



HAL
open science

The Sale of Data: Learning Synergies Before M&As

Antoine Dubus, Patrick Legros

► **To cite this version:**

| Antoine Dubus, Patrick Legros. The Sale of Data: Learning Synergies Before M&As. 2024. <hal-03698203v5>

HAL Id: hal-03698203

<https://hal.science/hal-03698203v5>

Preprint submitted on 30 Oct 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

The Sale of Data: Learning Synergies Before M&As*

Antoine Dubus[†] Patrick Legros[‡]

October 30, 2024

Abstract

Firms may share information to discover potential synergies between their data sets and algorithms, eventually leading to more efficient mergers and acquisitions (M&A) decisions. However, information sharing also modifies the competitive balance when companies do not merge, and a firm may be reluctant to share information with potential rivals. Under general conditions, we show that firms benefit from (partially) sharing information. By doing so, they can merge conditionally based on high synergies. Compared to a *laissez-faire* situation, the presence of a regulator allowing or refusing the M&A may increase or decrease information sharing, with a concomitant increase or decrease in consumer surplus. Hence, regulation can *lower the surplus* of consumers it is willing to protect. An optimal merger policy combines merger control with mandated data-sharing rules.

Keywords: Artificial Intelligence; Synergies; Mergers; Incomplete Information; Antitrust.

JEL: G34; K21; L1; L21; L24; L5; L86.

*We would like to thank Stefan Bechtold, Andreea Cosnita-Langlais, Jacques Crémer, David Gilo, Jan Krämer, Mathieu Parenti, Pierre Régibeau, Shiva Shekhar, Thibaud Vergé, Patrick Waelbroeck, as well as participants to the 2021 CRESSE conference, the 2022 IIOC conference, the 2023 DISS workshop, the 2024 Conference on Regulators and Regulation in the Digital Era, the 2024 IBEO workshop, the 2024 EARIE conference, the 2024 ECARES workshop, the Paris Seminar on the Digital Economics, and to the LIEN seminar for insightful comments and discussions. This project benefited from financial support from FNRS (Project PDR T.01.47.19) and the European Research Council (under the European Union’s Seventh Framework Program (FP7-IDEAS-ERC), ERC Grant Agreement OIO- 339950). A previous version of this work has circulated under the title “Data-Driven Mergers and Acquisitions with Information Synergies.”

[†] Department of Management, Technology and Economics, ETH Zürich Leonhardstrasse 21 Switzerland – 8092 Zürich, Switzerland; antoinedubus@gmail.com.

[‡] Université Libre de Bruxelles, ECARES and CEPR; patrick.legros@ulb.be.

The rise of AI-powered production and operation systems is pressing digital firms to acquire the largest amount of data to improve their product quality and maximize their profits.¹ A central way to secure access to high-quality data is by acquiring data-intensive firms. In recent years, the possibility to acquire the data sets and data sources of a target has indeed become an essential motivation for many M&As (de Cornière and Taylor, 2024a; Gautier and Maitry, 2024).² For instance, one reason Facebook acquired WhatsApp and Instagram was to merge the profiles of users of these platforms with those of Facebook, optimizing its targeted advertising systems.

These data-driven mergers generate new types of synergies resulting from the combination of data sets and algorithms, especially as the efficiency of AI systems is boosted with rich data from various sources. Nevertheless, merging comes at a risk for firms, and many M&As between digital firms fail to deliver positive outcomes (Gautier and Lamesch, 2021).³ Indeed, while the profits of a firm can be enhanced by leveraging the data accumulated by the target into its algorithms, this is not a certainty: the synergies between the data and algorithms of firms are unknown before the M&A, even if companies have a good understanding of the likelihood of these synergies. The value of these information synergies can be known for sure only by integrating the new data into a firm's information systems and by eventually training its algorithms with it. As emphasized by Experian, the role of data quality and information synergies is becoming more and more central for M&As between digital firms and brings significant uncertainty over merger outcomes.⁴ Anticipating the synergies resulting from a merger is, therefore, a central issue for firms engaging in M&As and for regulators willing to protect consumers.

In this paper, we consider how sharing data before a merger can help firms learn the complementarity of data and algorithms that they have developed and the extent of synergies that may arise after a M&A. Data sharing has become an increasingly common market practice among firms (Scaria, Berghmans, Pont, Arnaut and Leconte, 2018), sometimes even among direct competitors (Choe, Cong and Wang, 2024). We argue that data shar-

¹For Data-Guzzling AI Companies, the Internet Is Too Small, Wall Street Journal, April 1, 2024.

²For the years 2015-2021, Gautier and Maitry (2024) evaluate that 30% of digital M&A by big tech firms were data-driven, and particularly by firms using AI intensively.

³See also The Three Reasons Why Tech M&A Deals Fail To Deliver Value, Forbes, October 19, 2017. In particular, several flagship mergers have failed because synergies have been inaccurately anticipated, including America Online/Netscape, Twitter/Vine, Yahoo/Tumblr, and Yahoo/Broadcast.com.

⁴The critical role of data quality in mergers and acquisitions, Experian, last accessed, March 19, 2024.

ing could also be used in the context of M&As when firms want to anticipate the value of information synergies before moving further into the merger process. We provide a theoretical analysis to understand the conditions for information sharing and pre-merger learning of synergies. In turn, we analyze the optimal design of a merger policy when firms may engage in pre-merger data-sharing practices. The increasing role of data in digital markets has indeed called for changes in existing regulations to ensure competitive markets and to protect consumers, with a special emphasis on merger control (Cr mer, de Montjoye and Schweitzer, 2019; Tirole, 2023).

We consider a market where two firms, labeled 1 and 2, compete for the sale of their products. Firm 2 can acquire Firm 1, which would generate information synergies, but does not know for sure whether such a merger is profitable: if synergies are high, Firm 2 is willing to merge, but if they are low, the merger induces a loss and firms are better off competing.⁵ To anticipate merger outcomes, Firm 2 can learn the value of the synergies before the merger takes place by acquiring some of Firm 1’s data, but doing so is costly: by giving away some of its data, Firm 1 also gives away a strategic asset that can help Firm 2 being more competitive, to the detriment of Firm 1 (Arrow, 1972; Jones and Tonetti, 2020; Wu, Hitt and Lou, 2020).⁶ This loss of value of Firm 1 matters if synergies are learned to be low and firms end up competing, but also if synergies are high and the merger takes place, in which case Firm 2 can pay a lower price for the acquisition if Firm 1 has shared some of its data and lost its competitiveness. Hence, Firm 1 is reluctant to share its data, and Firm 2 must compensate for the expected loss from sharing at a price that increases with the amount of data it wants to obtain.

In the absence of merger control, we show that firms always want to share information if their best alternative is to merge under incomplete information. This suggests that firms should not merge under incomplete information when they can share information. In other words, according to our model, if firms engage in a M&A, they should necessarily have shared information before doing so and know the value of synergies at the time of the M&A. This result holds as soon as the regulation is not binding and does so even if firms

⁵Merger losses typically result from the cost to merge, potential shocks of culture (Weber and Camerer, 2003) or X-inefficiencies.

⁶Throughout the article, we use equivalently the terms information “sharing” and “selling,” consistently with the literature (H rner and Skrzypacz, 2016) and with the definitions adopted in recent data protection laws (see for instance the California Consumer Privacy Act).

have an excellent estimate of the likelihood of synergies before sharing and are almost sure that synergies are high. In this case, firms still benefit from sharing information and learning the value of synergies before the M&A, as the probability that they don't merge and end up competing more fiercely because of the shared information is low.

We then examine the impact of regulation on the firms' decision to share information and, in turn, on consumer surplus. A regulator such as a competition authority will have a lenient view on information sharing practices: competition between firms will be fiercer after the information is shared, to the benefit of consumers. However, for this reason, the regulator may be tempted not to allow M&As even if synergies are high to protect consumer surplus, reducing the incentives for information sharing. Hence, we show that the presence of the regulator may discourage firms from sharing information and may induce them to either merge under incomplete information or compete instead of sharing. In turn, firms compete less intensively when they share less information, to the detriment of consumers. Thus, while the regulator decides whether to block the M&A to maximize consumer surplus, its presence may, in fact, *reduce* consumer surplus compared to a laissez-faire situation. This result is in the spirit of second-best analysis. It suggests that the protection of consumers through merger control can be detrimental to their surplus and that no regulatory intervention may be best for both consumers and firms. This negative impact of regulatory oversight can be offset if the regulator can mandate information sharing by the firms on top of merger control.

Finally, we show that information sharing allows firms to influence regulators' decisions. Indeed, by sharing information, firms can merge conditional on synergies being high, which maximizes the gains from a merger for firms and for consumers. Hence, sharing information can be used by the firms to convince the regulator that a M&A will be good for consumers. In contrast, the regulator would otherwise block a merger under incomplete information for which there is a risk that synergies are low and the merger is detrimental to consumers.

Our results have important strategic implications. For managers of large digital companies, our setting provides a way to anticipate the value of a M&A when the merger of data sets and algorithms is involved. When merger control is lenient, merging under incomplete information over the value of the information synergies is never profitable if firms can obtain some data from their potential target instead and make their merger

decision with perfect information over the merger outcome.

Sharing can also have subtle effects that influence the decisions of a competition authority and may help firms proceed with a M&A. Indeed, when merger control is stringent, the firms can induce the regulator to accept the M&A if they share some information, even though the regulator would block the merger without sharing. Such effects should be accounted for by managers, as they can allow them to secure M&A deals and yield significant profit gains.

Hence, for managers of potential targets such as digital start-ups, being ready to share data can enable valuable M&As to take place. At the same time, they would not occur without information sharing – either because a merger under incomplete information is not profitable or when it is profitable because merging under incomplete information may not be allowed by the competition authority. This suggests that, as firms adopt pre-merger data-sharing practices, the number of efficient M&A deals should rise, while firms should engage in fewer inefficient M&As. We discuss ways to enable firms to share their data, either in exchange for money using data marketplaces or for free, when the potential target can have a stake in the M&A.

These issues are particularly pressing since the wide adoption of AI techniques is sharply raising the potential value of data-driven mergers, increasing further the numbers of data-driven M&As.⁷ Hence, our main message is prospective and highlights the potential benefits of information sharing for firms and consumers in the future.

It is even likely that firms willing to anticipate the value of information synergies have already adopted pre-merger data-sharing practices. Several merger cases point to this. First, before being acquired by Google, Fitbit had moved its data to Google Cloud Healthcare API. Doing so allowed Google to leverage its AI algorithms using Fitbit’s data, and at that time, this strategic move was seen by specialists as a first step in the direction of the acquisition of Fitbit by Google.⁸

Secondly, before acquiring The Weather Company, IBM had dealt with a partnership granting it access to The Weather Company’s data through the IBM Cloud. In turn, both firms integrated weather data with IBM analytics services. The firms expected high

⁷Make Data a Strategic Priority in Your Post-Merger Integration, PwC, last accessed, August 20, 2024.

⁸Why Fitbit could make a good Google acquisition, ZDNET, May 3, 2018.

complementarity between the data and prediction services of The Weather Company and the data collected by a large amount of IBM IoT sensors.⁹ Our analysis suggests these types of partnerships are a way for firms to probe the complementarity of their data and algorithms, allowing them to make efficient M&A decisions. In the case of Google/Fitbit and IBM/The Weather Company, these partnerships were followed by acquisitions, implying that the firms may have assessed a high level of synergies between their data and algorithms.

Pre-merger data-sharing practices will likely surpass these illustrative examples since firms do not necessarily need a (sometimes complex) partnership to assess synergies; they can simply share part of their data sets. Yet, there is no empirical evidence of pre-merger data sharing outside broader partnerships, mainly because data-sharing deals are rarely advertised by firms. Even if firms have the right to share their data with third-parties,¹⁰ they are usually not transparent about it since data-sharing practices may raise red flags among consumers willing to protect their privacy.

Our theoretical framework provides valuable insights for regulators regarding the likelihood of pre-merger information-sharing practices. When empirical evidence is difficult to find, we inform policymakers, such as competition authorities, that pre-M&A information-sharing practices may already have been adopted by digital firms. This calls for structural regulatory changes since we show that strict merger control can reduce social welfare when it ignores the role of pre-merger data sharing in the merger process. As previously explained, an optimal regulation combines merger control with mandated data-sharing policies. Such policies have recently been enacted in the European Data Act, for instance,¹¹ and we argue that competition authorities should use these types of regulations to protect at best consumers and digital industries.

The remainder of this article is organized as follows. We review the literature on information sharing and data-driven M&As in Section 1, we describe the model in Section 2, and we characterize the equilibrium in Section 3. We analyze in Section 4 how regulation

⁹IBM and The Weather Company Partner to Bring Advanced Weather Insights to Business, PR Newswire, March 31, 2015

¹⁰For instance, sharing and selling personal data is allowed under Article 1798.100 of the California Consumer Privacy Act ([California Consumer Privacy Act](#)) and in Europe under Article 47 of the General Data Protection Regulation ([General Data Protection Regulation](#)), as long as there is a legitimate interest (which may include the assessment of a merger value) for the firm sharing the data.

¹¹[Data Act](#), December 22, 2023.

shapes information sharing and surplus. We extend the model in several directions in Section 5. We provide managerial and policy implications in Section 6, and we conclude in Section 7.

1 Literature

Our main contribution highlights a novel rationale for rival firms to benefit from sharing information. When firms share information, the resulting competition becomes more intense, in line with the effects analyzed by [Arrow \(1972\)](#), and by [d’Aspremont, Bhattacharya and Gérard-Varet \(2000\)](#) and [Anton and Yao \(2002\)](#) in the case of innovation. However, we show that efficiency gains compensate for this competitive loss as firms learn the synergies from merging their data sets and make their M&A decision according to the value of these synergies. A follow-up contribution is to show that this trade-off has nontrivial effects on the optimal regulation of information-sharing practices. Sharing information among rival firms, data-driven mergers, and regulating information sharing have been separately studied in the literature.

The literature has analyzed firms selling consumer data to their competitors data for the identification of loyal and switching customers ([Chen, Narasimhan and Zhang, 2001](#); [Liu and Serfes, 2006](#)), and more recently for first-degree price discrimination purposes ([Choe et al., 2024](#)) and when data generates a consumption externality ([Bhargava, Dubus, Ronayne and Shekhar, 2024](#)).

Concerning data-driven M&As, [Chen, Choe, Cong and Matsushima \(2022\)](#) and [de Cornière and Taylor \(2024a\)](#) theoretically analyze the impacts of a data-driven merger on consumers when data can be used for product quality enhancement. In [Chen et al. \(2022\)](#), a data-driven merger increases consumer surplus as long as competitors remain in the market. This is not always the case in [de Cornière and Taylor \(2024a\)](#), and a merger’s impact on consumers critically depends on whether firms can trade data before the merger takes place and on the extent to which data allows firms to extract surplus. [Bounie, Dubus and Waelbroeck \(2023\)](#) analyze mergers between data intermediaries and shows that their competitive impacts on product markets depend on how a merger changes the selling strategies of intermediaries and their incentives to collect data. A merger is always profitable for a

firm in these models, focusing on consumer merger impacts. We use a general formulation of firms' profits and consumer surplus before and after a M&A, such that our model nests these different micro-founded effects. In turn, we show how accounting for uncertainty over the merger outcome critically changes the M&A decisions of the firms and consumer surplus.

There is an active policy debate on how to regulate data-driven digital markets. When data has pro-competitive effects, [Crémer et al. \(2019\)](#) and [Tirole \(2023\)](#) propose to foster data-sharing practices to ensure competition on a level playing field. An extreme way of doing so is through mandated data sharing rules forcing firms to share data with their competitors ([Feasey and de Streel, 2020](#)). For instance, the Digital Markets Act recently enacted in Europe enforces a data access right under Article 61, which requires large digital gatekeepers providing online search services to make their search data accessible to other digital firms under fair, reasonable, and non-discriminatory terms.¹² Our contribution to these debates will be to characterize the conditions for a regulator to allow firms to share information and to mandate data sharing between rival firms. In turn, our results imply that mandated data-sharing rules should give firms incentives to request access to other companies' data and to explore these data to learn the value of information synergies. Hence, this suggests a causal impact of mandated data-sharing rules on firms' incentives to merge and merger efficiency.

Finally, competition authorities have also implemented a new merger remedy to prevent firms from acquiring data dominance. In merger cases such as Facebook/WhatsApp and Google/Fitbit, the merging firms have been forbidden to merge their data sets after the merger occurred ([Krämer and Shekhar, 2024](#)). Our model accounts for such a data-siloing remedy, and we show that firms share more information when they anticipate that data silos may be requested.

2 Model

We consider two firms, indexed by 1 and 2, that are competitors for providing a service or product and making individual profits π_1^0 and π_2^0 . The industry profit is $\pi^0 := \pi_1^0 + \pi_2^0$.

¹²See [The Digital Markets Act: ensuring fair and open digital markets, European Commission, last accessed October 10, 2024](#).

The baseline model in Section 3 assumes that if firms decide to merge, no regulator can prevent the M&A. Regulatory oversight is analyzed in Section 4.

Figure 1 introduces the sequence of events; we then delve into each stage, the variables of interest, and our main assumptions. The Appendix provides a quality competition rationale for the assumptions made below.

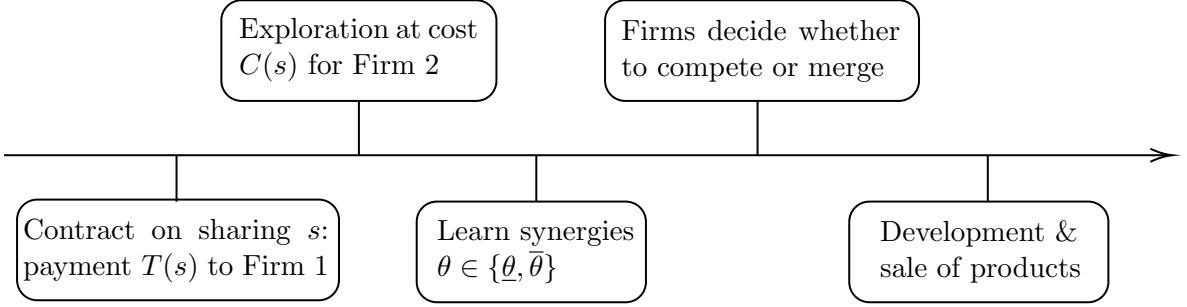


Figure 1: Sequence of events

Sharing and contracting. Firms have a stock of data generated by their activities. Firm 1 can share a proportion $s \in [0, 1]$ of its data with Firm 2 in exchange for a lump sum transfer $T(s)$.

Synergies and exploration. Combining data from Firms 1 and 2 will generate information synergies of value $\theta \in \{\underline{\theta}, \bar{\theta}\}$, $\bar{\theta} > \underline{\theta}$, which will impact the profits of the firms and the surplus of consumers. The value of θ is unknown to firms, but each company knows that $\theta = \underline{\theta}$ with probability α , and $\theta = \bar{\theta}$ with probability $1 - \alpha$.¹³

By exploring Firm 1's data, Firm 2 learns the value of the synergies and can, in turn, develop a product that uses the data from Firm 1. Inferring the total synergistic value of the data of Firm 1 from a subset s entails a cost of exploration of $C(\cdot)$, which depends on the amount of data explored. Upon paying this cost, the firms learn the value of the synergies θ . To simplify, we assume in the basic model analysis that both firms learn synergies. We show in Section 5.1 that our results are robust to the case where Firm 2 receives this information privately.

It is well documented in the literature on statistics and machine learning that inferring information from missing data is costly, and statistical models perform better when more

¹³Our results also hold for general distributions of probabilities over a continuous set of outcomes of the type $\theta \in [\underline{\theta}, \bar{\theta}]$. For simplicity, we focus on the binary case.

data is available (see, e.g., [Neiswanger and Xing \(2017\)](#)).¹⁴ For this reason, we assume that the exploration cost $C(\cdot)$ required to infer the level of synergies decreases with the amount of information explored.¹⁵ For simplicity, we also make standard Inada conditions:¹⁶

(H1) Exploration cost: $C(\cdot)$, $C''(\cdot) \geq 0$, $C(0) = +\infty$, $C'(0) = -\infty$ & $C'(1) = C(1) = 0$.

Hence, if s information has been shared, Firm 2 incurs an exploration cost of $C(s)$.

Note that other costs can arise, like structural costs to store and analyze the data, or develop new algorithms. For simplicity these development costs are included in the profit functions in the different outcomes of the game.

Merger decision. The decision to merge can happen under imperfect information if synergies are not learned. On the contrary, if Firm 2 has acquired and explored data from Firm 1, firms can also merge with perfect information about the synergies.

Hence, firms face the following options at the beginning of the game: compete; share information before the M&A, and make their M&A decision with perfect information over the synergies; or merge under incomplete information. We assume that a merger is final and that divestment of assets is not possible.¹⁷

At the M&A stage, we focus on Firm 2 making a TIOLI offer to Firm 1 and capturing all industry surplus from the merger. We will see that this bargaining mode yields an equilibrium amount of data shared that also maximizes industry profits. We analyze other distributions of bargaining power in Section 5.2.

¹⁴Intuitively, if more data increases the cost of exploration, Firm 2 can focus on a subset of the database.

¹⁵An alternative way to model this inference is using a probability to learn the synergies that increase with the amount of data shared. Both models are isomorphic and yield similar qualitative insights.

¹⁶What matters here is that this cost decreases with s . Other conditions are for analytical convenience and can be easily relaxed without changing the qualitative results.

¹⁷In practice, divestment can follow a merger, and the model can be extended to allow for divestment. For instance, Nokia bought Withings in 2016 – a company specializing in health wearables – and distributed watches under the Nokia name. At the demand of the previous owner of Withings, Nokia divested in 2018 and the connected watches sold under the Withings name again. See [Nokia is selling its digital health business back to the co-founder of Withings, The Verge, May 2, 2018](#). Nevertheless, divestment can be difficult to achieve for data-driven mergers that may raise privacy concerns among consumers, and which play an important role in their valuation of digital products. Such concerns could hardly be forgotten if, after the merger, synergies are low and firms separate their activities. See for instance ['Tossed my Fitbit in the trash': users fear for privacy after Google buys a company, The Guardian, November 6, 2019](#).

Competition. After sharing information and learning the value of the synergies, Firm 2 can improve its product using the data. If firms compete, their profits are denoted by $\pi_i^C(s, \theta)$, continuous in s for any θ .

Integrating data from Firm 1 into its algorithms allows Firm 2 to enhance the consumer value for its product to an extent that depends on the value of information synergies. In a competitive setting, this may negatively impact the profit of Firm 1 (Arrow, 1972; Anton and Yao, 2002), and we assume that $\pi_1^C(s, \theta)$ decreases with s .

$$(H2) \quad \text{Arrow effect: } \frac{\partial \pi_2^C(s, \theta)}{\partial s} \geq 0 \geq \frac{\partial \pi_1^C(s, \theta)}{\partial s}.$$

We denote by $\pi^C(s, \theta)$ the total industry profit under competition in state θ when Firm 2 has acquired s data from Firm 1: $\pi^C(s, \theta) = \pi_1^C(s, \theta) + \pi_2^C(s, \theta)$.

The Arrow assumption is compatible with industry profits increasing with the amount of data shared. We assume that sharing data reduces the industry's total profits when synergies are low, leaving the possibility that they increase with s when synergies are high.

$$(H3) \quad \text{Industry loss with low synergies: } \frac{\partial \pi^C(s, \theta)}{\partial s} < 0.$$

Data sharing may also increase the profits of firms that share information, for instance, if it facilitates collusion or coordination with the receiver. If this were the case when synergies are low, firms would always want to share information since doing so softens competition and allows them to make better M&A decisions. The tradeoff between the competitive loss from sharing and the efficiency gain in merger decision starts playing a role as soon as data sharing reduces the profits of Firm 1 and of the industry, which is ensured by Assumptions (H2) and (H3) for all values of s . Under these conditions, firms are initially reluctant to engage in data-sharing practices.

When synergies are high, there may be a non-monotonic relationship between the amount of sharing and industry profits under competition. If Firm 2 is initially at a competitive disadvantage, a small amount of information sharing will not enable Firm 2 to be a leader on the market but will increase the competitive pressure on Firm 1, decreasing industry profits. As firms share large amounts of information, Firm 2 may be

the new leader in the market when synergies are high, providing high value to consumers and weakening competition with Firm 1. This non-monotonic pattern is present in our quality model.¹⁸

$$(H4) \quad \pi^C(s, \bar{\theta}) \text{ is quasi-convex in } s.$$

Under this condition, $\pi^C(s, \bar{\theta})$ can be any convex function, any monotonous function (including concave functions), or any function that first decreases and then increases.

Finally, in the limit case where $s = 0$, the firms make the baseline competitive profits (which do not depend on the value of information synergies):

$$(1) \quad \forall i, \theta, \pi_i^C(0, \theta) = \pi_i^0.$$

Merger with information sharing. If firms merge after data has been shared, the merged firm makes profits denoted by $\pi^M(\theta)$, which depends on the value of the synergies.

For ex-ante information sharing to create an option value, we assume that the industry profit is higher under a merger than under competition only if synergies are high, that is

$$(H5) \quad \begin{aligned} \text{Option value: } & \forall s, \pi^M(\bar{\theta}) > \pi^C(s, \bar{\theta}), \\ & \& \pi^M(\underline{\theta}) < \pi^C(s, \underline{\theta}). \end{aligned}$$

Note that this assumption combined with (1) implies $\pi^M(\bar{\theta}) > \pi^M(\underline{\theta})$.

A merger is detrimental to firms if synergies are low. This loss captures merger costs, or the potential value losses resulting from shocks of cultures, for instance. A merger will yield a positive outcome only if the information synergies are high and dominate the total losses induced by the M&A.¹⁹ Information sharing will thus allow the firms to avoid mergers when synergies are low. Gaining this option is costly for firms because Firm 2 incurs the exploration cost $C(s)$, and also because the industry competitive profits are reduced when information is shared and synergies are low under (H3).

¹⁸Using the terminology of [de Cornière and Taylor \(2024b\)](#), data is unilaterally pro-competitive in our model when synergies are low. With high synergies, data may be either unilaterally pro- or anti-competitive, or pro-competitive for small amounts of data shared, and anti-competitive after a point.

¹⁹For digital products that intensively use consumer data, the developer's identity of a product is not neutral: a product developed by Google has the stamp "Google" on it. In particular, it inherits consumers' concerns about privacy, which may lower their valuation for the product after the acquisition.

Merger under imperfect information. When firms merge under incomplete information, the merged firm makes profits equal to $\pi^M(\bar{\theta})$ when synergies are high (with prob. α) and to $\pi^M(\underline{\theta})$ when synergies are low (with prob. $1 - \alpha$). The merged entity has access to all the firms' data and incurs no inference cost (since $C(1) = 0$). Thus, the expected payoff of the industry if there is a merger under imperfect information is

$$\mathbb{E}[\pi^M(\theta)] := (1 - \alpha)\pi^M(\bar{\theta}) + \alpha \pi^M(\underline{\theta}).$$

Hence, a merger under incomplete information is beneficial only if

$$(2) \quad \mathbb{E}[\pi^M(\theta)] \geq \pi^0.$$

A M&A is efficient for firms if condition (2) is satisfied and the expected payoff of a merger under imperfect information is higher than industry profits without sharing. It is clear that without sharing, Firm 2 will acquire Firm 1 only when the M&A is ex-ante efficient.

3 Equilibrium Analysis

Given our assumption that both firms learn the level of synergy if there is exploration, the game is one of symmetric information. Our concept of equilibrium is subgame perfection, and as usual, we proceed backward in our analysis.

As given in Figure 1, the timing is as follows: in the first stage, Firm 2 chooses to either stay uninformed, or to purchase s information from Firm 1 for transfer $T(s)$, in which case it explores the data at a cost $C(s)$ and both firms learn θ . In the second stage, Firm 2 chooses whether to compete with Firm 1, or to make a TIOLI offer to acquire Firm 1. If Firm 1 declines the offer, firms compete. Hence, to solve the game, we first consider Firm 2, which acquires data from Firm 1. We characterize the price of an acquisition if synergies are high, and the profits in case firms compete (either if synergies are low, or if synergies are high and Firm 1 declines the offer of Firm 2). We then derive Firm 2's expected payoff and characterize the optimal amount of information acquired by Firm 2. Finally, we provide conditions for information sharing to yield greater profits than competing without sharing and than merging under incomplete information.

3.1 Profits with Information Sharing

Stage 2: profits with sharing. Suppose Firm 1 shares s with Firm 2, who explores the data (at a cost $C(s)$), such that firms learn the value of the synergies. Under Assumption (H5), firms are willing to merge when synergies are high (with prob. $1 - \alpha$). In this case, Firm 2 can make a TIOLI offer to buy Firm 1's asset at a price $\pi_1^C(s, \bar{\theta})$ that will make Firm 1 indifferent between merging and not merging. The resulting M&A profits are equal to $\pi^M(\bar{\theta})$. If synergies are low (with prob. α), a merger is not profitable, and firms compete with a total industry profit $\pi^C(s, \underline{\theta})$.

Stage 1: sharing decision. Firm 1 makes expected profits when sharing s information equal to $\mathbb{E}[\pi_1^C(s, \theta)] = (1 - \alpha)\pi_1^C(s, \bar{\theta}) + \alpha\pi_1^C(s, \underline{\theta})$. According to the Arrow effect, Firm 1 incurs a competitive loss from sharing information, and Firm 2 pays $T(s) = \pi_1^0 - \mathbb{E}[\pi_1^C(s, \theta)]$ to compensate for this loss and to acquire information s .

Lemma 1. *Firm 2 pays $T(s) = \pi_1^0 - \mathbb{E}[\pi_1^C(s, \theta)]$ for sharing s . If synergies are learned to be high, Firm 2 pays $\pi_1^C(s, \bar{\theta})$ to acquire Firm 1.*

Firm 2 is willing to acquire information only if it can recoup the exploration cost $C(s)$ and the price of information $T(s)$. We note $u_2(s, \alpha)$ the expected value of Firm 2 purchasing information s from Firm 1 and exploring, net of the no-sharing payoff π_2^0 :

$$(3) \quad u_2(s, \alpha) := \overbrace{(1 - \alpha)(\pi^M(\bar{\theta}) - \pi_1^C(s, \bar{\theta}))}^{\text{Firm 2's profits if } \bar{\theta} \text{ and firms merge}} + \overbrace{\alpha\pi_2^C(s, \underline{\theta})}^{\text{Firm 2's profits if } \underline{\theta}} - \overbrace{(\pi_1^0 - \mathbb{E}[\pi_1^C(s, \theta)])}^{\text{Price of data } T(s)} - \pi_2^0 - C(s) \\ = \Pi_A(s, \alpha) - \pi^0$$

where $\Pi_A(s, \alpha)$ denotes the industry ex-ante profit if s is shared before the merger

$$(4) \quad \Pi_A(s, \alpha) := (1 - \alpha)\pi^M(\bar{\theta}) + \alpha\pi^C(s, \underline{\theta}) - C(s).$$

Because Firm 2 makes TIOLI offers to Firm 1 when acquiring information and at the time of the merger, it captures all industry's surplus. Hence, the optimal amount of information shared by Firm 1 will maximize $u_2(\cdot)$ as well as the total industry's profits $\Pi_A(\cdot)$.

Overall, the value of ex-ante sharing will be to create an option for Firm 2 when making

its merger decision. It will be able to merge only when synergies are high, and the merger is efficient, thereby avoiding inefficient mergers when synergies are low.

Optimal amount of information shared. An increase in the amount of information shared has two opposite effects on the expected profits of Firm 2. On the one hand, more information is costly to acquire from Firm 1. Under Assumption (H3), $\frac{\partial \pi^C(s, \underline{\theta})}{\partial s} < 0$ and the potential gains for Firm 2 acquiring s information in the competition mode when synergies are low are always dominated by the loss of Firm 1, captured by transfer $T(s)$. To minimize this loss, Firm 2 needs to learn the value of synergies using the smallest possible information.

On the other hand, more information decreases the data exploration cost $C(s)$. Under (H1), using only a tiny share of data to learn the synergies induces a very high cost, which is not profitable for Firm 2. Overall, the optimal amount of information shared balances these two opposite effects of information acquisition on the profits of Firm 2, and the equilibrium amount of information shared by firms $s^*(\alpha)$, which depends on α , satisfies

$$(5) \quad \alpha \frac{\partial \pi^C(s^*(\alpha), \underline{\theta})}{\partial s} = C'(s^*(\alpha)).$$

For simplicity, we assume a unique $s^*(\alpha)$ satisfies this condition. This is the case, for instance, when $\pi^C(s, \underline{\theta})$ is concave in s .

3.2 Equilibrium Information Sharing

There will be sharing of information if the maximal industry expected payoff when information is shared before the merger ($\Pi_A^*(\alpha) := \Pi_A(s^*(\alpha), \alpha)$) is greater than (i) the expected profits of merging under imperfect information $\mathbb{E}[\pi^M(\theta)]$ and (ii) the competitive profits of the firms π^0 :

$$\Pi_A^*(\alpha) \geq \max\{\mathbb{E}[\pi^M(\theta)], \pi^0\}.$$

The benefits of sharing information depend on the best alternative to sharing for the firms, i.e., merging under incomplete information or competing. If competition dominates a merger under incomplete information, sharing can allow M&As when synergies are high. If merging under incomplete information dominates competition, sharing allows the firms

to avoid mergers when synergies are low.

Information sharing will be profitable if it yields a greater expected payoff than this best alternative. In the rest of this section, we first show that Firm 2's equilibrium profits with information sharing are always greater than those when merging under incomplete information. We then provide conditions for information sharing to dominate competition.

Sharing information dominates merging under incomplete information. Sharing information gives Firm 2 the option to avoid mergers when synergies are low, thereby yielding profits that are always greater than a merger under incomplete information. The exploration cost and competitive loss in case of low synergies resulting from information sharing are offset by the gains from merger avoidance in case of low synergies.

Proposition 1.

Information sharing is more profitable than merging under incomplete information.

Proof. We can rearrange the expression of the expected profits of Firm 2 with information sharing (which are equal to those of the industry as shown in (3)):

$$\Pi_A(s, \alpha) = \mathbb{E}[\pi^M(\theta)] + \underbrace{\alpha(\pi^C(s, \underline{\theta}) - \pi^M(\underline{\theta}))}_{\substack{\text{Gains from merger} \\ \text{avoidance if } \underline{\theta} > 0 \text{ (H5)}}} - \underbrace{C(s)}_{\substack{\text{Exploration} \\ \text{cost, } < 0 \text{ (H1)}}$$

From (3), we know that the equilibrium amount of information shared $s^*(\alpha)$ maximizes $\Pi_A(s, \alpha)$. Hence, necessarily, $\Pi_A^*(\alpha) \geq \Pi_A(1, \alpha) > \mathbb{E}[\pi^M(\theta)]$. \square

Proposition 1 shows that, by sharing information and learning the value of synergies before the M&A, firms can always do better than merging under incomplete information. This is because the benefit of having the option not to merge when synergies are low is first order, while the incremental competitive and exploration costs with partial sharing is second order. This suggests that, in the absence of merger control, M&As under incomplete information do not occur as long as firms can share information and learn the value of synergies. In other words, in our model, if a merger takes place, firms have necessarily shared information before the merger and do not merge under incomplete information.

Merging vs. competing. While industry profits π^0 are independent from the degree of uncertainty of the synergies before the merger, this is not the case for $\mathbb{E}[\pi^M(\theta)]$ and $\Pi_A(s, \alpha)$, which depend non trivially on the value of α .

In particular, $\mathbb{E}[\pi^M(\theta)]$ and $\Pi_A(s, \alpha)$ are the highest when $\alpha = 0$, in which case they both are equal to $\pi^M(\bar{\theta})$.²⁰ Therefore, a necessary condition for a merger to take place is

$$(6) \quad \pi^M(\bar{\theta}) \geq \pi^0.$$

Otherwise, firms always prefer competition to mergers and to sharing information.

When α increases, the probability of low synergies becomes higher and $\mathbb{E}[\pi^M(\theta)]$ and $\Pi_A(s, \alpha)$ decrease, with $\Pi_A(s, \alpha) > \mathbb{E}[\pi^M(\theta)]$ for $\alpha > 0$. In the limit case where $\alpha = 1$, (H3) and (H5) ensure that a merger is never profitable and firms always compete with π^0 .

At $\alpha_1 = \frac{\pi^M(\bar{\theta}) - \pi^0}{\pi^M(\bar{\theta}) - \pi^M(\underline{\theta})}$, firms are indifferent between merging under incomplete information and competing. Moreover, under condition (6), there exists α_2 , with $0 < \alpha_1 < \alpha_2 < 1$ such that firms share information before the merger if and only if $\alpha \leq \alpha_2$. When α is smaller than α_1 , sharing information dominates merging under incomplete information which constitutes the best outside option. In this case, information sharing allows firms to avoid mergers when low synergies exist. When $\alpha_1 < \alpha < \alpha_2$ sharing information dominates competition and will enable M&As to take place when synergies are high. When α is greater than α_2 , firms compete. Figure 2 illustrates these results.

²⁰When $\alpha = 0$, $\Pi_A(s, \alpha)$ is equal to $\pi^M(\bar{\theta}) - C(\cdot)$. The firms share all the data ($s^*(0) = 1$) and incur an exploration cost equal to $C(1)$, so that $\Pi_A(1)$ in this case is equal to $\pi^M(\bar{\theta})$.

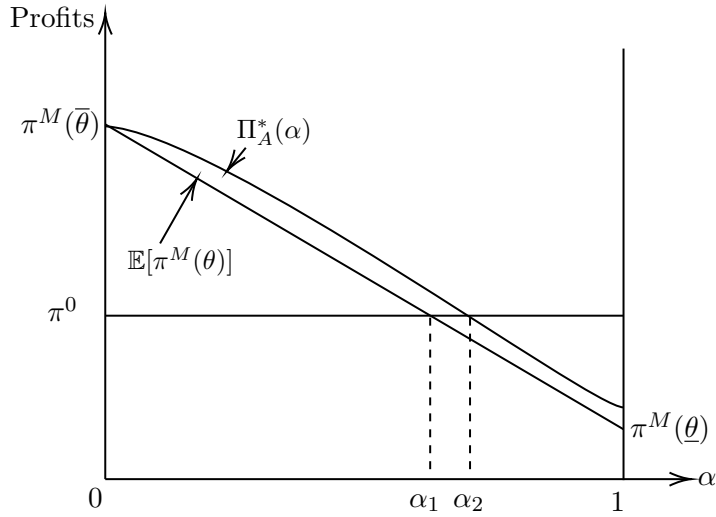


Figure 2: Equilibrium profits without regulation.

This intuition is formally established in the following proposition.

Proposition 2.

- (i) *There is information sharing only if $\pi^M(\bar{\theta}) \geq \pi^0$.*
- (ii) *Under this condition, there exist α_1 and α_2 , with $0 < \alpha_1 < \alpha_2 < 1$ such that:*
 - *information sharing happens if, and only if, $\alpha \leq \alpha_2$,*
 - *sharing prevents firms from merging when synergies are low if $\alpha \leq \alpha_1$ and allows mergers to occur when synergies are high if $\alpha \in (\alpha_1, \alpha_2]$.*

Proposition 2 shows that firms can benefit from information sharing even if they have an excellent estimate (α close to one or zero). In particular, when α is close to zero, sharing almost all data is the optimal strategy because the probability of firms competing is low (see (5)). While merging under incomplete information dominates competition when α is close to zero, sharing and exploring information gives the option not to merge when synergies are low at a small incremental cost for exploration (since an optimum $s^*(\alpha)$ is close to one in this case).

Information sharing also broadens the scope of profitable M&As, since it allows mergers to take place when $\alpha_1 < \alpha < \alpha_2$, while firms would rather compete if sharing was not possible. This result suggests that the number of efficient M&A deals should rise as pre-merger information-sharing practices are adopted by firms.

4 Information Sharing in the Shadow of a Regulator

We introduce a competition authority in charge of allowing or preventing M&As. This regulator clears M&As that strictly increase consumer surplus and blocks them otherwise.²¹

We analyze how the presence of the regulator impacts the firms' incentives to share information before the merger. We will show that firms may share less information when there is a regulator than in a laissez-faire situation. This is detrimental to consumers, and regulation can lower the surplus of consumers it is willing to protect. We then discuss regulatory options to correct this negative effect of merger control.

4.1 Consumer Surplus

Without sharing, CS^0 denotes consumer surplus when firms compete. When a portion s of data has been shared, and firms compete in state θ , consumer surplus will equal $CS^C(s, \theta)$. We assume that surplus under competition increases with s .

$$(H6) \quad \text{Consumer surplus: for all } (s, \theta), \frac{\partial CS^C(s, \theta)}{\partial s} \geq 0.$$

In the limit case where $s = 0$, consumers enjoy the baseline competitive surplus (which does not depend on the value of information synergies):

$$\forall \theta, CS^C(0, \theta) = CS^0.$$

Surplus after a M&A. A M&A will impact surplus by changing the competitiveness of the market and by allowing the merged firm to offer a product quality that depends on the synergies. We denote $CS^M(\theta)$ consumer surplus after a M&A, which is a function of the synergies θ . We assume that, compared to the baseline competitive surplus CS^0 , a M&A benefits consumers only when synergies are high and lowers their surplus otherwise:

$$(H7) \quad CS^M(\bar{\theta}) > CS^0 > CS^M(\underline{\theta}).$$

²¹A regulator could also include industry profits in its M&A decision. This could capture long-term considerations as the firms' profits today change their ability to invest in innovation, which will later on benefit consumers. Our qualitative results are robust to this type of alternative merger rule.

We will see in the next section that (H7) ensures some M&As will be accepted under incomplete information, while other M&As can be blocked by the regulator. Otherwise, either $CS^0 > CS^M(\bar{\theta})$ and all mergers are blocked, or $CS^M(\underline{\theta}) > CS^0$ and all mergers are cleared under incomplete information.

If firms have shared all information and synergies are high, we assume surplus is greater under competition than after a M&A. In this case, consumers benefit from the information synergies and the enhanced competition.

$$(H8) \quad CS^C(1, \bar{\theta}) > CS^M(\bar{\theta}).$$

Overall, these assumptions are consistent with a narrative where consumers benefit from better product quality when synergies are high and from a higher intensity of competition between firms when s increases.

4.2 Merger Control

When evaluating a M&A proposal, the regulator will compare surplus if the merger is cleared or blocked. The surplus gains from a merger depend on whether firms have shared information before the M&A and whether the synergies are known to the firms and the regulator. Let

$$G(s, \theta) := CS^M(\theta) - CS^C(s, \theta)$$

be the gain in consumer surplus from a M&A if firms share s and synergies are θ .

Merger control with information sharing. At the time the regulator evaluates a M&A, Firm 1 has already shared s with Firm 2. Hence, both firms know the value of θ . Firms request M&A approval if synergies are high, and the regulator can infer the value of θ from their request.²² Thus, the surplus gains after sharing do not depend on the value of α since firms ask for M&A approval only in case of high synergies.

The regulator clears a merger if $G(s, \bar{\theta})$ is non-negative. Assumption (H7) ensures that M&As are accepted if s is not too high. Moreover, (H8) implies that if firms share too

²²Alternatively, [Cosnita-Langlais and Tropeano \(2012\)](#) analyze how firms can signal the value of high synergies when they are unknown to the regulator.

much information, surplus under competition will be high, and the regulator will prefer to block a M&A. Hence, as $G(s, \bar{\theta})$ decreases with s , the regulator allows a M&A if

$$s \leq \hat{s}^A$$

where $\hat{s}^A \in [0, 1]$ is the lowest amount of information that satisfies $CS^C(\hat{s}^A, \bar{\theta}) = CS^M(\bar{\theta})$.

Merger control without information sharing. Without sharing, the firms and the regulator anticipate an expected gain from merging of:

$$(7) \quad \begin{aligned} \mathbb{E}[G(0, \theta)] &:= (1 - \alpha)G(0, \bar{\theta}) + \alpha G(0, \underline{\theta}) \\ &= (1 - \alpha)CS^M(\bar{\theta}) + \alpha CS^M(\underline{\theta}) - CS^0. \end{aligned}$$

and the regulator allows the merger if $\mathbb{E}[G(0, \theta)]$ is non-negative. This expression decreases with α under (H7): it is equal to $CS^M(\bar{\theta}) - CS^0 > 0$ when $\alpha = 0$, and to $CS^M(\underline{\theta}) - CS^0 < 0$ when $\alpha = 1$. Hence, there exists

$$(8) \quad \alpha^R = \frac{CS^M(\bar{\theta}) - CS^0}{CS^M(\bar{\theta}) - CS^M(\underline{\theta})} \in (0, 1)$$

such that mergers are accepted under incomplete information only when α is below α^R .

As shown in Proposition 2, a merger under incomplete information yields higher profits than competition when $\alpha \leq \alpha_1$. Hence, the maximum expected profits without sharing is

$$(9) \quad \Pi_{noshare}^R(\alpha) := \begin{cases} \mathbb{E}[\pi^M(\theta)] & \text{if } \alpha \leq \min\{\alpha^R, \alpha_1\} \\ \pi^0 & \text{if } \alpha > \min\{\alpha^R, \alpha_1\} \end{cases}$$

4.3 Equilibrium Strategies

When information is shared, the industry's expected profits depend on whether the regulator will accept or block the merger.

$$\Pi_A(s, \alpha) = (1 - \alpha)\pi^M(\bar{\theta}) + \alpha \pi^C(s, \underline{\theta}) - C(s), \quad \text{if the merger is \textbf{Approved},}$$

$$\Pi_B(s, \alpha) = (1 - \alpha)\pi^C(s, \bar{\theta}) + \alpha \pi^C(s, \underline{\theta}) - C(s), \quad \text{if the merger is \textbf{Blocked}.}$$

Let Σ be the set of information shared that induces the regulator to authorize a merger if synergies are high. (Since no regulatory oversight exists in the baseline model, $\Sigma = [0, 1]$.) When a regulator is focused on consumer surplus, $\Sigma := \{s : G(s, \bar{\theta}) \geq 0\}$, and we have shown there exists $\hat{s}^A \in [0, 1]$ such that $\Sigma = [0, \hat{s}^A]$. Let $s_A^*(\alpha) := \operatorname{argmax}_{s \in \Sigma} \Pi_A(s, \alpha)$ and $s_B^*(\alpha) := \operatorname{argmax}_{s \notin \Sigma} \Pi_B(s, \alpha)$.

If $s^*(\alpha) \in \Sigma$, regulation has no effect since firms choose $s_A^*(\alpha) = s^*(\alpha)$. However, if $s^*(\alpha) \notin \Sigma$ (i.e., $s^*(\alpha) > \hat{s}^A$), firms have two options. Either they follow a ‘‘puppy dog’’ strategy and share \hat{s}^A to induce the regulator to approve the merger. Or they concede the merger will be blocked and choose the best sharing consistent with no approval.

Overall, if firms choose to share information, they will induce a merger under high synergies if $\Pi_A(s_A^*(\alpha), \alpha) \geq \Pi_B(s_B^*(\alpha), \alpha)$. Let

$$\Pi_{share}^R(\alpha) := \max\{\Pi_A(s_A^*(\alpha), \alpha), \Pi_B(s_B^*(\alpha), \alpha)\}$$

be the maximum profits of the firms when they share information under a regulator. Then, there will be information sharing only if $\Pi_{share}^R(\alpha) \geq \Pi_{noshare}^R(\alpha)$.

As soon as the presence of the regulator forces firms to adapt their sharing strategies, they achieve lower profits and prefer to merge under incomplete information when α is small or to compete instead of sharing when α is close to α_2 . In these cases, regulation discourages firms from sharing, and they merge under incomplete information or compete without sharing instead.

Lemma 2. *Under regulation, there exist α_0 and α_2^R such that:*

- *firms merge under incomplete information instead of sharing when $\alpha \in [0, \alpha_0]$;*
- *firms compete instead of sharing when $\alpha \in [\alpha_2^R, \alpha_2]$, where $\alpha_2^R < \alpha_2$ when regulation is binding, i.e., when $s^*(\alpha_2) > \hat{s}^A$.*

The regulator may also block M&As under incomplete information but allow them after information has been shared. In this case, firms can convince the regulator of the benefits of a merger by sharing information and ask for a merger only if synergies are high.

Lemma 3. *There exists α^R such that firms can convince the regulator to allow the merger*

in case synergies are high by sharing information when $\alpha \in (\alpha^R, \alpha_2^R]$ (with $\alpha^R < \alpha_2^R$ if $\Pi_A^*(\alpha^R) \geq \pi^0$), while without sharing, the regulator would block a M&A.

Figure 3 below illustrates how regulation changes the firms' equilibrium strategies.²³

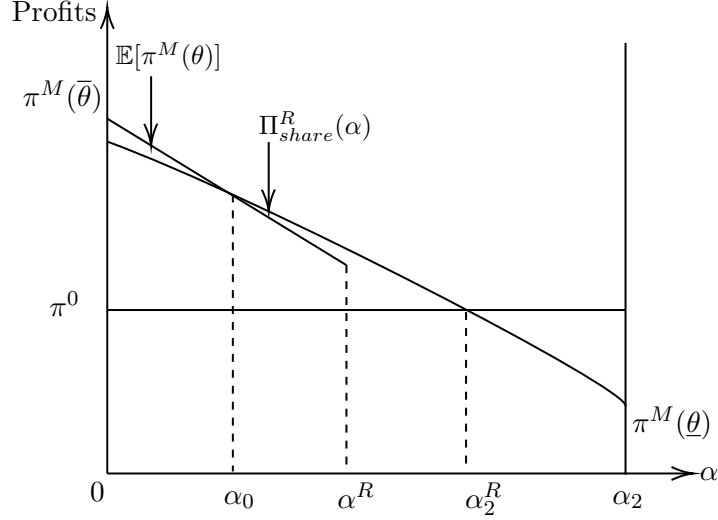


Figure 3: Equilibrium profits under regulation.

When firms share information, $\Pi_{share}^R(\alpha)$ depends on whether they share and merge or share and compete. For sharing and competing to be profitable, it must yield more profits than competing without sharing. This requires $\pi^C(s, \bar{\theta})$ to be greater than π^0 for some values of s . As $\pi^C(s, \bar{\theta})$ is quasi-concave, this necessary condition boils down to $\pi^C(1, \bar{\theta}) > \pi^0$.

In turn, the firms will prefer to share and merge or share and compete depending on the value of threshold \hat{s}^A above which mergers are blocked after information has been shared, which determines the value of profits $\Pi_A(s_A^*(\alpha), \alpha)$ and $\Pi_B(s_B^*(\alpha), \alpha)$.

Lemma 4. *Firms may share and compete only if $\pi^C(1, \bar{\theta}) > \pi^0$. Then, there exist α^B , $\alpha_2^B < \alpha_2$ and $\hat{s}^A(\alpha)$ such that sharing information and competing is the equilibrium strategy if and only if $\alpha \in (\alpha^B, \alpha_2^B)$ and $\hat{s}^A < \hat{s}^A(\alpha)$.*

Regulation will lower consumer surplus by reducing firms' incentives to share. This is because consumers value information sharing between firms: it intensifies competition while allowing Firm 2 to provide them with a higher utility. On the contrary, if firms

²³We focus on $\alpha < \alpha_2$, since otherwise, competing without sharing is the dominant strategy anyway and the presence of the regulator does not change the equilibrium outcome.

choose to share more information, anticipating that the merger will be blocked, merger control will benefit consumers.

Proposition 3.

Suppose the regulator authorizes a merger only if it increases consumer surplus.

- *If firms share information and request a merger, the amount of information shared and consumer surplus are smaller than in the absence of a regulator.*
- *If firms do not share information, the expected consumer surplus is smaller than in the absence of a regulator.*
- *If firms share information and the merger is blocked, the amount of information shared and consumer surplus are higher than in the absence of a regulator.*

By sharing less information, firms lower consumer surplus under competition and increase the surplus gain from M&A approval. The resulting impact on expected consumer surplus is, therefore, negative. This effect is the strongest when regulation ultimately discourages firms from sharing, such that they either merge under incomplete information or compete instead of sharing. Since firms are constrained in their sharing strategies, the presence of the regulator also reduces the industry's profits. This implies that in these cases, no-regulation Pareto dominates a situation where a regulator is willing to protect consumers through merger control.

Regulation can benefit consumers by increasing firms' incentives to share information when they know a merger will be blocked anyway. On the one hand, more information shared increases consumers' surplus when firms compete. On the other hand, the regulator blocks the merger precisely in cases where competition yields a higher surplus. For both reasons, regulation benefits consumers when the regulator blocks the merger after sharing.

4.4 Optimal Regulation

We consider different regulatory tools recently discussed or implemented in the case of data-driven mergers, and we analyze their impacts on the firm's strategies and consumers. We analyze successively variations in the strength of merger control, mandated data sharing rules, and data silos.

4.4.1 Merger Control Stringency

A regulator can be more or less lenient when considering the required surplus gain to allow a merger. Starting from a strict consumer surplus evaluation, a regulator may allow mergers that yield a slightly lower consumer surplus than competition. (This is implicitly the case in horizontal merger guidelines where the price level approximates consumer surplus, and mergers are approved when the anticipated increase in the Herfindhal index due to the merger is small.)²⁴ Conversely, a regulator may be cautious and only allow M&As that increase surplus above a certain threshold. This begs the question of the “optimal degree of stringency” in such an environment.

To model this, assume $r \in \mathbb{R}$ such that a merger is approved when the gain $G + r$ is non-negative. (A lenient regulation has r positive, while a stringent one has r negative.) That is, $G(s, \bar{\theta}) + r \geq 0$ when firms share and explore, or $\mathbb{E}[G(0, \theta)] + r \geq 0$ when firms do not share information.

As r increases, the set $\Sigma(r) := \{s : G(s, \bar{\theta}) + r \geq 0\}$ and the equilibrium bound $\alpha^R(r)$ also increase, making mergers under incomplete information more frequent.

When firms share information, condition $G(s, \bar{\theta}) \geq -r$ affects the decision to share and merge vs. share and compete, and $\Pi_{share}^R(\alpha)$ decreases with r . If firms share $s_A^*(\alpha)$, a decrease in r lowers consumer surplus by reducing data sharing by the firms.

By continuity or $\Pi_{share}^R(\alpha)$, there exists a value r_0 such that firms prefer to share and have the merger blocked if and only if $r < r_0$. Hence, if r becomes smaller than r_0 , a more stringent regulation benefits consumers by inducing firms to share more information and compete regardless of the value of synergies.

Firms may also not share information because of regulation. In line with our previous analysis, there exist thresholds $\alpha_0(r)$ (increasing with r) above which $\Pi_{share}^R(\alpha) > \mathbb{E}[\pi^M(\theta)]$, and $\alpha_2^R(r)$ (decreasing with r) above which $\pi^0 > \Pi_{share}^R(\alpha)$.

Firms will not share either when $\alpha < \alpha_0(r)$, and firms merge under incomplete information, or when $\alpha \in [\alpha_2^R(r), \alpha_2]$, and firms compete without sharing. There, the regulator can increase consumer surplus by setting r high enough for mergers to be accepted with $s^*(\alpha)$,

²⁴Alternatively, the regulator could internalize the long-term effects of mergers on innovation.

such that firms benefit from sharing. We illustrate this result in the quality competition model analyzed in the Appendix.

Overall, because regulation has an ambiguous impact on the sharing strategies of the firms and on consumer surplus, variation in regulation stringency will also change consumer surplus ambiguously depending on the impact on sharing. There is no one-size-fits-all degree of stringency, and the choice of the regulator requires knowing the value of α . In the next section, we analyze an alternative regulatory tool allowing the regulator to directly control the amount of data shared by the firms.

4.4.2 Mandated Data Sharing

The negative impacts of merger control on consumer surplus come from changes in the firms' incentives to share information in the presence of the regulator. In this section, we analyze the possibility for the regulator to control this amount of information shared. The regulator anticipates how mandating data sharing will impact the competitive profits of the firms and consumer surplus and how it will determine its further decision to accept or block the M&A if synergies are high. Hence, the regulator will choose $s_A \in \Sigma$ to maximize $\mathbb{E}[CS(s_A)]$ if it anticipates that it will allow the merger if synergies are high, with

$$\mathbb{E}[CS(s_A)] := (1 - \alpha)CS^M(\bar{\theta}) + \alpha CS^C(s_A, \underline{\theta}).$$

If the regulator anticipates that it will block the merger, it will mandate the sharing of $s_B \notin \Sigma$ to maximize $\mathbb{E}[CS(s_B)]$, where

$$\mathbb{E}[CS(s_B)] := (1 - \alpha)CS^C(s_B, \bar{\theta}) + \alpha CS^C(s_B, \underline{\theta}).$$

A direct consequence of the authority having control over the information shared by the firms is that it can avoid the surplus losses resulting from changes in the amounts of information shared by firms in the presence of regulatory oversight. Indeed, the regulator can choose s to maximize the expected surplus. Because the regulator focuses on consumers, it maximizes their surplus using mandated data-sharing policies, forcing firms to share an amount $s = 1$ of information.

Proposition 4. *Regulatory oversight, merger control, and a mandated data-sharing policy yield a greater consumer surplus than a laissez-faire situation. Full data sharing is surplus maximizing despite potential industry losses if the regulator is sufficiently oriented toward protecting consumers.*

These types of mandated data-sharing rules have recently been enacted, such as in the Data Act in Europe.²⁵ Our analysis suggests that they can complement merger control when firms are willing to engage in data-driven M&As.

4.4.3 Merger Remedy: Data Silos

In recent flagship M&As such as Facebook/WhatsApp and Google/Fitbit, the European Commission implemented a new type of merger remedy, allowing the M&As to go through but preventing the combination of data sources from the merging parties (Krämer and Shekhar, 2024). The rationale behind such data silos is to allow for the positive effects of a merger unrelated to data, such as efficiency gains or the complementarity of the companies' patent portfolios, while preventing potential negative data-driven effects. The latter usually relate to privacy issues and increased market power resulting from the merger of data sources.

We consider such data silos and analyze whether they increase or decrease the willingness of companies to share their data. We introduce an exogenous probability γ under which the data sources of firms cannot be merged in case the M&A goes through and the merging firm cannot fully benefit from the resulting synergies. Consequently, a M&A with data silos is motivated only by reduced competition, and $\pi^M(s, \bar{\theta})$ are the profits after the merger when data silos are requested, and s information has been shared. We make the natural assumption that these profits increase with s : $\frac{\partial \pi^M(s, \bar{\theta})}{\partial s} > 0$.

If synergies are high, with probability $(1 - \gamma)$ firms merge and make a profit equal to $\pi^M(\bar{\theta})$; with probability γ , firms merge, but data remain separate, and the only synergies that take place are those resulting from the data shared before the M&A, yielding industry profits equal to $\pi^M(s, \bar{\theta})$. Therefore, Firm 2 is still interested in acquiring Firm 1 in the case of high synergies. Hence, the expected gains of Firm 2, denoted by u_2^{silo} , are equal

²⁵Data Act, December 22, 2023.

to:

$$\begin{aligned}
 (10) \quad u_2^{silo}(s, \alpha) &= (1 - \alpha) \left[\underbrace{(1 - \gamma)\pi^M(\bar{\theta})}_{\text{Profits if M\&A without silos}} + \underbrace{\gamma \pi^M(s, \bar{\theta})}_{\text{Profits if silos requested}} \right] + \alpha \pi^C(s, \underline{\theta}) - \pi^0 - C(s) \\
 &= \Pi_A(s, \alpha) - (1 - \alpha)\gamma [\pi^M(\bar{\theta}) - \pi^M(s, \bar{\theta})]
 \end{aligned}$$

The main lesson here is that data silos increase the incentives of Firm 2 to acquire information because $\pi^M(s, \bar{\theta})$ increases with s . While the firms' incentive to share information increases, their expected payoff decreases when the probability of a silo remedy increases.

Proposition 5. *A data-silo remedy increases information sharing.*

5 Extensions

In this section, we consider several extensions of the baseline model. As in the basic model, we do not explicitly introduce a regulator in these extensions, but it should be clear that the qualitative effects identified in Section 4 will be similar.²⁶ In Section 5.1, we first consider the equilibrium when Firm 2 learns the value of θ privately. We then analyze Nash bargaining on the final value of the M&A in Section 5.2.

5.1 Asymmetric Learning of Synergies

In the primary analysis, we assume that Firm 1 and the regulator will learn the value of synergies when Firm 2 explores the data. However, Firm 2 can also explore the data privately and then report the value of the synergies. We analyze the possibility of learning synergies privately, showing that it does not impact information sharing and M&A decisions. The intuition is that for Firm 1 to accept the M&A, Firm 2 must offer a higher price when it has private information, increasing the expected payoff of Firm 1 when sharing information. This change will fully translate into a lower cost of information. Therefore, the expected return of Firm 2 when acquiring data from Firm 1 will equal the expected payoff with public learning of synergies. Hence, companies approach the regulator only when synergies are high and there is no information asymmetry.

²⁶This also corresponds to lenient regulation analyzed in Section 4.4.1, which we have shown may be chosen by the regulator to increase consumer surplus.

Consider the situation where, after having acquired s and invested $C(s)$, Firm 2 learns θ privately. As usual, there are three candidates for pure strategy equilibrium by Firm 2: pooling and not offering a M&A, pooling and offering a M&A, and separating by offering a M&A only when synergies are high, equivalent to an excluding equilibrium. However, pooling equilibria are not sustainable as Firm 2 is not interested in acquiring Firm 1 when synergies are low. We will, therefore, focus on the separating equilibrium.

Let $p(s)$ be the price offered by Firm 2 for the M&A when synergies are high and information sharing is s . When synergies are low, Firm 2 does not make an offer to Firm 1. Firm 2 can deviate from the separating strategy in one of two ways.

A first deviation is not to offer a M&A when synergies are high. Firm 2 obtains $\pi_2(s, \bar{\theta})$ in this case. Therefore, deviation is not profitable if $\pi^M(\bar{\theta}) - p(s) \geq \pi_2(s, \bar{\theta})$.

A second deviation is to offer price $p(s)$ when synergies are low. In this case, Firm 1 believes synergies are high and accepts the M&A when $p(s)$ exceeds the payoff $\pi_1^C(s, \bar{\theta})$.

A separating strategy is incentive-compatible when the acquisition price satisfies the inequality.

$$\pi^M(\bar{\theta}) - \pi_2^C(s, \bar{\theta}) \geq p(s) \geq \pi_1^C(s, \bar{\theta}).$$

Firm 2 maximizes profits by choosing the lowest price that satisfies incentive compatibility, equal to $\pi_1^C(s, \bar{\theta})$. Therefore, Firm 1's continuation payoff equals $\pi_1^C(s, \underline{\theta})$ when synergies are low and $\pi_1^C(s, \bar{\theta})$ when synergies are high. Hence, the equilibrium level of information shared is identical to the baseline model with symmetric information about θ .

5.2 Nash Bargaining

The ability of firms to contract on s may be limited. For instance, if s is observable by the parties but not contractible, ex-ante transfers $T(s)$ are not incentive-compatible. By contrast, M&A decisions are contractible, and the parties can make transfers contingent on the M&A. If Firm 2 has full bargaining power at the time of a M&A decision, Firm 1 will prefer not to share information rather than share and induce Firm 2 to explore. Indeed, in the case of low synergies, Firm 1 will get $\pi_1^C(s, \underline{\theta})$ while in case of high synergy, there is a merger, but Firm 1 will get its outside option $\pi_1^C(s, \bar{\theta})$. By [H2](#), the expected value of $\pi_1^C(s, \theta)$ is inferior to π_1^0 , and Firm 1 prefers not to share information. Hence,

there can be information sharing when monetary contracts $T(s)$ are not feasible only if Firm 1 has a stake in the returns of a M&A.

In this extension, we assume that the spoils of a M&A are shared following the cooperative Nash bargaining solution. Firm 1 has a bargaining power weighted by $\mu \in [0, 1]$, while Firm 2 has a power weighted by $1 - \mu$. To simplify the exposition, we assume that α is large enough so that $\mathbb{E}[\pi^M(\theta)] - \pi^0$ is negative. Hence, if Firm 2 does not explore, there is competition, and payoffs are π_i^0 . In turn, anticipated payoffs following no exploration are independent of s :

$$\forall s, i = 1, 2, u_i(s, \alpha; noexpl) := \pi_i^0.$$

By contrast, if there is exploration, Firm 2 bears a cost of $C(s)$ before learning synergies. There is competition with low synergies and accompanying payoffs $\pi^C(s, \underline{\theta})$ and there is a merger following high synergies, the surplus from the merger $\pi^M(\bar{\theta}) - \pi^C(s, \bar{\theta})$ being shared via Nash bargaining.

$$\begin{aligned} u_1(s, \alpha; expl) &:= \mathbb{E}[\pi_1^C(s, \theta)] + (1 - \alpha)\mu(\pi^M(\bar{\theta}) - \pi^C(s, \bar{\theta})) \\ u_2(s, \alpha; expl) &:= \mathbb{E}[\pi_2^C(s, \theta)] + (1 - \alpha)(1 - \mu)(\pi^M(\bar{\theta}) - \pi^C(s, \bar{\theta})) - C(s). \end{aligned}$$

By the Arrow condition [H2](#), $u_1(s, \alpha; expl)$ is a decreasing function of s while $u_2(s, \alpha; expl)$ is an increasing function of s . There is exploration only if $u_2(s, \alpha; expl) \geq u_2(s, \alpha; noexpl)$, or

$$(11) \quad C(s) \leq \mathbb{E}[\pi_2^C(s, \theta)] - \pi_2^0 + (1 - \alpha)(1 - \mu)(\pi^M(\bar{\theta}) - \pi^C(s, \bar{\theta})).$$

By the Arrow condition and the Inada condition [H1](#), the condition fails at $s = 0$. On the other hand, the condition is satisfied at $s = 1$ by [H2](#), and as we have assumed $C(1) = 0$. Moreover, as $u_2(s, \alpha; expl)$ increases with s , there exists a unique cutoff $\underline{s} \in (0, 1)$ such that Firm 2 explores if, and only if, s is greater than \underline{s} (see section [D](#) in the appendix for an illustration of this possibility).

Firm 1 will benefit from sharing s only if there is an exploration by Firm 2 and if $u_1(s, \alpha; expl)$ is greater than π_1^0 . Because $u_1(s, \alpha; expl)$ is a decreasing function of s , a

necessary and sufficient condition for information sharing and exploration under Nash bargaining is that s is smaller than a cutoff value $\bar{s} \in [0, 1]$. There can be information sharing and exploration only if $\bar{s} \geq \underline{s}$.

By H2 and the implicit function theorem, both cutoff values \bar{s} and \underline{s} in (11) are increasing functions of μ : as Firm 2 has less bargaining power, it will be incentivized to explore for larger values of s to compensate for the lower payoff under exploration. As for Firm 1, a larger value of μ will make it more willing to share information because Firm 1 can recoup the competition loss when there is a merger.

6 Implications and Discussion

6.1 Strategic Implications

Our results have implications for managers of digital companies willing to acquire new data-driven targets and for data-driven firms that could be potentially acquired. Indeed, a data-driven merger always comes with uncertainty over the synergistic value of different data sets. While companies such as Google and Facebook have reasonable estimations of the type of data owned by other digital firms, they cannot anticipate perfectly the synergies that will result from a merger between their data and those of another firm without effectively crunching these data together.²⁷

Therefore, our first normative result is that learning the value of synergies can be a more profitable strategy than merging under incomplete information and that it will be if merger control is non-binding. This implies that due diligence in data-driven M&A should include a precise assessment of the data sets and data sources of potential targets. This is a precondition if Firm 2 wants to acquire a share s of the information of Firm 1 against a lump sum transfer $T(s)$,²⁸ which requires Firm 2 to know the total stock of data owned by Firm 1 or at least to have a reasonable estimation of this amount of information.²⁹

²⁷The recent example of Unity highlights the potential losses that may result from misestimating the value of data sources: Unity lost 110 million USD in 2022 after training AI algorithms on bad-quality data accessed through a client and integrated into its own data sets ([The Impact of Bad Data and Why Observability is Now Imperative, IBM, June 2, 2022.](#))

²⁸This type of transfer is commonly used in the literature on information sharing between firms ([Chen et al., 2001; Liu and Serfes, 2006; Choe et al., 2024.](#))

²⁹In practice, side payments to acquire another firm's data occur routinely in data marketplaces ([Spiekermann, 2019](#)). In particular, [Scaria et al. \(2018\)](#) assesses data sharing between firms in various industries and shows how side payments for data acquisition have become common.

Managerial Insight 1. *A prospective buyer should assess the amount of data a potential target owns to ensure that contracting over data sharing is feasible.*

This assessment could come at negligible costs since digital firms regularly disclose their number of users and for which data protection laws require consumers' consent before collecting their data. For instance, a mobile application must ask for consumer approval before accessing specific sources of information, such as the microphone, camera, or specific folders, and before collecting the related data (Kesler, Kummer and Schulte, 2020; Affeldt and Kesler, 2021). This is indeed illustrated by major data-driven acquisitions. For instance, Facebook had a good idea of the size of the consumer base of WhatsApp and Instagram and of the type of data collected by the social media before initiating the M&As.³⁰

Once data sharing has occurred, a follow-up result is that Firm 2 should explore this data to learn its synergistic value. The resulting inference cost and competitive loss are indeed dominated by the efficiency gains from the M&A as long as merger control is not too stringent. In the current state of merger control in Europe and in the US, almost all mergers are allowed by competition authorities (Kwoka and Valletti, 2021). In such a case, firms should never merge under incomplete information, even if they are almost certain that synergies will be high and the merger will be profitable.

Managerial Insight 2. *When merger control is lenient, firms should share data before proceeding with a M&A to learn the synergistic value of their data sets and should not merge under incomplete information.*

In case a prospective buyer cannot assess the size and quality of the data of a potential target,³¹ data sharing can occur without side payments and without the need for a contract over the amount of information shared when firms share the spoils from a merger, according to a cooperative Nash bargaining game. This requires the potential target to have at least some bargaining power over the acquirer, such that it also benefits from part of the merger gains, as we show in Section 5.2.

³⁰See [In One Chart, Here's Why Facebook Is Blowing \\$19 Billion On WhatsApp](#). Forbes, February 19, 2014.

³¹The acquisition of Twitter and the revelation that the firm has provided incorrect numbers about the extent of fake accounts highlights the difficulties of an acquirer to correctly evaluate the value of the data asset of another firm. ([Elon Musk puts Twitter deal on hold over fake account details](#), May 13, 2022.)

Managerial Insight 3. *A firm having a stake in a potential M&A can induce a larger competitor to engage in the M&A by sharing some of its data, prompting the larger firm to explore the data and assess its synergistic value.*

Finally, firms can influence the decision of a competition authority by sharing more or less information. We have even characterized cases where a M&A would not go through under incomplete information but is accepted by a regulator if firms share information.

Managerial Insight 4. *Information sharing and exploration can allow firms to convince a regulator that synergies are high when they engage in merger proceedings.*

6.2 Policy Implications

There is also a growing debate among academics and policymakers on regulating information-sharing practices among firms and how they can impact market competition ([Jullien and Sand-Zantman, 2021](#); [Bhargava et al., 2024](#)).

We highlight a new source of surplus gains that competition authorities should consider when making merger approval decisions by eliciting a novel rationale for pro-competitive information sharing among market competitors. Ignoring these practices can induce social inefficiencies directly resulting from regulators' willingness to protect consumer surplus.

Policy Insight 1. *Classical merger control that ignores information-sharing practices among firms can reduce consumer surplus. An efficient regulation combines merger control with mandated data-sharing rules.*

Mandated data sharing regulations have already been implemented to promote the competitiveness of digital markets, as discussed in Section 4.4.2, and as merger remedies in the Thomson/Reuters case.³² The novelty of our recommendation is to enforce mandated data-sharing rules in situations where firms are willing to merge and would like to learn the value of synergies before doing so but prefer to share little information before the merger or to merge under incomplete information to maximize their chances to have the merger approved. If a regulator can observe whether data has been shared in the due diligence process, it could assess whether mandated data-sharing rules are required to force firms

³²Case No COMP/M.4726 - Thomson Corporation/Reuters Group.

to learn the value of synergies before the merger and make better M&A decisions. Our analysis has shown that doing so can enhance surplus.

Finally, by showcasing how firms can use data exchanges to anticipate the value of synergies, our analysis suggests that recent mandated data-sharing rules can foster more competitive markets and encourage firms to better anticipate the synergistic value of information in case of a merger. Indeed, in our model, once information has been shared, a firm benefits from exploring and using it. This implies that learning naturally follows information sharing, even when it results from mandated data-sharing regulations. Hence, while firms would not have engaged in data-sharing practices without data-sharing rules, they can benefit from exploring the data they can request from their competitor. This implies that these new types of data regulations can also improve merger efficiency to benefit firms and consumers.

Policy Insight 2. *Mandated data-sharing rules can induce firms to explore potential targets' data and learn their synergistic value, leading to more efficient merger decisions and higher consumer surplus.*

7 Conclusion

We have analyzed an environment in which the motive for information sharing is to facilitate the discovery of synergies and improve merger decisions. Our analysis provides prospective results that may help managers adapt their practices to better anticipate information synergies – especially with the wide implementation of AI in information systems – and help regulators optimize their merger rules. Our results also beg the question of whether pre-merger data-sharing practices are adopted by digital firms. To assess whether this motive for information sharing is at play, empirical researchers and regulators should identify an increase in the amount of data exchanged and used by competing firms before the merger process.

Firms can share information in different ways. Our analysis has shown that because of the risks of expropriation, information sharing may require a contract and a money transfer. Hence, a convenient way to share data is through data marketplaces, which enable contracts between sellers and buyers of large data sets. Information on the transactions on

these data marketplaces would help assess whether digital firms are adopting pre-merger information-sharing practices.

But, as highlighted by our cooperative Nash bargaining analysis, firms may also share information without contracting and money transfer, as long as the potential target has some bargaining power, and thus has a stake in the final value of the M&A. In this case, a simple way for firms to share data is through virtual data rooms that are commonly used in due diligence processes.³³ Under Article 23 of the Digital Markets Act recently implemented in Europe,³⁴ members of the European Commission have a right of inspection under which they could request access to the information held by large gatekeepers such as Google and Facebook and, in particular, verify whether they owned data from firms they acquired before the acquisition occurred.

Our model can be built upon to explore further research directions. First, we have ignored the possibility of divestment for the firms in case they merge under incomplete information and low synergies. The possibility of resale after an inefficient merger can impact the firms' incentives to merge and their willingness to share information. Secondly, our analysis focuses on one competition stage where the shared data is useful for a competitor. Yet data can be long- and short-lived and useful only for a certain time. The impact of short-lived data on the firms' decision to share and merger efficiency is an important question that remains to be explored. Thirdly, in our setting, firms can perfectly anticipate the decision of the regulator. Yet some mergers are blocked, raising the question of ex-ante uncertainty over the regulator's decision and how it impacts market equilibrium.

Finally, because learning the level of synergies yields more efficient M&As decisions, information sharing can impact firms' willingness to merge and thus market concentration, innovation, and consumer surplus. In particular, the number of merger failures should decrease if data-driven companies can better anticipate the efficiency of a M&A. The identification of these causal links is a topic for further research.

³³The Importance Of Online Data Rooms In Mergers And Acquisitions. *Forbes*, August 15, 2016

³⁴See *The Digital Markets Act: ensuring fair and open digital markets*, European Commission, last accessed October 10, 2024.

References

- Affeldt, P. and Kesler, R. (2021), ‘Big tech acquisitions—towards empirical evidence’, *Journal of European Competition Law & Practice* **12**(6), 471–478.
- Anton, J. J. and Yao, D. A. (2002), ‘The sale of ideas: Strategic disclosure, property rights, and contracting’, *The Review of Economic Studies* **69**(3), 513–531.
- Arrow, K. J. (1972), Economic welfare and the allocation of resources for invention, in ‘The Rate and Direction of Inventive Activity’, Princeton University Press, pp. 609–626.
- Bhargava, H., Dubus, A., Ronayne, D. and Shekhar, S. (2024), ‘The strategic value of data sharing in interdependent markets’.
- Bounie, D., Dubus, A. and Waelbroeck, P. (2023), ‘Competition between strategic data intermediaries with implications for merger policy’.
- Chen, Y., Narasimhan, C. and Zhang, Z. J. (2001), ‘Individual marketing with imperfect targetability’, *Marketing Science* **20**(1), 23–41.
- Chen, Z., Choe, C., Cong, J. and Matsushima, N. (2022), ‘Data-driven mergers and personalization’, *The RAND Journal of Economics* **53**(1), 3–31.
- Choe, C., Cong, J. and Wang, C. (2024), ‘Softening competition through unilateral sharing of customer data’, *Management Science* **70**(1), 526–543.
- Cosnita-Langlais, A. and Tropeano, J.-P. (2012), ‘Do remedies affect the efficiency defense? an optimal merger-control analysis’, *International Journal of Industrial Organization* **30**(1), 58–66.
- Crémer, J., de Montjoye, Y.-A. and Schweitzer, H. (2019), ‘Competition policy for the digital era’, *Report for the European Commission* .
- d’Aspremont, C., Bhattacharya, S. and Gérard-Varet, L.-A. (2000), ‘Bargaining and sharing innovative knowledge’, *The Review of Economic Studies* **67**(2), 255–271.
- de Cornière, A. and Taylor, G. (2024a), ‘Data-driven mergers’, *Management Science*, *forthcoming* .

- de Cornière, A. and Taylor, G. (2024b), ‘Data and competition: A simple framework’, *RAND Journal of Economics*, *forthcoming* .
- Feasey, R. and de Streel, A. (2020), *Data sharing for digital markets contestability: Towards a governance framework*, Centre on Regulation in Europe asbl (CERRE).
- Gautier, A. and Lamesch, J. (2021), ‘Mergers in the digital economy’, *Information Economics and Policy* **54**, 100890.
- Gautier, A. and Maitry, R. (2024), ‘Big tech acquisitions and product discontinuation’, *Journal of Competition Law & Economics* p. nhae010.
- Hörner, J. and Skrzypacz, A. (2016), ‘Selling information’, *Journal of Political Economy* **124**(6), 1515–1562.
- Jones, C. I. and Tonetti, C. (2020), ‘Nonrivalry and the economics of data’, *American Economic Review* **110**(9), 2819–58.
- Jullien, B. and Sand-Zantman, W. (2021), ‘The economics of platforms: A theory guide for competition policy’, *Information Economics and Policy* **54**, 100880.
- Kesler, R., Kummer, M. and Schulte, P. (2020), Competition and privacy in online markets: Evidence from the mobile app industry, *in* ‘Academy of Management Proceedings’, Academy of Management Briarcliff Manor, NY 10510, p. 20978.
- Krämer, J. and Shekhar, S. (2024), ‘Regulating algorithmic learning in digital platform ecosystems through data sharing and data siloing: Consequences for innovation and welfare’, *MIS quarterly* .
- Kwoka, J. and Valletti, T. (2021), ‘Unscrambling the eggs: breaking up consummated mergers and dominant firms’, *Industrial and Corporate Change* **30**(5), 1286–1306.
- Liu, Q. and Serfes, K. (2006), ‘Customer information sharing among rival firms’, *European Economic Review* **50**(6), 1571–1600.
- Neiswanger, W. and Xing, E. (2017), Post-inference prior swapping, *in* ‘International Conference on Machine Learning’, PMLR, pp. 2594–2602.

- Scaria, E., Berghmans, A., Pont, M., Arnaut, C. and Leconte, S. (2018), *Study on data sharing between companies in Europe – Final report*, Publications Office.
- Shapiro, C. and Varian, H. (1998), *Information rules: A strategic guide to the network economy*, Harvard Business Press.
- Spiekermann, M. (2019), ‘Data marketplaces: Trends and monetisation of data goods’, *Intereconomics* **54**(4), 208–216.
- Tirole, J. (2023), ‘Competition and the industrial challenge for the digital age’, *Annual Review of Economics* **15**, 573–605.
- Weber, R. A. and Camerer, C. F. (2003), ‘Cultural conflict and merger failure: An experimental approach’, *Management science* **49**(4), 400–415.
- Wu, L., Hitt, L. and Lou, B. (2020), ‘Data analytics, innovation, and firm productivity’, *Management Science* **66**(5), 2017–2039.

A Proof of Lemmas 2, 3, and 4

Firms merge under incomplete information instead of sharing. When α is close to zero, a M&A is accepted under incomplete information. On the contrary, firms are constrained on their sharing strategy: the optimal amount of information shared without the regulator when α equals zero is $s^*(0) = 1$ (see (5)), but the regulator blocks a M&A in this case since $G(1, \bar{\theta}) = CS^M(\bar{\theta}) - CSC(1, \bar{\theta})$ is below zero (see (H8)). Hence, for small values of α , the presence of the regulator lowers the firms’ profits with sharing, but not those if they merge under incomplete information.

Since in the absence of regulation, the firms’ profits for a M&A under incomplete information are arbitrarily close to those with information sharing, firms prefer to merge under incomplete information instead of sharing when there is a regulator for small values of α . In this case, regulation discourages firms from sharing.

Formally, there exists $\alpha_0 \in (0, 1]$ such that firms prefer to merge under incomplete information instead of sharing when there is a regulator for α below α_0 .

Firms cannot merge under incomplete information but merge after sharing.

Consider now the decision of the regulator to allow a M&A under incomplete information. We have shown that M&As are cleared under incomplete information when α is below $\alpha^R = \frac{CS^M(\bar{\theta}) - CS^0}{CS^M(\bar{\theta}) - CS^M(\underline{\theta})}$. For CS^0 sufficiently close to $CS^M(\bar{\theta})$, this threshold is lower than α_1 , and mergers under incomplete information are blocked by the regulator when $\alpha \in [\alpha^R, \alpha_1)$, even though they are more profitable than competing for the firms.³⁵

In this case, firms can still induce the regulator to allow the M&A by sharing information. Indeed, if $s^*(\alpha^R)$ is smaller than \hat{s}^A , firms share $s^*(\alpha^R)$ information and the merger is approved when synergies are high. If $s^*(\alpha^R)$ is greater than \hat{s}^A , firms share information and merge with high synergies if

$$\Pi_A(\hat{s}^A, \alpha^R) = (1 - \alpha^R)\pi^M(\bar{\theta}) + \alpha^R \pi^C(\hat{s}^A, \underline{\theta}) - C(\hat{s}^A) \geq \pi^0.$$

In other words, when $\alpha \in [\alpha^R, \alpha_1)$ the firms can ensure that a M&A takes place when synergies are high by exploring the data as long as $\Pi_A(s_A^*(\alpha), \alpha) \geq \pi^0$. This implies that the surplus gains from a M&A will be high too.

Firms compete instead of sharing. When α is close to α_2 , the profits after sharing without regulation are close to π^0 . If a M&A with information sharing is blocked at α_2 , firms can induce the regulator to accept the merger by sharing $\hat{s}^A < s^*(\alpha_2)$, but doing so lowers their profits below π^0 . Hence, by exerting a constraint on the strategies of the firms, the regulator can also induce them not to share information and to compete instead.

Formally, when $G(s^*(\alpha_2), \bar{\theta}) \leq 0$, there exists $\alpha_2^R < \alpha_2$ such that firms prefer to compete instead of sharing when there is a regulator for $\alpha \in [\alpha_2^R, \alpha_2)$.

Sharing and competing can be the firms' equilibrium strategy when it yields greater profits than (i) merging under incomplete information; (ii) sharing and have the M&A accepted; (iii) and than competing without sharing.

Sharing and competing vs. merging under incomplete information. Sharing and competing will yield higher profits than a merger under incomplete information

³⁵In terms of primitives, we have $\alpha^R < \alpha_1$ when $\frac{CS^M(\bar{\theta}) - CS^0}{CS^M(\bar{\theta}) - CS^M(\underline{\theta})} < \frac{\pi^M(\bar{\theta}) - \pi^0}{\pi^M(\bar{\theta}) - \pi^M(\underline{\theta})}$.

if $\Pi_B(s_B^*(\alpha), \alpha)$ is greater than $\mathbb{E}[\pi^M(\theta)]$. Consider the difference between both profit functions:

$$\Pi_B(s, \alpha) - \mathbb{E}[\pi^M(\theta)] = (1 - \alpha) \underbrace{(\pi^C(s, \bar{\theta}) - \pi^M(\bar{\theta}))}_{<0 \text{ (H5)}} + \alpha \underbrace{(\pi^C(s, \underline{\theta}) - \pi^M(\underline{\theta}))}_{>0 \text{ (H5)}} - C(s)$$

For $s = 1$, the exploration cost equals zero, and this difference is positive for α greater than a threshold α^B . Hence, this difference will also be positive for $s_B^*(\alpha)$ information shared in this case. This implies that sharing and competing yields higher profits than merging under incomplete information for α high enough.

Sharing and competing vs. sharing and merging when synergies are high.

$\Pi_B(s_B^*(\alpha), \alpha)$ will be greater than $\Pi_A(\hat{s}^A, \alpha)$ if \hat{s}^A is small enough. Indeed, for $\hat{s}^A = 1$ all mergers are accepted under high synergies as $s^*(\alpha) \leq \hat{s}^A$. On the contrary, sharing \hat{s}^A is not a profitable strategy when it is close to zero since the exploration cost will be prohibitively high. Hence, for any value of α , there exists $\hat{s}^A(\alpha)$ such that $\Pi_A(\hat{s}^A(\alpha), \alpha) = \Pi_B(s_B^*(\alpha), \alpha)$ if $s_B^*(\alpha) > \hat{s}^A(\alpha)$. The existence of $\hat{s}^A(\alpha)$ is guaranteed since the value of \hat{s}^A is determined by the relation $CS^C(\hat{s}^A, \bar{\theta}) = CS^M(\bar{\theta})$, where $CS^M(\bar{\theta})$ can take any value as long as conditions (H7) and (H8) are satisfied.

Thus, when $\hat{s}^A \leq \hat{s}^A(\alpha)$, regulation exerts a strong constraint on the strategies of the firms, up to a point where sharing and having the M&A blocked is more profitable for the firms than sharing less information to have the M&A accepted. This strong regulatory constraint results from a sharp increase of consumer surplus with s when firms compete, such that firms must share few information, otherwise a M&A will necessarily be detrimental to consumers and will be blocked by the regulator.

Competing vs. sharing and competing.

Consider $\alpha \in (\alpha^B, \alpha_2)$ and $\hat{s}^A < \hat{s}^A(\alpha)$ defined above, such that sharing and competing dominates sharing and merging, and mergers under incomplete information are blocked. In this case, sharing s and competing can also be more profitable than competing without sharing if the following difference is positive.

$$\Pi_B(s, \alpha) = (1 - \alpha) (\pi^C(s, \bar{\theta}) - \pi^0) + \alpha \underbrace{(\pi^C(s, \underline{\theta}) - \pi^0)}_{<0 \text{ (H3)}} - C(s)$$

Because profits with sharing are below π^0 when firms are constrained, sharing and competing will dominate competition for $\alpha < \alpha_2^B < \alpha_2$. The quality competition rationale illustrates this equilibrium.

B Proof of Proposition 3

At the beginning of the game, the expected surplus when $s^*(\alpha)$ information is shared without merger control is:

$$\mathbb{E}[CS^{no}] := (1 - \alpha)CS^M(\bar{\theta}) + \alpha CS^C(s^*(\alpha), \underline{\theta}).$$

When firms share $\hat{s}^A < s^*(\alpha)$ to have the merger accepted by the regulator, the expected surplus at the beginning of the game depends on the realization of θ . If synergies are high with prob. $1 - \alpha$, firms ask for a M&A, which is cleared by the regulator, and surplus equals $CS^M(\bar{\theta})$. If synergies are low with prob. α , firms compete with \hat{s}^A information shared and surplus equals $CS^C(\hat{s}^A, \underline{\theta})$. Overall, the expected surplus with sharing at the beginning of the game is:

$$\mathbb{E}[CS(\hat{s}^A)] := (1 - \alpha)CS^M(\bar{\theta}) + \alpha CS^C(\hat{s}^A, \underline{\theta}).$$

Hence, regulation reduces surplus if the following difference is negative:

$$\mathbb{E}[CS(\hat{s}^A)] - \mathbb{E}[CS^{no}] = \alpha(CS^C(\hat{s}^A, \underline{\theta}) - CS^C(s^*(\alpha), \underline{\theta})) < 0.$$

This term is negative since \hat{s}^A is smaller than $s^*(\alpha)$. Hence, the presence of the regulator reduces both consumer surplus and firms' profits.

When firms merge under incomplete information because of the regulator, the expected surplus is $\mathbb{E}[CS^M(\theta)]$, and the variations in surplus due to regulation are equal to:

$$\mathbb{E}[CS^M(\theta)] - \mathbb{E}[CS^{no}] = \alpha(CS^M(\theta) - CS^C(s^*(\alpha), \underline{\theta})) < 0.$$

Consumer surplus unilaterally decreases because of the regulator. Consumers lose since

firms do not compete with information when synergies are low. Moreover, firms also lose as they no longer share information, even though this would be the unconstrained optimum for the industry.

When firms prefer to compete because of the regulator, consumer surplus is CS^0 . The variations of surplus due to the presence of the regulator in this case is equal to:

$$CS^0 - \mathbb{E}[CS^{no}] = CS^0 - (1 - \alpha)CS^M(\bar{\theta}) - \alpha CS^C(s^*(\alpha), \underline{\theta}) < 0.$$

In this last case again, the presence of the regulator reduces consumer surplus. Indeed, surplus if firms share information is either realized under a merger with high synergies, or under competition with information shared if synergies are low. In both cases, the resulting surplus is greater than in the baseline competitive mode without sharing.

The presence of the regulator increases surplus if firms share more information.

When firms share $s_B^*(\alpha) > s^*(\alpha)$ and compete, the expected surplus with sharing at the beginning of the game is:

$$\mathbb{E}[CS(s_B^*(\alpha))] := (1 - \alpha)CS^C(s_B^*(\alpha), \bar{\theta}) + \alpha CS^C(s_B^*(\alpha), \underline{\theta}).$$

Hence, regulation increases surplus if the following difference is positive:

$$\begin{aligned} \mathbb{E}[CS(s_B^*(\alpha))] - \mathbb{E}[CS^{no}] &= (1 - \alpha)(CS^C(s_B^*(\alpha), \bar{\theta}) - CS^M(\bar{\theta})) \\ &\quad + \alpha(CS^C(s_B^*(\alpha), \underline{\theta}) - CS^C(s^*(\alpha), \underline{\theta})) > 0. \end{aligned}$$

We show that $s_B > s^*(\alpha)$, such that firms share more information if the M&A is blocked. A necessary condition for sharing and competing to be an equilibrium strategy is that $\pi^C(s, \bar{\theta}) > \pi^0$ for at least some values of s . Otherwise, $\Pi_B(s, \alpha) < \pi^0$. By quasi-convexity of $\pi^C(s, \bar{\theta})$, this implies that $\pi^C(1, \bar{\theta}) > \pi^0$.

This also implies that $\pi^C(s_B^*(\alpha), \bar{\theta})$ is increasing as we have assumed it is quasi-convex. This means that sharing and competing can be the best strategy for the firm when $\alpha \in (\alpha^B, \alpha_2)$ and $\hat{s}^A < \hat{s}^A(\alpha)$ and the competitive profits with sharing and high synergies are high enough. In this case, firms expect an increase in profits resulting from the information synergies when synergies are high.

We can show that $s_B^*(\alpha) > s^*(\alpha)$ using simple first-order conditions on Π_B : either Π_B is increasing at $s^*(\alpha)$, such that $s_B^*(\alpha)$ is greater than $s^*(\alpha)$; or Π_B is decreasing at $s^*(\alpha)$, which also implies that $s_B^*(\alpha)$ is greater than $s^*(\alpha)$ since it means that $\pi^C(s^*(\alpha), \bar{\theta})$ has a downward slope, and we have shown that $s_B^*(\alpha)$ is necessarily on the upward slope of $\pi^C(s, \bar{\theta})$. Overall, firms share more information since doing so increases the competitive profits when synergies are high and the merger is blocked.

The difference $CS^C(s_B^*(\alpha), \underline{\theta}) - CS^C(s^*(\alpha), \underline{\theta})$ is positive since $s_B^*(\alpha)$ is greater than $s^*(\alpha)$. Moreover, $CS^C(s_B^*(\alpha), \bar{\theta})$ is greater than $CS^M(\bar{\theta})$ since the regulator blocks the merger. Overall, the presence of the regulator increases consumer surplus when it blocks the merger.

C A Quality Competition Model

We provide micro-foundations using a simple model of information sharing and mergers when firms compete by selling products of different qualities. While we use here a mode of competition in utility, alternative applications include differentiated Cournot competition, for instance.

Before information is shared, Firm 1 sells a product of quality q_1^0 at a price p_1^0 , and Firm 2 sells a product of quality q_2^0 at a price p_2^0 . There is a mass 1 of consumers with quasi-linear utility functions $u(q_i, p_i) = q_i - p_i$. Firms compete à la Bertrand to sell their products, and the firm winning the market makes profits equal to $\pi_i = p_i$.

For simplicity, at the beginning of the game, $q_1^0 > 0$, $q_2^0 = 0$, and Firm 1 is a monopolist in the market. Hence, the equilibrium prices and profits are $\pi_1^0 = p_1^0 = q_1^0$ and $\pi_2^0 = p_2^0 = 0$.

Information sharing. Suppose that Firm 1 shares $s > 0$, and, for now, let us ignore the possibility of a M&A. If Firm 2 invests $C(s) = \frac{(1-s)^2}{s}$ and learns θ , it can develop a product of quality $q_2(s, \theta) = s\theta$ while the product quality of Firm 1 does not change. We assume that when a product is on the market, consumers know its valuation immediately. This holds even if firms do not know the quality of the product at the time they launch it. Indeed, the literature on the pricing of information goods ([Shapiro and Varian, 1998](#)) has for long pointed out that consumers can quickly discover their product valuation before

acquiring it through sampling, free downloading, freemium, ratings, and reviews.

To ensure that the main hypotheses of the baseline model hold in this framework, we assume that $\bar{\theta} > u > 2\underline{\theta}$, and we discuss these conditions below. Consumers purchase the product that yields the highest utility, and Bertrand competition implies the equilibrium profits of the firms are

$$\begin{aligned}\pi_1^C(s, \theta) &= 0, & \pi_2^C(s, \theta) &= s\theta - u \text{ if } s\theta - u \geq 0, \\ \pi_1^C(s, \theta) &= u - s\theta, & \pi_2^C(s, \theta) &= 0 \text{ if } s\theta - u \leq 0.\end{aligned}$$

The assumptions of our primary analysis are satisfied with this quality competition model.

$$(H2) \quad \begin{aligned}\frac{\partial \pi_2^C(s, \theta)}{\partial s} &= \theta \geq 0 \geq \frac{\partial \pi_1^C(s, \theta)}{\partial s} = 0 \text{ if } s\theta - u \geq 0, \\ \frac{\partial \pi_2^C(s, \theta)}{\partial s} &= 0 \geq 0 \geq \frac{\partial \pi_1^C(s, \theta)}{\partial s} = -\theta \text{ if } s\theta - u \leq 0.\end{aligned}$$

As we have assumed that $u > \underline{\theta}$, when synergies are low the competitive payoffs are equal to $\pi_1^C(s, \underline{\theta}) = u - s\underline{\theta}$ and $\pi_2^C(s, \underline{\theta}) = 0$. This ensures that (H3) is satisfied:

$$(H3) \quad \frac{\partial \pi_1^C(s, \underline{\theta})}{\partial s} = -\underline{\theta} < 0.$$

Finally, the industry profits with sharing when synergies are high are equal to:

$$\begin{aligned}\pi^C(s, \bar{\theta}) &= u - s\bar{\theta} \text{ if } s\bar{\theta} - u \leq 0, \\ \pi^C(s, \bar{\theta}) &= s\bar{\theta} - u \text{ if } s\bar{\theta} - u \geq 0.\end{aligned}$$

M&A. When firms merge, the merged entity sells as a monopolist a product of quality equal to $q_2(1, \bar{\theta}) = \bar{\theta}$ if synergies are high and to $q_2(1, \underline{\theta}) = \underline{\theta}$ if synergies are low. As we have assumed that $\bar{\theta} > u$ and $u > 2\underline{\theta}$, Firm 2 is willing to merge only when synergies are high and we recover the option value of the baseline model:

$$(H5) \quad \begin{aligned}\pi^M(\bar{\theta}) &= \bar{\theta} > \pi^C(s, \bar{\theta}) = \max\{u - s\bar{\theta}, s\bar{\theta} - u\}, \\ \pi^M(\underline{\theta}) &= \underline{\theta} < u - s\underline{\theta}.\end{aligned}$$

Information sharing. The expected profit of Firm 2 purchasing s from Firm 1 is:

$$(1 - \alpha)(\bar{\theta} - u) - \alpha\underline{\theta}s - C(s).$$

By concavity of this expression, the equilibrium amount of information shared is unique and satisfies

$$\alpha\underline{\theta} = -C'(s^*(\alpha)) = \frac{1 - s^*(\alpha)^2}{s^*(\alpha)^2} \implies s^*(\alpha) = \sqrt{\frac{1}{1 + \alpha\underline{\theta}}}.$$

Consumer surplus. The surplus of consumers is equal to zero if firms do not share information or if they merge. If firms share information and compete, consumer surplus equals $\min\{u, \theta s\}$. This weakly increases with s , and is linear on $[0, \frac{u}{\theta}]$ and $[\frac{u}{\theta}, 1]$.

Regulation. A merger under incomplete information does not change consumer surplus:

$$\mathbb{E}[G(0, \theta)] = 0$$

and a M&A is always accepted under incomplete information since a regulator clears M&As only if they increase consumer surplus. This is a polar case where a merger does not induce any gain for consumers under incomplete information.

When firms share s information, a M&A in case of high synergies is detrimental to consumers:

$$G(s, \bar{\theta}) = -\max\{u, s\bar{\theta}\}.$$

This function is always negative, and the merger is never approved after information has been shared. Hence, the presence of the regulator discourages firms from sharing information, and they prefer to either merge under incomplete information or share information and compete.

In case firms share information and compete, they anticipate profits equal to:

$$(1 - \alpha)(\max\{u - s\bar{\theta}, s\bar{\theta} - u\}) + \alpha(u - s\underline{\theta}) - C(s)$$

For sharing to be profitable, it is necessary that $s\bar{\theta} > u$. Moreover, for sharing to dominate

competition without sharing, we must have:

$$(1 - \alpha)(s\bar{\theta} - 2u) - \alpha s\underline{\theta} - C(s) > 0.$$

We can see that a sufficient condition for sharing and competing to be a profitable strategy is when the above condition is satisfied for $s = 1$. In this case, the inequality writes:

$$\bar{\theta} > \frac{\alpha}{1 - \alpha}\underline{\theta} + 2u.$$

Under this sufficient condition, we see that the presence of the regulator does not necessarily discourage firms from sharing, since their profits in case synergies are high can be significantly greater than those without sharing.

On the contrary, when $\bar{\theta} < 2u$, $(1 - \alpha)(s\bar{\theta} - 2u) - \alpha s\underline{\theta} - C(s)$ will always be negative, and firms will not share information under this sufficient condition.

Optimal stringency. Profits in case of sharing and competing are

$$\Pi_B(s, \alpha) = (1 - \alpha)(s\bar{\theta} - u) + \alpha(u - s\underline{\theta}) - C(s)$$

which are maximized for

$$(12) \quad s_B^*(\alpha) = \begin{cases} 1 & \text{if } \alpha\underline{\theta} \leq (1 - \alpha)\bar{\theta} \\ \sqrt{\frac{1}{1 - (1 - \alpha)\bar{\theta} + \alpha\underline{\theta}}} & \text{if } \alpha\underline{\theta} \geq (1 - \alpha)\bar{\theta} \end{cases}$$

For any α , there exists $\hat{\theta}$ ($> 2u$) such that firms share and compete if $\bar{\theta} > \hat{\theta}$ and do not share otherwise.

Hence, the optimal degree of stringency depends on $\bar{\theta}$. If $\bar{\theta} > \hat{\theta}$, the regulator adopts the baseline regulation with $r = 0$ and surplus is high with firms sharing information and competing.

If $\bar{\theta} \leq \hat{\theta}$, firms do not share, and the regulator can induce the firms to share by increasing the value of r . Specifically, a M&A will be accepted if

$$G(s, \bar{\theta}) + r \geq 0 \implies r - \max\{u, s\bar{\theta}\} \geq 0$$

Consumer surplus increases when firms share more information, anticipating a merger if synergies are high. A regulator can incentivize sharing by the firms by adopting a more lenient regulation with $r > 0$. By doing so, the regulator first gives firms incentives to share information \hat{s}^A , which increases with r . For $r \geq \max\{u, s^*(\alpha)\bar{\theta}\}$, \hat{s}^A is greater than $s^*(\alpha)$ and the firms will share their optimal amount of information $s^*(\alpha)$. Hence, an optimal regulation adopts a level of leniency $r \geq \max\{u, s^*(\alpha)\bar{\theta}\}$.

D Nash Bargaining in the Quality Model

In the quality model, consider the following specification:

$$\bar{\theta} = 4, \underline{\theta} = 0, u = 1, \alpha = \frac{3}{4}, C(s) = \frac{(1-s)^2}{s}.$$

Moreover, assume that Firm 1 has smaller bargaining power than Firm 2, that is $\mu \leq \frac{1}{2}$.

In this case, $\pi_1^0 = 1$, $\pi_2^0 = 0$, and without sharing, merging under incomplete information yields an expected profit of $\mathbb{E}[\theta] = 1$, which is equal to $\pi^0 = 1$.

If Firm 1 shares data and Firm 2 explores, there is competition with probability α , and merger with probability $1 - \alpha$. Hence, the expected profits at the time Firm 2 does the exploration are:

$$u_1(s, \alpha; expl) = \begin{cases} \frac{1}{4}(3\mu + 4(\mu - 1)s + 4) & \text{if } s \leq \frac{1}{4} \\ \frac{1}{4}(\mu(5 - 4s) + 3) & \text{if } s \geq \frac{1}{4} \end{cases}$$

$$u_2(s, \alpha; expl) = \begin{cases} \frac{(3+4s)(1-\mu)}{4} - \frac{(1-s)^2}{s} & \text{if } s \leq \frac{1}{4} \\ \frac{4s\mu+4-5\mu}{4} - \frac{(1-s)^2}{s} & \text{if } s \geq \frac{1}{4}. \end{cases}$$

The lower bound on s for exploration solves $u_2(s, \alpha; expl) = \pi_2^0 = 0$, while the upper bound on s for Firm 1 to benefit from exploration solves $u_1(s, \alpha; expl) = \pi_1^0 = 1$. Straightforward computations show that Firm 1 benefits from sharing s and exploration when s is smaller

than

$$\bar{s}(\mu) = \begin{cases} \frac{3\mu}{4(1-\mu)} & \text{if } 0 < \mu \leq \frac{1}{4} \\ \frac{5\mu-1}{4\mu} & \text{if } \frac{1}{4} < \mu < \frac{1}{2} \end{cases}$$

At $s = \frac{1}{4}$, Firm 2 has an expected payoff under exploration equal to $1 - \mu - \frac{9}{4}$ which is negative. Therefore, the lower bound on s must be in the region $s \geq \frac{1}{4}$, and

$$\underline{s}(\mu) = \frac{12 - 5\mu + \sqrt{25\mu^2 - 56\mu + 80}}{8(1 - \mu)}$$

There will be exploration only if $\bar{s}(\mu)$ is greater than $\underline{s}(\mu)$. This requires that μ is large enough (greater than 0.305). As the bargaining power of Firm 1 increases, we see in Figure 4 that the equilibrium shares of information $\underline{s}(\mu)$ and $\bar{s}(\mu)$ increase.

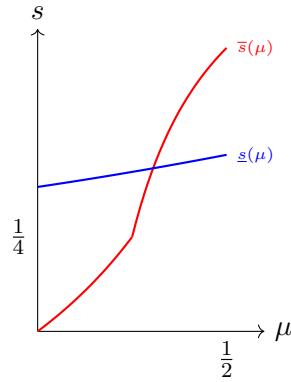


Figure 4: Incentive bounds with Nash bargaining