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Can foreclosure benefit consumers? The case of innovation in new markets

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Abstract

Innovation concerns have been at the core of some recent horizontal and non-horizontal mergers. This has led to a growing literature that has specifically focused on horizontal mergers. In this paper, I show that foreclosure may benefit consumers in non-horizontal mergers when firms compete to innovate in a new market. This is because it may allow consumers to benefit from an innovation to which they would not have access to in the absence of foreclosure. I determine the conditions leading to this conclusion and argue that a cautious approach to foreclosure by competition authorities is warranted when firms compete to innovate in a new market.

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1. Introduction

The expected effect of mergers on innovation has been a key component of the review of recent transactions by competition authorities. In Europe, it has been at the center of the assessment of some horizontal mergers and has induced debates on the economic framework best suited to deal with innovation. Recent contributions to the economic literature have in particular aimed to account for the different channels through which a horizontal merger may impact the incentive to innovate.[1] The European Commission ("the Commission") also reviewed in the last few years several non-horizontal mergers involving innovation considerations and that were only cleared subject to remedies addressing the foreclosure concerns of the Commission.[2] The theories of harm related to innovation in non-horizontal mergers have, however, been much less debated than in horizontal mergers.

This paper aims to shed light on the assessment of non-coordinated effects, and more specifically foreclosure, in non-horizontal mergers when firms compete to innovate, by considering the case of innovation in a new market.[3] I show that, in this specific case, foreclosure does not necessarily lead to harm for consumers. This is because, although foreclosure may discourage competitors to innovate, it increases the incentive to innovate of the merged entity and may lead *ex-ante* to a higher expected consumer surplus. Although not a general outcome, it arises in certain circumstances that I describe in this paper.

This paper relates to the literature on foreclosure in non-horizontal mergers. Starting with the seminal paper by Ordover, Saloner and Salop (1990), this literature has considered the incentives that a merged entity may have to foreclose competitors. In a standard framework in which firms compete in prices or in quantities, foreclosure is often considered as harmful to both competitors and consumers as it softens competition, although there are specific instances of pro-competitive foreclosure.[4]

With respect to competition in innovation, the literature similarly highlights the harmful effect of foreclosure on consumers in the case of incremental innovation affecting the product's value (Allain, Chambolle and Rey (2011)) or the upstream production cost (Stefanadis (1997)). In a more general setting, however, Rey and Tirole (2007) argue that foreclosure may be desirable if it promotes dynamic efficiency through more innovation, even if at the expense of static efficiency. I build upon this reasoning and provide a concrete example of potentially pro-competitive effects of foreclosure on innovation by considering innovation in new markets.

Furthermore, this paper is relevant from a policy perspective. Indeed, the idea that foreclosure is presumptively harmful for consumers is reflected in the Commission's Non-Horizontal Merger Guidelines[5], which refer to "anticompetitive foreclosure" and do not make a distinction between parameters of competition (prices, quantities, quality, choice, innovation) when assessing the consequences of foreclosure. By challenging the view that foreclosure necessarily

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[1] *See* Federico, Langus and Valletti (2018) and Federico, Langus, and Valletti (2017). For a response, see Denicolò. and Polo (2018) and Jullien and Lefouilli (2018).

[2] *See* COMP/M.9064, Telia Company/Bonnier Boradcasting Holding, Commission decision of 12 November 2019; COMP/M.5984, Intel/McAfee, Commission decision of 26 January 2011; COMP/M.6564, ARM/Giesecke & Devrient/Gemalto/JV, Commission decision of 6 November 2012; COMP/M.8314, Broadcom/Brocade, Commission decision of 12 May 2017

[3] I define a new market as one in which neither the merged entity nor its competitors are already present prior to innovating. Therefore, there is no incumbent.

[4] See for instance Choi and Yi (2000), Chipty (2001) and Jullien, Reisinger and Rey (2018). Some exceptions are Choné, Linnemer and Vergé (2021), who show that, although foreclosure harms consumers when suppliers are symmetric, it may increase consumer surplus in an asymmetric setting and Loertscher and Reisinger (2014), who show that foreclosure may increase consumer surplus when firms compete in quantities and vertical integration reduces the monopsony distortion and leads to an increase in the quantities produced by the merged entity.

[5] *See the* Guidelines on the Assessment of Non-Horizontal Mergers under the Council Regulation on the Control of Concentrations between Undertakings, Official Journal of the European Union, 18.10.2008, C265/6-25.

harms consumers when firms compete to innovate, this article calls for a nuanced approach with respect to the assessment of the effect of foreclosure on consumer surplus in non-horizontal mergers when firms compete to innovate in a new market.

2. Model

I consider, without loss of generality, a setup with one upstream firm (hereafter, 'U') and two downstream firms (hereafter, 'D_1' and 'D_2'). Both D_1 and D_2 must purchase a differentiated input from U to be able to innovate with a respective probability of θ_1 and θ_2, with the two probabilities being independent from each other.[6] This input plays the same role as R&D since it is an investment that downstream firms must make to innovate at the downstream level. Without loss of generality, I assume that only one unit of input is required, which means that the input price corresponds to the investment cost for the downstream firms. If innovation is successful, downstream firms compete in prices and sell differentiated products to consumers. There is a continuum of consumers of the same type with a utility function based on Singh and Vives (1984)[7]:

$$U(q_1, q_2) = \alpha_1 q_1 + \alpha_2 q_2 - (\beta q_1^2 + 2\gamma q_1 q_2 + \beta q_2^2)/2$$

where q_1 and q_2 are the quantities purchased from D_1 and D_2 respectively and α_1, α_2 and β represent consumers' preferences regarding the two innovations. The parameter γ determines the nature of the relationship between the two innovations, which are substitutes if $\gamma > 0$ and complements if $\gamma < 0$. The closeness of competition between the two innovations increases with γ. Furthermore, α_1, α_2 and γ are positive and $\beta^2 - \gamma^2 > 0$, $\alpha_1\beta - \alpha_2\gamma > 0$ and $\alpha_2\beta - \alpha_1\gamma > 0$.

I assess the impact on innovation of a merger between U and a downstream firm (D_1) by comparing two scenarios: one in which the merger occurs ("the merger scenario") and one ("the counterfactual scenario") in which there is no merger.

The innovation process may be described as a sequential game involving the three firms (U, D_1 and D_2).

In the merger scenario, the three stages of this sequential game are as follows:

(1) The merged entity decides whether to foreclose D_2 by refusing to supply the input.[8]
(2) In the absence of foreclosure in the first stage, the merged entity and D_2 bargain over the input price.
(3) In the absence of foreclosure in the first stage, both the merged entity and D_2 simultaneously decide whether to invest and innovate with a certain probability, given their respective input cost.[9] If, however, the merged entity forecloses D_2 in the first stage, the investment decision is only made by the merged entity.

In the counterfactual scenario, the three stages of the sequential game are as follows:

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[6] I assume here that each downstream firm possesses its own know how regarding its potential innovation, meaning that the relationship between the upstream and downstream levels is limited to the sale of an input by the upstream firm to a downstream firm. Therefore, I abstract from a setting in which innovation would be conducted at the upstream level, since the question raised by the merger would then concern its effect on the licensing of innovations to downstream firms rather than its effect on innovation *per se*.

[7] *See* Singh and Vives (1984).

[8] Although I specifically refer here to total foreclosure (i.e. the merged entity refuses to supply the input), the reasoning is similar in the case of partial foreclosure to the extent that foreclosure makes the investment unprofitable for D_2.

[9] For D2, this cost is given by the price bargained with the merged entity in the second stage while, for the merged entity, it is equal to the cost of internal use of the input.

(1) U decides whether to supply the required input to D1 and/or D2.
(2) For the downstream firm(s) that U accepts to supply in the first stage, the input price is set through bilateral negotiations between U and the downstream firm(s).
(3) The downstream firm(s) that U accepts to supply in the first stage decide whether to invest and innovate with a certain probability, given the investment cost, which is given by the price negotiated with the upstream firm in the second stage.

In both scenarios, firms invest only if their expected profit is positive given their probability of success.

2.1. Merger scenario

In this section, I discuss the merger scenario and proceed as usual by backward induction.

2.1.1 Foreclosure

In the last stage of the game, if D_2 is foreclosed and the merged entity invests, the latter is a monopolist with a probability equal to θ_1. In this case, the utility function of the representative consumer is equal to: $U(q_1) = \alpha_1 q_1 - \beta q_1^2/2$. The inverse demand is given by $q_1 = a_1 - bp_1$ with $b = \frac{1}{\beta}$ and $a_1 = \frac{\alpha_1}{\beta}$.
Assuming for simplicity that the downstream marginal cost of production is equal to zero, the merged entity maximizes its profit function:

$$\pi_1 = p_1(a_1 - bp_1) \quad (1)$$

This leads to $p_1^{mon} = \frac{a_1}{2b} = \frac{\alpha_1}{2}$ and $\pi_1^{mon} = \frac{\alpha_1^2}{4\beta}$.
From an *ex-ante* perspective (i.e. before the merged entity decides to invest), where $\underline{P_1}$ is the cost of the input required for innovating, the expected profit of the merged entity is equal to $\theta_1 \pi_1^{mon} - \underline{P_1}$, which I assume to be positive as otherwise the merged entity would never invest.

2.1.2 No Foreclosure

In the last stage of the game, if D_2 is not foreclosed and both D_1 and D_2 invest: (i) the merged entity is a monopolist with a probability equal to $\theta_1(1 - \theta_2)$ (ii) D_2 is a monopolist with a probability equal to $\theta_2(1 - \theta_1)$ and (iii) there is a duopoly with a probability equal to $\theta_1\theta_2$.
In the first two cases, that is if D_i is a monopolist at the downstream level, it earns a profit equal to $\pi_i^{mon} = \frac{\alpha_i^2}{4\beta}$ with $i = 1,2$ as derived from (1).
In the third case, that is if there is a duopoly, the inverse demand for the innovation of D_i is given by:

$$q_i = a_i - bp_i + dp_j \text{ for } i \neq j \in \{1,2\}$$

with $a_i = \frac{\alpha_i\beta - \alpha_j\gamma}{\beta^2 - \gamma^2}$, $b = \frac{\beta}{\beta^2 - \gamma^2}$ and $d = \frac{\gamma}{\beta^2 - \gamma^2}$.
Each firm maximizes its profit, which is given by:

$$\pi_i = p_i(a_i - bp_i + dp_j) \text{ for } i \neq j \in \{1,2\}$$

leading to $p_i^{duo} = \frac{2a_i b + da_j}{4b^2 - d^2}$ and $\pi_i^{duo} = \frac{b(2a_i b + da_j)^2}{(4b^2 - d^2)^2}$ for $i \neq j \in \{1,2\}$.
Ex-ante, there are four potential outcomes to the simultaneous entry game with the following expected profit for the merged entity and D_2:

1. If both firms simultaneously decide to invest, the expected profit of the merged entity is equal to $\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1}$ where $P_2^{m\_duo}$ is the price bargained by the merged entity and D_2 for D_2's input in the merger scenario when both firms invest and $\underline{P_2}$ the seller's reservation price for this input (i.e., its marginal cost). The expected profit of D_2 is equal to $\theta_1\theta_2\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} - P_2^{m\_duo}$.
2. If only D_2 invests, the profit of the merged entity is equal to $P_2^{m\_mon} - \underline{P_2}$ where $P_2^{m\_mon}$ is the price bargained for D_2's input when only D_2 invest. The expected profit of D_2 is equal to $\theta_2\pi_2^{mon} - P_2^{m\_mon}$.
3. If only the merged entity invests, its expected profit is equal to $\theta_1\pi_1^{mon} - \underline{P_1}$ and D_2 obtains zero.
4. If no firm invests, they both obtain zero.

I assume that the following two conditions are not simultaneously met as otherwise D_2 would not invest in equilibrium, not only in the merger scenario but also in the counterfactual scenario:

$$\underline{P_2} > \theta_2\theta_1\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} \text{ and } \underline{P_1} < \theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon}$$

This ensures that only the first two outcomes are potential Nash equilibria of the game.
In the second stage of the game, if the merged entity did not foreclose D_2 in the first stage, the merged entity and D_2 bargain to determine the price of the input used by D_2, which is the solution of the following Nash bargaining game:

$$\arg\max_{(P_2^m)} (E(\pi_2) - P_2^m)^{\sigma_2}(P_2^m - \underline{P_2})^{1-\sigma_2} \quad (2)$$

where $E(\pi_2)$ is the expected variable profit of D_2, P_2^m is the price bargained by the merged entity and D_2 for D_2's input and $\sigma_2 \in]0;1[$ is the bargaining power of D_2. As is apparent from (2), the negotiated price depends on the expected profit of D_2, which depends in turn on whether D_2 is a monopolist or competes with the merged entity.
An important component of the negotiation between the merged entity and D_2 depends on the ability of the merged entity to commit not to compete with D_2. If the merged entity can commit not to invest in the last stage of the game and chooses to do so, the solution of the Nash bargaining game is:

$$P_2^{m\_mon} = (1-\sigma_2)\theta_2\pi_2^{mon} + \sigma_2\underline{P_2}$$

If, however, the merged entity does not commit (or is unable) not to invest in the last stage of the game, the solution of the Nash bargaining game is:

$$P_2^{m\_duo} = (1-\sigma_2)\left(\theta_2(1-\theta_1)\,\pi_2^{mon} + \theta_1\theta_2\pi_2^{duo}\right) + \sigma_2\underline{P_2}$$

2.1.3 The decision of the merged entity to foreclose its downstream competitor

In the first stage of the game, the merged entity decides to foreclose D_2 if its expected profit is higher than absent foreclosure.

Proposition 1 *The comparison between the expected profit of the merged entity with and without foreclosure shows that:*

- *A higher probability of success of the merged entity increases the incentive to foreclose as its positive impact on the expected profit of the merged entity is larger when D_2 is foreclosed than when it is not.*
- *If the merged entity does not commit not to enter, a higher probability of success of D_2 has an ambiguous effect on the incentive to foreclose. On the one hand, a higher value of θ_2 makes it more likely that the merged entity will compete with D_2 downstream instead of being a monopolist, which decreases its expected profit. On the other hand, it allows the merged entity to negotiate a higher price for the input purchased by D_2.*
- *If the merged entity commits not to enter, a higher probability of success of D_2 decreases the incentive to foreclose as it leads to a higher profit without foreclosure for the merged entity, which is able to negotiate a higher input price with D_2.*
- *A higher bargaining power of D_2 increases the incentive to foreclose, as it allows D_2 to negotiate a lower input price in the absence of foreclosure, independently of whether the merged entity commits not to enter downstream.*

Proof. See Appendix.

In Table I, I summarize the effect of the parameters discussed above on the incentive of the merged entity to foreclose D_2.

Table I. Relevant parameters for the assessment of the incentive to foreclose and direction of effect on the merged entity's incentive to foreclose

Parameter	Direction of effect on the merged entity's incentive to foreclose
Probability of success of D2 (without commitment by the merged entity not to invest in the absence of foreclosure)	Ambiguous
Probability of success of D2 (with commitment by the merged entity not to invest in the absence of foreclosure)	-
Probability of success of the merged entity	+
Bargaining power of the merged entity	-

2.2. Counterfactual scenario

In the counterfactual scenario, both D_1 and D_2 purchase the input from U. In line with the literature on private contracts, I consider that U negotiates with both D_1 and D_2 as it cannot credibly commit to supply only one downstream firm.[10]

2.2.1. The three stages of the game

In the last stage of the game, the expected profit of D_1 and D_2 depends on their investment decision:

1. If both firms simultaneously invest, the expected profit of D_1 is equal to $\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} - P_1^{c\_duo}$ and the expected profit of D_2 is equal to $\theta_1\theta_2\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} - P_2^{c\_duo}$, with $P_1^{c\_duo}$ and $P_2^{c\_duo}$ the prices bargained respectively for D_1 and D_2's inputs in the counterfactual scenario when both firms invest.
2. If only D_i $(i = 1,2)$ invests, its expected profit is equal to $\theta_i\pi_i^{mon} - P_i^{m\_mon}$, with $P_i^{m\_mon}$ the price bargained for D_i's input when only one firm invests, and the other downstream firm obtains zero.
3. If no firm invests, they both obtain zero.

As in the merger scenario, only the first two outcomes may arise as Nash equilibria given the conditions imposed on $\underline{P_1}$ and $\underline{P_2}$, in order to avoid a situation in which D_2 would not invest in the absence of foreclosure:

- Both D_1 and D_2 purchase the input and invest: in this case, foreclosure unambiguously harms consumers as it deprives them from the opportunity of benefiting from D_2's innovation in addition to D_1's innovation.[11]

[10] *See* Rey and Tirole (2007).

[11] To show this, let us define CS_1 as the consumer surplus when only D_1's innovation is available, CS_2 as the consumer surplus when only D_2's innovation is available and CS_{12} as the consumer surplus when both innovations are available. The expected consumer surplus in the merger scenario when D_2 is foreclosed is equal $\theta_1 CS_1$ and the expected consumer surplus in the counterfactual scenario when both firms invest is

- Only D_2 purchases the input ("outcome A"): this outcome is particularly interesting as it involves a comparison between potential innovation by D_2 (in the counterfactual scenario) and potential innovation by D_1 (in the merger scenario). In this case, the effect of foreclosure on consumers is not straightforward and requires a comparison between the expected consumer surplus in both scenarios.

In the second stage of the game of the counterfactual scenario, the negotiated price P_i^c is the solution of:

$$\arg \max_{(P_i^c)} (E(\pi_i) - P_i^c)^{\sigma_i} (P_i^c - \underline{P_i})^{1-\sigma_i} \text{ with } i = 1,2$$

Finally, in the first stage of the game, U negotiates with both D_1 and D_2 as explained at the beginning of this section.

2.2.2. Conditions under which only D_2 invests

For foreclosure to potentially benefit consumers, it must be the case that only D_2 invests (outcome A). This is the case if D_1 would make a loss if D_2 invests, or in other words that:

$$\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} - P_1^{c\_duo} < 0 \quad (3)$$

and if investing is a dominant strategy for D_2, that is if:

$$min\left(\theta_2\pi_2^{mon} - P_2^{c\_mon}; \theta_1\theta_2\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} - P_2^{c\_duo}\right) > 0 \quad (4)$$

Lemma 1 *D_2 is the only firm to invest if* $\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} < \underline{P_1}$ *and* $\theta_1\theta_2\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} > \underline{P_2}$.
Proof. See Appendix.

2.3. Expected consumer surplus in both scenarios

If foreclosure arises in the merger scenario, the expected consumer surplus is equal to $E(CS^m) = \theta_1(U(q_1^{mon}) - \pi_1^{mon}) = \theta_1 \frac{\alpha_1^2}{8\beta}$.
In the counterfactual scenario, if only D_2 invests, the expected consumer surplus is equal to $E(CS^c) = \theta_2(U(q_2^{mon}) - \pi_2^{mon}) = \theta_2 \frac{\alpha_2^2}{8\beta}$.

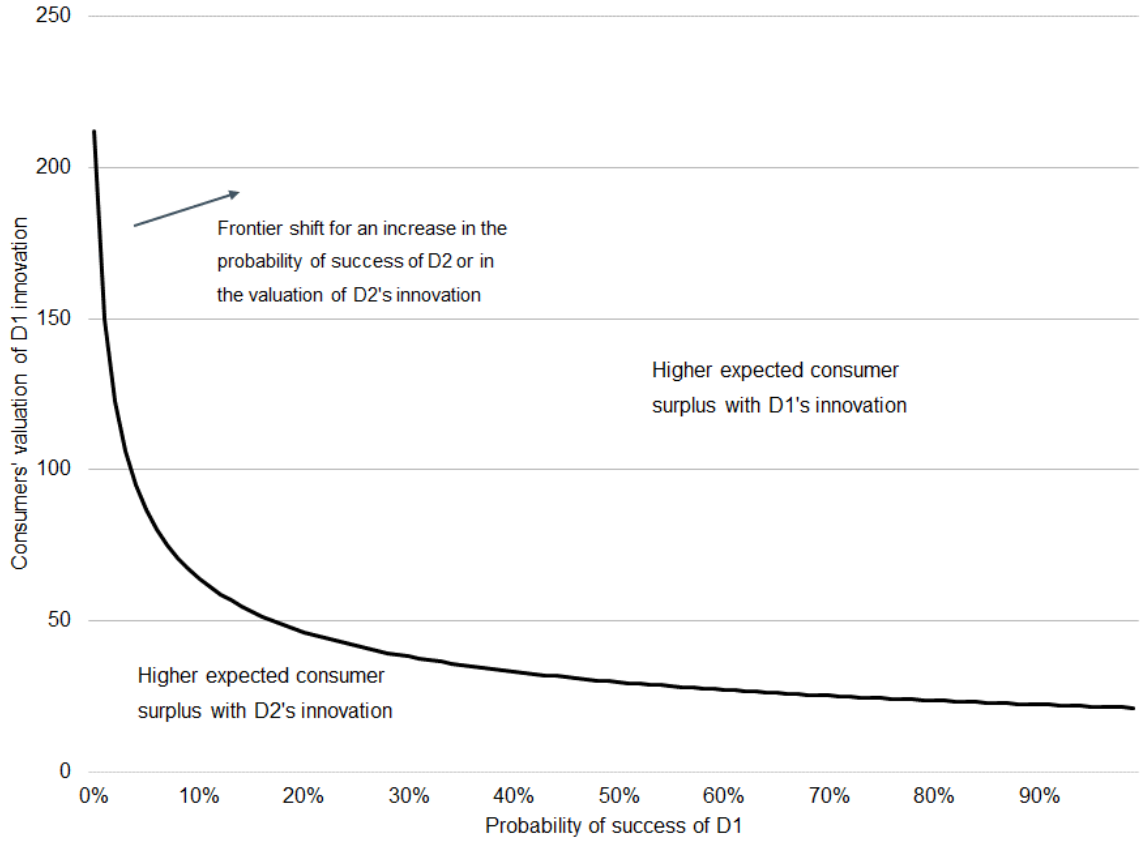
Proposition 2 *The comparison between the excepted consumer surplus in both scenarios depends on only four parameters. Foreclosure increases consumer surplus if* $\theta_1\alpha_1^2 > \theta_2\alpha_2^2$.
Proof. Straightforward comparison of $E(CS^m)$ and $E(CS^c)$.

In Figure 1, I present the combinations of parameters leading to a higher expected consumer surplus in the merger scenario with foreclosure than in the counterfactual scenario when only D_2 invests. It appears that, even if the probability of success (resp. the valuation of the potential

equal to $\theta_1\theta_2 CS_{12} + \theta_1(1-\theta_2)CS_1 + (1-\theta_1)\theta_2 CS_2$. A sufficient but not necessary condition for consumer surplus to be higher in the counterfactual scenario than in the merger scenario is that $CS_{12} > CS_1$, which is a very mild assumption.

innovation) of the merged entity is low, foreclosure may still be optimal for consumers if the valuation of its innovation by consumers (resp. its probability of success) is high.

Figure 1. Comparison of expected consumer surplus in the merger scenario with foreclosure and in the counterfactual scenario when only D_2 invests for a given valuation of D_2's innovation and a given probability of success of D_2



Note: the valuation of D_2's innovation is set at 30 and the probability of success of D_2 is set at 50 %.

It may seem at first sight that the conditions under which foreclosure benefits consumers are inconsistent with the conditions that lead to D_2 being the only firm to invest (outcome A) in the counterfactual scenario, which is a pre-requisite for foreclosure to increase consumer surplus. It is, however, important to note that the likelihood that D_2 is the only firm to invest in the counterfactual scenario does not only depend on the probability of success or on consumers' valuations but also on the closeness of competition between the two innovations and the reservation prices of U for the two inputs. For instance, a higher value of $\underline{P_1}$ increases the likelihood that the investment is unprofitable for D_1 in the counterfactual scenario. It does not, however, affect the comparison between the expected consumer surplus in the merger scenario with foreclosure and in the counterfactual scenario when D_2 is the only firm to invest. Therefore, this increases the likelihood that D_1 would not invest in the counterfactual scenario while leaving unchanged the likelihood that foreclosures increases consumer surplus.

In order to show that all conditions leading to an increase in expected consumer surplus may simultaneously be met, I consider a numerical example with the following parameter values: $\alpha_1 = 2,\ \alpha_2 = 3,\ \beta = 0.5,\ \gamma = 0.2,\ \theta_1 = 0.8,\ \theta_2 = 0.2$ and $\sigma_2 = 0.7$. All conditions are satisfied if $\underline{P_2} < 0.8$ and $\underline{P_1} > 0.2$.

3. Conclusion

This paper highlights the complexity of the assessment of the effect of foreclosure on innovation and ultimately consumers in the context of a non-horizontal merger. I show that, in the case of firms competing to enter in a new market through innovation, foreclosure may actually be decisive in providing an incentive to the merged entity to invest *ex-ante*. In this context, foreclosure may increase the expected consumer surplus compared to a situation in which competitors would not be foreclosed. This is in particular likely if the merged entity faces aggressive competitors. In this case, the investment of the merged entity may be unprofitable in the absence of foreclosure and discourage innovation. The main conclusion of this paper is that foreclosure may, under certain conditions, increase consumer surplus by allowing consumers to potentially have access to an innovation that they would not have access to absent foreclosure. From a policy perspective, it challenges the established view that foreclosure harms consumers and suggests that competition authorities should adopt a cautious approach regarding the assessment of the effects of foreclosure on innovation.

Appendix

Proof of Proposition 1

In the absence of foreclosure:

- If the merged entity commits not to enter the downstream market, its expected profit is equal to $P_2^{m\_mon} - \underline{P_2}$.
- If it does not (or cannot) commit not to enter the downstream market, its expected profit is equal to $\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1}$.

Therefore, the merged entity does not commit not to enter in the downstream market if:

$$\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1} > P_2^{m\_mon} - \underline{P_2}$$

and commits not to enter otherwise, to the extent that it is possible.

As a result, in the first stage of the game, the merged entity decides to foreclose D_2 if:

$$\theta_1\pi_1^{mon} - \underline{P_1} > max\left\{\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1}\,;\, P_2^{m\_mon} - \underline{P_2}\right\}$$

if it can commit not to enter and if

$$\theta_1\pi_1^{mon} - \underline{P_1} > \theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1}$$ if it cannot commit not to enter.

Let us define $f_1 = \theta_1\pi_1^{mon} - \underline{P_1} - \left(\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} + P_2^{m\_duo} - \underline{P_2} - \underline{P_1}\right)$ and $f_2 = \theta_1\pi_1^{mon} - \underline{P_1} - \left(P_2^{m\_mon} - \underline{P_2}\right)$

It is straightforward to conclude that:

- The incentive to foreclose of the merged entity increases with θ_1 since $\frac{\partial f_1}{\partial \theta_1} = \theta_2\left(\left(\pi_1^{mon} - \pi_1^{duo}\right) + (1-\sigma_2)(\pi_2^{mon} - \pi_2^{duo})\right) > 0$ and $\frac{\partial f_2}{\partial \theta_1} = \pi_1^{mon} > 0$.
- If the merged entity does not commit not to enter, an increase in θ_2 has an ambiguous effect on the incentive to foreclose since $\frac{\partial f_1}{\partial \theta_2} = \theta_1\left(\pi_1^{mon} - \pi_1^{duo}\right) - (1-\sigma_2)\left((1-\theta_1)\,\pi_2^{mon} + \theta_1\pi_2^{duo}\right)$.
- If the merged entity commits not to enter, the incentive to foreclose unambiguously decreases with θ_2 since $\frac{\partial f_2}{\partial \theta_2} = -(1-\sigma_2)\pi_2^{mon} < 0$.

- The incentive to foreclose increases with σ_2 since $\frac{\partial f_1}{\partial \sigma_2} > 0$ and $\frac{\partial f_2}{\partial \sigma_2} > 0$.

Proof of Lemma 1

In the counterfactual scenario, if both D_1 and D_2 invest, the downstream market is a potential duopoly and the negotiated price for each input ($P_i^{c\_duo}$), which is the solution of the Nash bargaining game, is equal to:

$$P_i^{c\_duo} = (1-\sigma_i)\left(\theta_i(1-\theta_j)\,\pi_i^{mon} + \theta_i\theta_j\pi_i^{duo}\right) + \sigma_i\underline{P_i} \text{ for } i \neq j \in \{1,2\}$$

If, however, only D_2 invests, the negotiated price $P_2^{c\_mon}$ is equal to:

$$P_2^{c\_mon} = P_2^{m\_mon} = (1-\sigma_2)\theta_2\pi_2^{mon} + \sigma_2\underline{P_2}$$

Replacing $P_i^{c\_duo}$ and $P_2^{c\_mon}$ by their expression in (3) and (4), we obtain that D_2 is the only firm to invest if $\theta_1\theta_2\pi_1^{duo} + \theta_1(1-\theta_2)\pi_1^{mon} < \underline{P_1}$ and $\theta_1\theta_2\pi_2^{duo} + \theta_2(1-\theta_1)\pi_2^{mon} > \underline{P_2}$.

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