergemann et al. (2019) and Choi et al. (2019)).

[18] For example consumers might not be aware that Facebook owns Instagram or that Google owns Android. There is ample evidence that users pay little or no attention to privacy policies and are unlikely to internalize potential externalities arising from the sharing of personal data. See Economides and Lianos (2019) for a perspective at the intersection of law and economics.

4 Micro-foundation of the Primary Market

As indicated, in order to state our main formal result, we can remain agnostic about how the data advantage translates into higher profitability. However, to contribute to the policy debate and evaluate welfare consequences, it is helpful to impose additional structure on our model of $\mathcal{P}$, which allows us to perform quantitative welfare analysis and highlight the peculiarity of data vis-à-vis generic economies of scope that might arise from serving the secondary market.

In particular, we think of the primary as a *two-sided advertising market*, catering to a unit mass of consumers and a representative advertiser who wishes to reach customers in order to sell a product that they value at $v_P > 0$ on average. We assume that platforms in the primary market compete for consumers by providing a service of potentially heterogeneous quality, *for free*, but then make a profit by behaving as monopolist over selling advertising to reach their customers.

To model this environment, we can let $D^i_P(q_i, q_{-i})$ represent the mass of customers served by firm $i \in \{A, B\}$ when it sets quality level q_i for its service and the competing platform $-i$ sets q_{-i}. We assume that platforms offer substitute services, with $D^i_P(q_i, q_{-i})$ being increasing in q_i and decreasing in q_{-i}. We also assume the market will always be fully served, that is $D^i_P(q_i, q_{-i}) + D^{-i}_P(q_i, q_{-i}) = 1$, including when platform i is a monopolist. Under these assumptions, an equilibrium (q^*_A, q^*_B) is reached in the primary market if, for all $i \in \{A, B\}$,

$$q^*_i = \arg\max_{q_i \geq 0} D^i_P(q_i, q_{-i}) \left(r^i(d_i) - c^i_P(q_i, d_i) \right), \tag{1}$$

where $d_i \in \{0, 1\}$ indicates whether or not i holds the data advantage, $c^i_P(q_i, d_i)$ is the cost of providing *per-user* quality q_i and $r_i(d_i)$ is the *per-user* advertising revenue.

Under standard assumptions on the demand and cost functions, an equilibrium (1) will exist. For instance, consider a *Bertrand-like* scenario where the utility of each consumer who is a user of platform i is simply q_i and therefore

$$D^i_P(q_i, q_{-i}) = \begin{cases} 1 & \textit{if } q_i > q_{-i} \\ 1/2 & \textit{if } q_i = q_{-i} \\ 0 & \textit{if } q_i < q_{-i}. \end{cases}$$

To exemplify, let $r^i(d_i) = v_P > 0$ and $c^i_P(q_i, d_i) = q_i + c^i_P - \alpha d_i$ with $\alpha > |c^A_P - c^B_P|$. That is, assume having the data advantage reduces the marginal cost of serving consumers with a given level of quality of service and it is decisive regarding which firm will be more efficient. For example, it may be argued that offering a certain quality of service in internet search is substantially less costly if the search engine owns important location data about the user, which may only become available through a different application. For $d_i = 1$, in equilibrium i will produce quality $v_P - c^{-i}_P$ and will make profit $\alpha + c^{-i}_P - c^i_P$, while the other firm will propose to produce the same quality but make zero profit. Hence, in this case, $\Pi^i_P(c^+) = \alpha + c^{-i}_P - c^i_P > 0 = \Pi^i_P(c^-)$ and $\Pi^A_P(m^+) = v_P + \alpha - c^A_P > v_P - c^A_P = \Pi^A_P(m)$ which is consistent with the reduced-form version of the model.

As it is apparent from the above, we envisage that the data advantage can operate by increasing per-costumer advertising revenues, that is $r_i(1) \geq r_i(0)$, or by decreasing production costs $c_i(q_i, 1) \leq$

$c_i(q_i, 0)$ as in the Bertrand-like scenario above, or in both ways. While the specific channel through which the data advantage operate will depend on the application, we now illustrate two important cases where data affects advertising revenues and has opposite consequences on the welfare of consumers. We do so by means of two simple models.

Data Improves Targeted Advertising. Additional data can raise per-customer advertising revenue by improving the efficacy of targeted advertising. To fix ideas, assume that, initially, a platform without secondary-market data assesses that consumers can be of n equally-likely and randomly distributed types and each of these types is only interested in buying one the n products of the advertiser at price v^P. Hence, while only operating in the primary market, a platform is able to advertise to the right consumer with the right ad with probability $1/n$. However, serving consumers in the secondary market allows a firm to learn about the type of consumer with some accuracy. For example, data collected in the secondary market may allow the platform to determine whether the customer is romantically engaged or not, thus reducing the risk of delivering an ad for a dating app to a non-single customer. One way to model such learning is to assume that accuracy a ranges from 1 to n and that the probability of identifying the correct customer becomes a_i/n once platform i possesses data with accuracy a_i. Then a platform who is able to extract the entire value from risk-neutral advertisers will obtain per-consumer (average) profit of $r^i(1) = v^P\,(a_i/n)$ with the data, while $r^i(0) = v^P/n$ without the data.

Data Enables Price Discrimination. Data can raise per-customer advertising revenues by allowing the advertising firms to price-discriminate across consumers. For example, data in the secondary market may allow the platform to tell apart high-income from low-income consumers, and that may be informative of their willingness to pay for products. To formalise this, assume that the representative advertiser wants to reach all consumers with a price-offer and consumers have valuation either v_L or v_H. Let the share of consumers with valuation v_H be μ with $\mu v_H + (1-\mu)v_L = v^P$ and suppose $\mu < v_L/v_H$ (i.e., without information the advertiser would charge a low price to every consumer). Next assume that the valuation of a consumer becomes known only if such a consumer is served in the secondary market. This allows the platform i in the primary market, if it also serves that customer in the secondary market, to direct the advertiser to price v_H when the consumer has high-valuation. Assuming the platform fully extracts the value generated by advertisers, having the data advantage generates per-user profit equal to $r^i(1) = \mu v_H + (1-\mu)v_L$, while, without data, per-user profit is $r^i(0) = v_L$.

Remarkably, these two frameworks illustrate that while the effect of a data advantage on profitability can be analogous, the implications for consumer welfare can be different depending on how the data advantage is formed. In the first case, where data improves targeted advertising, if one abstracts for a moment from considerations of privacy, consumer welfare need not decrease as a result of the platform holding additional data. A similar effect would normally arise if data reduced the cost of supplying quality, unless demand is fully inelastic as in our Bertrand-like example above. Instead, when additional data is used to price-discriminate, consumers with high-value lose their information rent. In this and the next section we restrict attention to firms' incentives and so we postpone to Section 6 a discussion of consumer welfare.

5 Exclusionary Entry

The characterization of the sub-game perfect equilibria of the entry-game contains the central insight of the paper and it is the subject of this section. The building of a data advantage, implemented through entry into a data-rich secondary market followed by predatory pricing *and* privacy-policy tying, may give rise to an increase in strength of the incumbent which induces exclusion of potentially more efficient competitors in the primary data-intensive market. Two conditions are required for this result. First, that data is pivotal for entry of B in the primary market, see (PDA) below. Second, that the efficiency-effect is large enough to make the exclusionary strategy rational (EE-IR) and incentive compatible upon entry (EE-IC). The proposition is followed by a heuristic explanation. A formal proof is relegated to the appendix.

Proposition 1 *In any subgame-perfect equilibrium the following holds.*

[a.] *If* $\Pi_P^B(c^+) < (1-\beta)f_P$, *then* B *stays out of* $\mathcal{P}$*;*

If $\Pi_P^B(c^-) > (1-\beta)f_P$, *then* B *enters* $\mathcal{P}$.

[b] *Assume instead*

$$\underbrace{\Pi_P^B(c^+) > (1-\beta)f_P > \Pi_P^B(c^-).}_{\textit{Pivotality of data advantage}} \tag{PDA}$$

[b.1.] *If, in addition,*

$$\underbrace{\Pi_P^A(m^+) - \Pi_P^A(c^-) - \Pi_P^B(c^+)}_{\textit{efficiency effect}} > \Big(\Pi_S^B(c) - (2-\beta)\Pi_S^A(c)\Big) - (1-\beta)(f_P - f_S) \tag{EE − IR}$$

and

$$\underbrace{\Pi_P^A(m^+) - \Pi_P^A(c^-) - \Pi_P^B(c^+)}_{\textit{efficiency effect}} > \Big(\Pi_S^B(c) - \Pi_S^A(c)\Big) - (1-\beta)f_P, \tag{EE − IC}$$

then A *enters* $\mathcal{S}$ *and obtains the data advantage, while* B *stays out of* $\mathcal{P}$*;*

[b.2.] *If either* $(EE-IR)$ *or* $(EE-IC)$ *does not hold, then* B *enters* $\mathcal{P}$.

The first part of the proposition identifies the scenarios in which a data advantage is *not* pivotal for entry, in the sense that B has a dominant strategy of either entering or staying out. Because the behavior of A has no bearing on the entry decision of B, we can say that, unless (PDA) holds, A has no *ability* to exclude B. Instead, exclusionary behavior can arise when data are *pivotal for entry*, that is when the (PDA) condition holds. In this case, A has the ability to avoid entry of B by denying it the data advantage. Then, conditions (EE-IR) and (EE-IC) further identify when the *efficiency effect* is large enough that such a strategy of entering the secondary market *and* securing the data advantage, thus preventing entry of B in the primary market, is individually rational for A and, indeed, incentive compatible upon entry. On the other hand, if, under (PDA), conditions (EE-IR) or (EE-IC) do not hold, then B will maintain the data-advantage and enter the primary-market.

From a practical standpoint, verifying assumption (PDA) may be complex. The chain of inequalities can be interpreted as requiring the existence of a wedge between the profit a firm can attain when it competes with the data advantage, versus the profit it attains when it competes with an opponent that has the advantage. Such a wedge must be large enough to bound fixed costs in the long-run. However, we expect the (EE-IR) and (EE-IC) assumptions to be widely satisfied in the set of markets we are studying. In particular, while the right-hand side of both inequalities is likely to be small if not negative, because competitive profits of the two firms in the secondary market are likely to be similar and so are costs of entry in both markets, the *efficiency effect* on the left-hand side is likely to be positive and substantial in many cases of interest. Intuitively, if all firms have access to a similar technology, a monopolist platform is able to generate substantially more profit than competing firms sharing the market.[19]

To parse case [b.1.] and conditions (EE-IR) and (EE-IC) it is instructive to start by considering the outcome of Bertrand competition in the secondary market upon entry of A, with the aide of Figure 2 below. In doing so, note that, due to (PDA) holding, B will enter the primary market if A stays out of the secondary market *or* if A enters but does not win competition in the secondary (see blue dotted arrows in Figure 2).

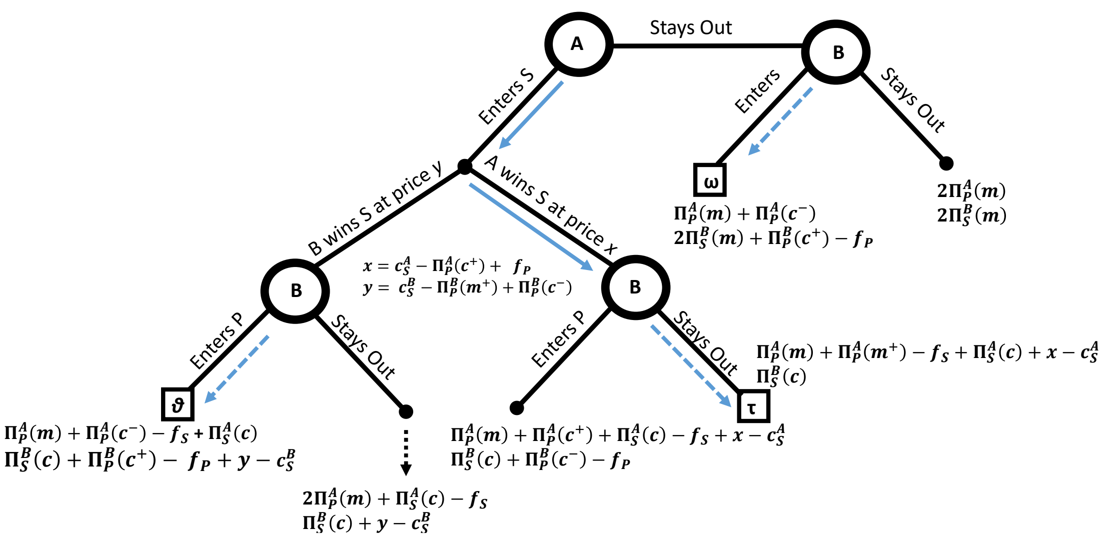


Figure 2: Equilibrium, $\beta = 0$ — Arrows indicate equilibrium; x and y are defined by equilibrium.

We first focus on (EE-IC), which determines behavior upon entry of A. As standard in the analysis of Bertrand competition, we begin by identifying the price that makes both firms *indifferent* between serving the entire market *and* letting the competitor serve it. That is, the cost of production *minus* the difference in future payoff from owning the data versus leaving the data in the hands of the competitor. This is equal to $c_S^A - (\Pi_P^A(m^+) - \Pi_P^A(c^-))$ for A (i.e., the amount x that makes A,

[19] The efficiency effect is negative if the industry structure that maximizes total profit is not a monopoly. For instance, this might be the case if consumer adoption is driven by expectations (e.g., due to network effects under interconnectedness) which in turn can be influenced by industry structure (e.g., see Condorelli and Padilla (2021).

whose payoff is the first line, indifferent between reaching terminal node $[\theta]$ and $[\tau]$ in Figure 2), because A stands to lose the difference between monopoly and competitive profits in the primary market; and it is equal to $c_S^B - (\Pi_P^A(c^+) - (1-\beta)f_P)$ for B (i.e., the y that makes B indifferent), because B stands to lose the competitive profits in the primary market with the data advantage net of the cost of entry.

We have identified above the *minimum acceptable price* for each firm. Importantly, such prices may be negative, given the impact of competition on future payoffs. Now, we can determine the winner of Bertrand competition by looking at the firm for which the minimum acceptable price is lowest *and* we can determine the profit of the winning firm (i.e., the payoff at $[\tau]$ with $x = c_S^B - (\Pi_P^A(c^+) - (1-\beta)f_P)$ if A wins and the payoff at $[\theta]$ with $y = c_S^A - (\Pi_P^A(m^+) - \Pi_P^A(c^-))$ if B wins) by assuming it ends up receiving the (higher) acceptable price of the competitor. Such profit will be positive, despite the winning firm being willing to price below cost in the secondary market, because it incorporates the future gain of serving the primary market with a data advantage.

Crucially, if $(EE-IC)$ holds, then A wins Bertrand competition in the secondary market. In particular, A's minimum acceptable price in the secondary market is lower than that of B if

$$c_S^A - (\Pi_P^A(m^+) - \Pi_P^A(c^-)) < c_S^B - (\Pi_P^A(c^+) - (1-\beta)f_P). \tag{2}$$

After observing that $c_S^A - c_S^B$ is equal to

$$\max\{c_S^A - c_S^B, 0\} + \min\{c_S^A - c_S^B, 0\} = \max\{c_S^A - c_S^B, 0\} - \max\{c_S^B - c_S^A, 0\} = \Pi_P^B(c) - \Pi_P^A(c),$$

we conclude that, upon entry, A wins competition in the secondary market, thus foreclosing entry of B in the primary, if

$$\Pi_P^A(m^+) - \Pi_P^A(c^-) - \Pi_P^A(c^+) > \Pi_S^B(c) - \Pi_S^A(c) - (1-\beta)f_P, \tag{3}$$

which is condition $(EE-IC)$.

To conclude our backward-induction argument, it remains to be shown that (EE-IR) implies that A will want to enter the secondary market in the first period. Indeed, when (EE-IR) holds with equality, A is indifferent between its payoff at terminal node $[\omega]$ in Figure 2, which is $(1-\beta)\Pi_P^A(m^+) + \Pi_P^A(c^-)$, and its payoff at node $[\tau]$ when $x = c_S^B - (\Pi_P^A(c^+) - (1-\beta)f_P)$. Now remember that (EE-IC) holding with equality makes A indifferent between node $[\tau]$ and node $[\theta]$. Because staying out of $\mathcal{S}$ implies that B enters and hence delivers to A the same payoff in the primary market as entering and losing the data advantage, then the difference between the two possible outcomes is just the net profit from entering the secondary-market. This is equal to terminal second period profits only, as profit from the first period is always zero both when A stays out of the secondary market and when it enters and loses the data advantage. Indeed, the right-hand side of (EE-IR) differs from the right-hand side of (3) above exactly by the discounted second-period (terminal) return from competition in the secondary market net of fixed costs of entry, that is $(1-\beta)(\Pi_S^A(c) - f_S)$.

We stress that the exclusionary equilibrium we exhibited would survive, with only slight modification to (EE-IC) and (EE-IR), in the presence of privacy-concerned consumers that patronise both markets. That is, suppose consumers incur small but relevant privacy loss l, expressed in monetary units, from being served by the same firm in both markets. Then, the indifference condition would imply that there is an equilibrium where A wins over B if its minimum acceptable price, minus l, is above the minimum acceptable price of B. Note that, because A wins over B, the expectation of consumers of incurring loss l in the primary market would be justified. In light of this extra transfer to consumers, also the cost of implementing the exclusionary strategy would be raised by an amount equal to l. In sum, exclusion becomes more difficult with privacy-concerned consumers but it is nonetheless possible.

Now suppose (PDA), (EE-IC) and (EE-IR) all hold. As we established, in equilibrium B will not enter the primary market even though it would have done so if A stayed away from the secondary market. However, even if this is the outcome, we can't conclude that the actions of A were led uniquely by exclusionary objectives. In particular, A might have wished to enter *regardless* of whether its entry produces exclusion or not. We will therefore say that behavior is *explainable by non-exclusionary concerns* if *both* entry *and* acquisition of the data advantage would take place whether or not B entered the primary market.

Remark 1 *Suppose (PDA), $(EE-IC)$ and $(EE-IR)$ hold. Behavior of A is explainable by non-exclusionary concerns if, and only if,*

$$(2-\beta)\Pi_S^A(c) = (2-\beta)\max\{c_B - c_A, 0\} \geq (1-\beta)f_S. \tag{ENC}$$

In words, as long as, A is more efficient than B in serving the secondary market and such cost advantage is large enough to justify entry, then A would have entered regardless of the impact of its actions on B. Remarkably, when behavior is explainable by non-exclusionary concerns corresponds to the case case where (EE-IC) implies (EE-IR).

In a logic analogous to that we use to separate predatory behavior from competitive pricing, in markets that are connected by data economies of scope, entry of A in a secondary market cannot be attributed to the desire of protecting monopoly power, if A expects to make sufficient profits in the secondary market. In the parlance of competition law, foreclosure would not be anti-competitive when (ENC) holds. Empirically, in order to corroborate a theory of harm based on data-driven envelopment one would have to conduct a test based on production costs in the secondary market.

It follows from condition (ENC) that the cases that are most likely to represent intentional exclusionary behavior are those where B is more efficient than A in serving the secondary market. This raises two questions: Can the exclusionary equilibrium arise if B is more efficient than A also in the primary market? If that is the case, can the exclusionary equilibrium be sub-optimal in the sense of generating too little entry in the primary market? Both questions can be answered in the affirmative.

Remark 2 *The conditions for exclusionary equilibrium,* $[b.1]$*, can arise, generically, even in cases where B is more cost-efficient than A in both markets, $c_P^B < c_P^A$ and $c_S^B < c_S^A$, and the efficiency gain is such that it would be socially optimal for B to enter the primary market, $c_P^A - c_P^B > (1-\beta)f_P$.*

Not only entry a competitor may be deterred by the conduct of A, but also the resulting outcome may be welfare reducing. The inefficiency is explainable by a cross-market externality problem. By providing excessive rents to consumers in the secondary market, A is able deter entry of B at the expenses of consumers in the primary market, who suffer from continued monopoly. Such externality is made possible by privacy-policy tying, which links the two markets, and by the atomistic nature of consumers.

We demonstrate the statement in Remark 2 above by means of examples, focusing on the Bertrand-like scenario described at the end of Section 4. Because in the Bertrand-like scenario there is no dead-weight loss from monopoly, welfare-optimality boils down to whether entry decisions are optimal in equilibrium or not. Let's begin with the first question. Firm B is more efficient than firm A in $\mathcal{P}$ if $c_P^B < c_P^A$. Then, the (PDA) condition becomes $\alpha + c_P^A - c_P^B > (1-\beta)f_P > 0$, which is satisfied as long the cost-advantage of holding data, α, is sufficiently large. The $(EE-IC)$ and $(EE-IR)$ conditions become $(v_P - c_P^A) - (c_P^A - c_P^B) > (c_S^A - c_S^B) - (1-\beta)f_P$ and $(v_P - c_P^A) - (c_P^A - c_P^B) > (c_S^A - c_S^B) + (1-\beta)(f_S - f_P - \max\{0, c_S^B - c_S^A\})$, respectively. For v_P sufficiently large, both can hold even when $c_P^A > c_P^B$ and $c_S^A > c_S^B$. Let's now discuss the second question. Whether entry by A followed by exclusionary behaviour is a welfare-optimal outcome or not depends on whether entry decisions are the same as those that a welfare-maximizing central authority would mandate. Clearly, a central authority would mandate entry of B into the primary market if the efficiency gain would be enough to cover fixed costs, that is if $(c_P^A - c_P^B) > (1-\beta)f_P$. It is then not difficult to see that (PDA),(EE-IC) and (EE-IR) can hold when that condition holds. This is obvious for the case of (PDA). By assuming $(c_P^A - c_P^B) = (1-\beta)f_P$ we can see that both (EE-IC) and (EE-IR) above can hold strictly when v_P is large enough.

6 Policy Analysis

A central theme of this paper is that the building of a data advantage by a firm with market power, achieved through privacy-policy tying, may have exclusionary effects that harm consumers. In order to evaluate such harm, we need to compare consumer surplus in the exclusionary equilibrium with that arising in alternative outcomes that could be implemented through appropriate policies.

The rest of this section evaluates the effect of several policies, mainly under the three assumptions (PDA), (EE-IC) and (EE-IR) that produce the exclusionary equilibrium. First, we consider an outright restriction on entry by A, which serves as our main counter-factual scenario to evaluate harm to consumers from the exclusionary equilibrium. Then, we consider two policies that have received ample attention by policy-makers, that is *prohibition to data tying* and *and mandating portability of data.* Finally, we consider an environment where firms are allowed *free trade of data.*

Measuring Welfare. To begin with, we need a measure of consumer-welfare. Our modeling of the secondary market leaves us little discretion. The welfare of consumers in the secondary market is zero if B remains monopolist, while it is $(v_S - p_1^*) + (1-\beta)W_S(c)$ if A enters, where p_1^* is the winning price-offer made to consumers in the first period and $W_S(c) = \left(v_S - \max\{c_S^A, c_S^B\}\right)$ is the welfare from final-period competition. Coming to the primary market, we also normalize to zero consumer welfare under monopoly, when A has no data. However, we let $W_P(m^+)$ indicate consumer welfare in the primary market when A is a monopolist and holds the data advantage. As discussed, additional data may benefit consumers or not so that $W_P(m^+)$ may be positive or negative. Borrowing terminology introduced in de Cornière and Taylor (2020), we say that the data advantage is *pro-competitive* if $W_P(m^+) > 0$, while it is *anti-competitive* if $W_P(m^+) < 0$. As illustrated in Section 4, data can be pro-competitive if it improves targeted advertising or the quality of service for consumers but it can be anti-competitive if it enables price discrimination. $W_P(m^+) < 0$ might also result from privacy considerations.

Lastly, because it will be relevant when discussing policies, we denote with $W_P(c^{++})$ consumer welfare in the primary market under competition when two firms have the data, with $W_P^i(c^+)$ the welfare when only firm i has the data advantage, and with $W_P(c)$ the welfare when no firm has it. We assume that all these surplus levels under competition are above zero, but whether $W_P(c^{++}) > W_P^i(c^+) > W_P(c)$ or $W_P(c^{++}) < W_P^i(c^+) < W_P(c)$ depends on whether the data is pro-competitive or anti-competitive.

Under the stated assumptions and recalling that we discount first-period variables in the primary market and second-period ones in the secondary, the welfare generated by the exclusionary equilibrium, which we denote W^E, is equal to

$$W_P(m^+) + (1-\beta)W_S(c) + v_S - c_S^B + \Pi_P^B(c^+) - (1-\beta)f_P.$$

The last four terms represent the welfare generated in the secondary market in the first period, which is where the action takes place, and the last two among them mainly account for the additional value consumers obtain in light of the price war that takes place for the control of data.

Additional Assumptions. Finally, to avoid dealing with tedious cases, and just at purpose of this section, we make two additional assumptions which we did not require for our main result. First, we assume that the *efficiency effect* is positive. That is

$$\Pi_P^A(m) - \Pi_P^A(c^+) - \Pi_P^B(c^-) \geq 0. \tag{EE - 0}$$

(Note that the condition above implies $(EE - IC)$ only if $\Pi_S^B(c) \leq \Pi_S^A(c)$.) Second, we assume $\Pi_P^i(c) = \Pi_P^i(c^{++}) \leq (\Pi_P^i(c^+) + \Pi_P^j(c^-))/2$, where $\Pi_P^i(c)$ and $\Pi_P^i(c^{++})$ denote the profit of firm i in the primary market when neither i nor j have the data advantage and when both have it, respectively. The equality implies the data advantage is competed away when both firms have it; the inequality implies that exploiting the data advantage actually materializes into additional industry profit even with competition.

6.1 Entry restrictions

Suppose A is forced to stay out of the target market. This represents our main counter-factual scenario to evaluate harm to consumers from the exclusionary equilibrium in the case where (ENC) does not hold and therefore entry of A would not be justified on purely commercial grounds.

In this modified model, B will enter the primary market holding a data advantage. Compared to the exclusionary equilibrium, there will be competition in primary market, while competition in the secondary market will be absent. Consumers benefit from this policy if, and only if

$$W_P^B(c^+) \geq W^E = W_P(m^+) + (1-\beta)W_S(c) + v_S - c_S^B + \Pi_P^B(c^+) - (1-\beta)f_P. \tag{4}$$

Abstracting from single-period payoffs (i.e., setting $\beta = 1$), the exclusionary entry-strategy harms consumers when the increase in surplus due to competition in the primary market, $W_P^B(c^+) - W_P(m^+)$, is larger than that in the secondary, measured as $v_S - c_S^B$, plus the transfer accrued as a result of the price-war, $\Pi_P^B(c^+)$. In turn, this is more likely to be true when the value generated in the primary market is high and profits from competition are, instead, small. For instance, in the case of intense Bertrand-like competition, with $c_P^B = c_P^A$, we have $W_P(c^+) = v_P - c_P^A$, $W_P(m^+) = 0$, and the condition boils down to $v_P - c_P^A > v_S - c_S^B$. In summary, we make the following observation.

Remark 3 *Restricting entry into the secondary market by the primary-market monopolist is more likely to benefit consumers when the value produced in the primary market is larger than the value produced in the secondary, production costs are around the same level, and competition is intense.*

6.2 Prohibition to data-tying

Suppose regulation prevents *all* firms from pooling consumer data across markets. This prohibition, which could be implemented by requiring the un-bundling of privacy policies, would, in effect, neutralize any data advantage.

To analyse this scenario it is necessary to consider first whether the data advantage is, as we shall say, *essential for competition* in the primary market or not. If

$$(1-\beta)f_P > \Pi_P^B(c), \tag{DEC}$$

then B would not enter the primary market unless it gets an edge over A through the data advantage. The data advantage is, therefore, essential for competing in the primary market.

Whether a data advantage is essential for competition or not will depend on the specific application. However, the analysis of some business cases may shed some light on which data might be essential for which industry. For example, it is conceivable that the development of the Android operating system by Google was also intended to obtain access to user-location data, which were already available to Microsoft through its Windows operating system. Arguably, by linking location data with its wealth of information, Google was able to limit the growth of Bing, its main rival search-engine, owned by Microsoft. Therefore, we posit that a data-advantage in the form of location data was, and may still be now, essential for competition in the web-search market.

When (DEC) holds, a generalized prohibition of data pooling will backfire. There will be no entry in either market, or, possibly, there will be entry only in the secondary market if (ENC) holds. This policy would therefore defy its purpose and induce consumer welfare of at most

$$W_P(m) + (2-\beta)W_S(c),$$

which is lower than W^E as it does not offer the additional value from the data-driven price-war.

Instead, if the data advantage is *not essential* for competition, then a prohibition to data tying will not impede entry of competitors in the primary market. However, it will prevent A from implementing its exclusionary strategy. Consumers will harness the benefit from increased competition in the primary market, although entry of A in the secondary market may not take place. On the one hand, if entry of A does not take place, consumers benefit from a prohibition to bundle data across markets if

$$W_P(c) \geq W^E$$

which is akin to condition (4) from the previous sub-section, except in the left-hand side welfare from competition with the data advantage in the primary market is replaced with the welfare from competition with no data advantage. On the other hand, if entry in the secondary market does take place, because (ENC) holds, then consumers benefit from a prohibition to data tying if

$$W_P(c) + (2-\beta)W_S(c) \geq W^E,$$

which is likely to hold, as we might conjecture $W_P(m^+) < W_P(c) - \Pi_P^B(c^+)$ and $(2-\beta)W_S(c) \sim (1-\beta))W_S(c) + v_S - c_S^B$.

Because it may be difficult verifying when data is essential for competition (DEC), we might conclude that a blanket prohibition of data tying, especially so when data is pro-competitive, is a risky policy that may, in some circumstances, end up harming consumers. However, an *asymmetric prohibition to data-tying*, which only applies to the dominant company, will carry a lower risk of harming consumers. As long as data is *not* essential for competition, it implements the same outcome as a generalized ban on data-pooling, thus neutralizing the ability of A to exclude B, but allowing B to harness data and use such data in the primary-market. This is welfare enhancing over a generalized ban if data are pro-competitive.

When a data advantage is essential for competition, instead, an asymmetric ban will reduce, although not completely eliminate, the incentives of A to carry out an exclusionary strategy: A can acquire the data with the only purpose of denying them to B. Now A stands to gain $\Pi_P^A(m) - \Pi_P^A(c^-)$ in the primary market rather than $\Pi_P^A(m^+) - \Pi_P^A(c^-)$ and so the conditions for an exclusionary equilibrium might remain in place. If exclusion takes place, then the outcome for consumers is still better than in the case of a generalized ban, because a price-war must take place in the secondary market. If exclusion does not take place, then the outcome is preferable to the one arising from a generalized ban and is the same as with a ban on entry of A, except A might now enter the secondary market thus generating higher welfare for consumers.

Remark 4 *A policy that prevents the dominant operator in the primary market to pool data is preferable to policy that imposes a generalized ban on privacy-policy tying, more so if data is pro-competitive. It reduces the incentive to foreclosure when a data advantage is essential for competition and eliminates them when data is not essential.*

6.3 Data Portability

In the scenario we consider here, data collected in the secondary market is portable across firms and non-rival, but consumers remain in control of the ability to transfer it from one firm to another.

We envisage that, after entry decisions have been made, consumers can *transfer their data to any firm operating in the same market*, possibly in exchange for a fee or at a cost, which we treat as negligible. For example, social-networking profiles built within the incumbent platform, might be made portable to other social-networking platforms.

To make progress, we focus on a model whereby the data collected in the secondary market allows firms in the primary market to identify the consumer and make *individualized* price-offers. Then, firms in the primary market treat every consumer as a single market. Each consumer decides to either make their data available to both firms or not, if both are in the primary market, before firms make their pricing decisions. In equilibrium, all individual consumers have the same incentives to either transfer or retain data and the assumption that closes the model is that profit levels in competition depend on the share of consumers that ports data to the other firm. For instance, suppose A serves all consumers in the secondary market. If there is entry of B and share λ of consumers transfers their data to B, then profits in the primary market are $(1-\lambda)\Pi_P^A(c^+) + \lambda\Pi_P^A(c^{++})$ for A and $(1-\lambda)\Pi_P^B(c^-) + \lambda\Pi_P^B(c^{++})$. Welfare can be defined analogously.

First, observe that whenever A and B are both in the primary market, consumers will either all always want to give away their data to the firm that does not have it or all refuse to do that. The former happens if data is pro-competitive, that is if $W_P(c^{++}) > W_P(c^-)$. The latter happens if data is anti-competitive. Hence, when data is anti-competitive, the possibility of data-sharing will have no effect on equilibrium behavior. Note that the exclusionary equilibrium arises, which leaves consumers worse off than if they shared the data. But we assume consumers cannot commit to share data with B to encourage entry.

Let's therefore focus on pro-competitive data. In this case, giving data to all firms will induce firms to compete the data advantage away, at least partially. Hence all consumers port their data if there is competition in the primary market. This implies that, as long as a *data advantage is not essential*, $\Pi_P^B(c^{++}) = \Pi_P^B(c) > (1-\beta)f_P$, firm B will always enter, making it impossible for A to exclude it. In turn, A enters the secondary market only if it is profitable to do so, that is only if $(2-\beta)\Pi_S^A(c) > (1-\beta)f_S$. In this scenario, where the data advantage is not essential, consumers benefit from data portability, as it neutralizes the risk of foreclosure.

On the other hand, consider the case where the *data advantage is essential* and $\Pi_P^B(c^{++}) = \Pi_P^B(c) < (1-\beta)f_P$. In this case, B will never enter the primary market, as it is unable to gain an exclusive data advantage, given consumers' optimal ex-post behavior. In light of the above A will stay out of the secondary market, unless, again, $(2-\beta)\Pi_S^B(c) \geq (1-\beta)f_S$. In any event, no price war will take place in the secondary market. As a result, consumers are left with a double monopoly (i.e., unless A enters). Remarkably, due to strategic considerations, assigning ownership of data to consumers may not always alleviate the exclusionary concern we discuss and, in fact, it may even aggravate it.

Remark 5 *Data portability does has no effect when data is anti-competitive. When data is pro-competitive, data portability will prevent exclusion if data is not essential for competition but it will harm consumers when a data advantage is essential for competition.*

We have seen that enforcing unrestricted portability may end up damaging consumers when data is essential for competition. Instead, a requirement to offer portability of data only levied on the dominant operator would both restore incentives to entry and eliminate those to foreclose — analogously to the case of a unilateral prohibition of data tying. In contrast to what happens with a unilateral ban on data-tying, if there is no threat of entry in the primary market, then data portability requirements still allow the dominant firm to enter the secondary market and vie to acquire data, which can happen if data raise monopoly profits enough in the primary market.

6.4 Data Trading

Finally, assume data is the property of the firm that collects it and that it is transferable and non-rival (i.e., the data advantage can be enjoyed by all firms to produce in a cheaper way the same service quality or extract a higher advertising profit in the primary market). We focus on the case where the data-owner can sell the data collected in the secondary market at the beginning of the second period, but after all entry decisions have been made. That is, we maintain that B cannot credibly commit not to enter the primary market as part of the data selling deal.[20]

Data trading is common among tech firms. For example, it is well known that Facebook used to share its data with other tech companies such as Amazon, in exchange for partnerships of various sorts.[21] However, the legal status of such practices is to a large extent uncertain and subject to debate in many jurisdictions, where the nature of property rights over data remains uncertain. It is therefore important to evaluate some of the consequences of assigning such rights to firms.

Again, whether a data advantage is essential for competition or not affects the outcome. Suppose, first, that a data advantage is *not* essential for competition in the primary market, that is $\Pi_P^B(c^{++}) = \Pi_P^B(c) > (1-\beta)f_P > \Pi_P^B(c^-)$. Then, B enters the primary market, unless A happens to be the *only* firm with the data advantage. In this case, as we shall argue next, exclusion remains an equilibrium. On the one hand, if A stays out of the secondary market *or* does not acquire the data advantage, B will enter the primary market without selling the data to A. In particular, a trade of data from B to A would only be profitable to both parties if $\Pi_P^A(c^{++}) - \Pi_P^A(c^-) > \Pi_P^B(c^+) - \Pi_P^B(c^{++})$, which is never true given the additional assumptions stated at the beginning of this section. On the other hand, if A enters, it has the same incentives as in the baseline model to win competition in the secondary market and obtain the data advantage, as it will then avoid entry of B. Note that A would have no incentive to sell the data once it acquires them, because $\Pi_P^A(m^+) - \Pi_P^A(c^{++}) > \Pi_P^B(c^{++}) - (1-\beta)f_P$ is implied by $(EE-0)$ and the assumption that $\Pi_P^i(c^{++}) \leq (\Pi_P^i(c^+) + \Pi_P^j(c^-))/2$. Hence, when data is not essential for competition, allowing data trade will likely have no impact on the outcome.

Instead, suppose a data advantage is essential for competition. Entry by B in the primary market is profitable if and only if it enjoys the data advantage exclusively. In this case, the possibility of trading data changes the strategic outlook of the game, because now B can credibly

[20]Such an agreement would be clearly illegal, as it would allow both firms to maintain monopoly in their respective markets. It would have the same effect of an acquisition, discussed in section 7. Consumers would not benefit.

[21]See Solon and Farivar (2019), "Mark Zuckerberg leveraged Facebook user data to fight rivals and help friends, leaked documents show", Nbcnews.

commit to remain out of the primary market if it sells its data to A. To analyse this case, suppose first A remains out of the secondary market. On the one hand, it would be willing to pay up to $\Pi_P^A(m^+) - \Pi_P^A(c^-)$ for data in order to avoid entry of B. On the other hand, B would be willing to accept $\Pi_P^B(c^+) - (1-\beta)f_P$ (i.e., the profit it makes by entering the primary market) to relinquish the data advantage. Because of assumption $(EE-0)$, we have $\Pi_P^A(m^+) - \Pi_P^A(c^-) > \Pi_P^B(c^+) - (1-\beta)f_P$. Hence, a trade of data will be feasible, i.e., acceptable to both parties, at any price in the interval $[\Pi_P^B(c^+) - (1-\beta)f_P, \Pi_P^A(m^+) - \Pi_P^A(c^-)]$. Let's denote with p^D the price at which both firms expect the trade of data to take place. Then A's payoff from remaining out of the market is $(1-\beta)\Pi_P^A(m) + \Pi_P^A(m^+) - p^D$.

Let's now consider what happens if A enters. In this case, either A or B will own the data advantage at the end of the first period. If A owns it, it will not sell it to B as data trading is now not feasible, due to the already mentioned assumption that the efficiency effect is positive. If B owns the data advantage, instead, a trade of data will become feasible at any price in the interval $[\Pi_P^B(c^+) - (1-\beta)f_P, \Pi_P^A(m^+) - \Pi_P^A(c^-)]$, as in the case where A remains out of the secondary market. Let's denote with p^D the price at which both firms expect the trade of data to take place. With this in mind, we can now evaluate the pricing behaviour of A and B in the secondary market. It takes just a bit of algebra to demonstrate the intuitive observation that, with data trading, the most efficient firm in serving the secondary market will win competition in the secondary market. In particular, the lowest acceptable price of A will be x that solves

$$\Pi_P^A(m^+) - c_S^A + x = \Pi_P^A(m^+) - p^D,$$

that is $x = c_S^A - p^D$, while, analogously, the lowest acceptable price for B will be $y = c_S^B - p^D$.

It follows that if A is less efficient than B in serving the secondary market, that is $\Pi_S^A(c) < \Pi_S^B(c)$, then it will remain out of such market and buy the data from B instead. Assuming the price paid for the data is the same whether it stays out of the secondary market or enters and loses competition there, there is no reason for A to sustain fixed costs only to end up making zero profit in the secondary market and paying for data. Instead, suppose A is more efficient than B. By entering it will make payoff $(1-\beta)\Pi_P^A(m) + \Pi_P^A(m^+) + (2-\beta)\Pi_S^A(c) - f_P - p^D$, where we used the fact that $\Pi_S^B(c) = 0$ as A is more efficient. Hence, we conclude that A will enter if and only if $(2-\beta)\Pi_S^A(c) > f_P$ and in that case will win competition in the secondary market.

The main conclusion we draw is that allowing firms to sell data they acquire does not eliminate the incentives of A to exclude B from the primary market, when such incentives are present to begin with. In particular, A now either out-prices B in the secondary market and acquires a data advantage this way or, whenever its more convenient, it avoids entry and buys data from B instead. A data purchase is possible when data is essential for competition, as in this case selling the data credibly commits B not to enter in the primary market. Moreover, a data trade will not happen when A would want to enter the secondary market anyway (i.e., behaviour of A is explainable by non-exclusionary concerns and (ENC) holds). Remarkably, when such a data sale happens, consumers are left worse-off than in the exclusionary equilibrium, because of there is no entry in any of the two markets, while both B and A retain monopoly profits. In short,

Remark 6 *Data-trading reduces strategic externalities between firms and facilitates monopoly pro-*

tection, typically resulting in lower consumer surplus than in the exclusionary equilibrium.

7 Mergers and Acquisitions

The existence of data-driven economies of scope opens up the possibility for the monopolist in the primary market to obtain a data advantage and protect its monopoly power by means of acquiring a dominant firm operating in the secondary market, as opposed to entering it with a new venture or by acquiring a smaller firm. As we elaborated in the introduction, we believe that many mergers and acquisitions in the past years have been data-driven. In this section we discuss this possibility in the context of our model and evaluate the consumer welfare consequences of allowing such mergers.

We can model such a scenario, by allowing A and B to merge prior to the initial entry decision of A. We will evaluate the feasibility and consequences of the merger in the the case where (PDA), $(EE-IC)$ and $(EE-IR)$ hold.

Because of these assumptions, if the merger is not consummated, the equilibrium is exclusionary and A obtains profit

$$(1-\beta)\Pi_P^A(m)+\Pi_P^A(m^+)-\Pi_P^B(c^+)+(2-\beta)\Pi_S^A(c)-\Pi_S^B(c)+(1-\beta)(f_P-f_S)$$

while B obtains $(1-\beta)\Pi_S^B(c)$.

To continue with the analysis, we identify the outcome for the merged firm following a merger. Maintaining, for simplicity of notation, that $c_S^B \leq c_S^A$ (i.e., that B is at least as efficient as A in serving the secondary market) this payoff is equal to

$$(1-\beta)(\Pi_P^A(m)+\Pi_S^B(m))+\Pi_P^A(m^+)+\Pi_S^B(m).$$

That is, the merged firm maintains a monopoly in both markets and also exploits the data in the primary market. This outcome, which is analogous to the outcome of data selling from B to A, which may materialize when data are transferable and a data advantage is essential for competition, harms consumers the most as it induces a double monopoly.

Clearly, the joint surplus of the two firms when merged will be larger than the joint surplus of the two firms in the exclusionary equilibrium. Indeed after a little algebra we can see that

$$(2-\beta)\Pi_S^B(m)\geq(2-\beta)\Pi_S^A(c)-\beta\Pi_S^B(c)-\Pi_P^B(c^+)+(1-\beta)(f_P-f_S),$$

because $\Pi_S^B(m) > \Pi_S^A(c)$ and $\Pi_P^B(c^+) \geq (1-\beta)f_P$ by the (PDA) condition. Hence, as one would expect, given that a merger achieves monopoly profits without duplicating fixed costs, in this environment there is always a price that A is willing to pay to acquire B, which would be acceptable to B. The merger is always profitable. However, observe that the range of acceptable prices for an acquisition, that is the relative bargaining position of the two parties, depends on whether a policy to prevent exclusionary behavior is in place or not. We state the following.

Remark 7 *Because it results in a double monopoly, a merger between the two firms operating in the primary and secondary market harms consumer more than the exclusionary equilibrium, in a way that is akin to a data trade that leaves B out of the primary market.*

Appendix

Proof of Proposition 1 Consider [a.] Net of fixed costs, $\Pi_P^B(c^+)$ is the most B expects from entry and $\Pi_P^B(c^-)$ is the least. Hence, if $\Pi_P^B(c^+) < (1-\beta)f_P$ then B stays out and if $\Pi_P^B(c^+) > (1-\beta)f_P$ it enters.

Therefore, if neither of the two conditions above holds, since $\Pi_P^A(c^+) > \Pi_P^A(c^-)$, we must have $\Pi_P^B(c^+) > (1-\beta)f_P > \Pi_P^B(c^-)$. Case [b.] imposes two additional assumptions. To analyse equilibrium, we proceed by backward induction. First, we compute equilibrium payoffs in the subgame that starts after A decides to stay out of $\mathcal{S}$. In period one A and B make discounted monopoly profits $(1-\beta)\Pi_P^A(m)$ and $\Pi_S^B(m)$, respectively. Then, if B does not enter, in the second period they both achieve again monopoly profits. Instead, suppose B enters. In this case B still obtains $(1-\beta)\Pi_S^B(m)$ in the second period, as it remains monopolist in the target market. In addition, by competing in the primary market, it makes $\Pi_P^B(c^+)$. We conclude that, in the subgame that starts after A stays out, B enters, as (PDA) implies $\Pi_S^B(c^+) > (1-\beta)f_P$. In the equilibrium of this subgame A obtains

$$(1-\beta)\Pi_P^A(m) + \Pi_P^A(c^-). \qquad (1)$$

The result of this argument is illustrated in figure 3(a).

To determine the initial action of A, let's now analyze the equilibrium entry decision of B in the subgame where A enters. There are two cases to consider. First, B wins Bertrand competition for the target market in period one. Then it will make net second-period (incremental) profit equal to $\Pi_P^B(c^+) - (1-\beta)f_P + (1-\beta)\Pi_S^B(c)$ if it enters the primary market, while it will make $(1-\beta)\Pi_S^B(c)$ if it stays out. As it was the case for the other branch of the tree, assumption 1 implies B will enter the market. This point is illustrated Figure 3(b).

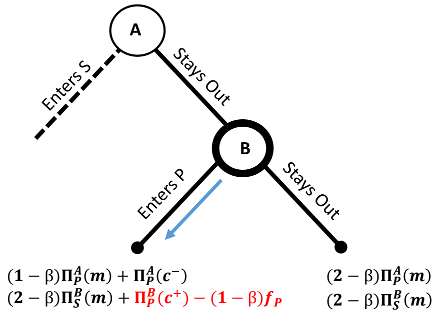
Now suppose A wins the data advantage in $\mathcal{S}$. Consider again the decision of B. By staying out it makes $(1-\beta)\Pi_S^B(c)$ incremental profit. If it enters, it competes with A in $\mathcal{P}$. Given the data advantage acquired by A, B will make second-period (incremental) profit equal to $(1-\beta)\Pi_S^B(c) + \Pi_P^B(c^-) - (1-\beta)f_P$. It follows from (PDA) that B will prefer to stay out if A enters the target market and wins the data advantage. This is illustrated in Figure 3(c).

We are now ready to wrap-up. We first determine the outcome of Bertrand competition if A enters and then we compare it with the outcome from staying out. As illustrated in the main text, under $(EE-IC)$ the outcome of Betrand competition is such that A serves the market at price $c_S^B - \Pi_P^B(c^+) - f_P$. As illustrated above, B stays out. The profit of A is

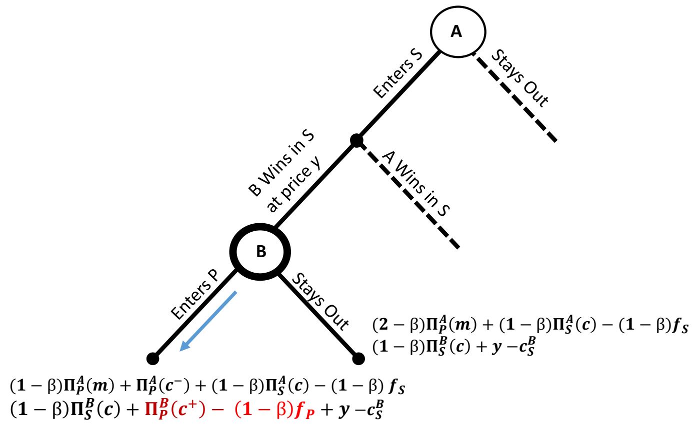
$$(1-\beta)\Pi_P^A(m) + \Pi_P^A(m^+) + (1-\beta)(\Pi_S^A(c) - f_S) - c_P^A + c_S^B - \Pi_P^B(c^+) + (1-\beta)f_P. \qquad (2)$$

To conclude the proof of [b] we need to verify that entering the secondary market is indeed optimal for A. That is, we need to show that $(2) > (1)$. Assumption $(EE-IR)$ guarantees that this is the case, after we substitute $c_S^A - c_S^B$ with $\Pi_S^B(c) - \Pi_S^A(c)$.

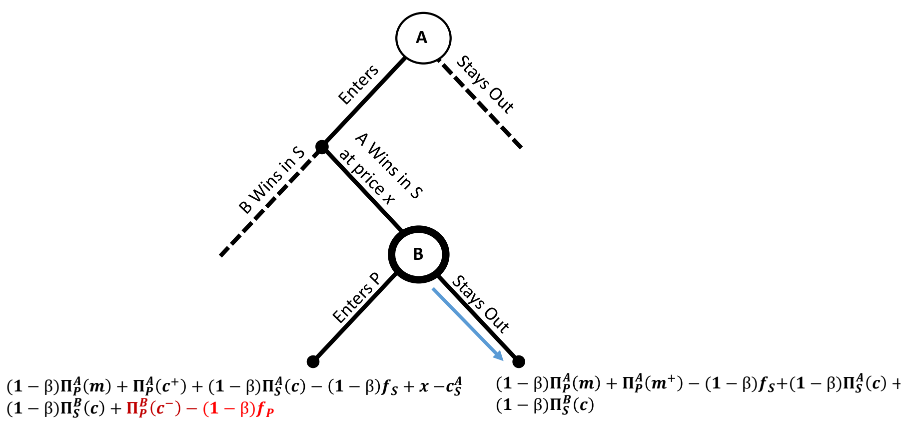
Finally consider [c]. We argued that if $(EE-IC)$ does not hold, than B enters. If $(EE-IC)$ holds and $(EE-IR)$ fails, it follows from the observation in the paragraph above that A is better off remaining out of the market. If A stays out of the secondary market, then B enters. $\square$



(a) Equilibrium decision of B in the subgame after A stays out



(b) Equilibrium decision of B in the subgame where A enters but B wins the target market



(c) Equilibrium decision of B in the subgame where A enters and wins the target market

Figure 3: Equilibrium Construction: The decision node being analyzed is highlighted in bold; in red, the difference in payoffs between the two outcomes of the decision; the arrow indicates the optimal decision; x and y are arbitrary payments.

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