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Ex post or ex ante?
On the optimal timing of merger control

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Ex post or ex ante?

On the optimal timing of merger control

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Abstract

We study the optimal timing of merger control by comparing the pre- and post-closing enforcement. Mergers have both pro- and anticompetitive effects, and the parties' (the agency and the merging firms) verifiable information on them is endogenous: it depends on the timing of the merger control, as well as on some investment in evidence production. The ex post enforcement turns out optimal whenever the costs of providing verifiable information on both efficiency gains and market power are sufficiently low, regardless of whether the firms know ex ante or not their true merger type.

Keywords: merger control, competition policy, evidence production

JEL classification: L41, K21, D82

1   Introduction

The ability of the parties to provide evidence on the merger's consequences for competition and consumers plays a critical role in current merger control. The following examples illustrate this.

On February 1st, 2012, the European Commission (EC) prohibited the Deutsche Börse/NYSE-Euronext merger (case M.6166). The EC banned ex ante this planned merger to near monopoly on the European financial derivatives market, despite future substantial efficiency gains argued by the parties (around 3 billion euros). By contrast, in January 2004, the Federal Trade Commission (FTC) decided to close its investigation of the consummated merger between Genzyme and Novazyme[1]. The FTC's decision not to challenge this merger to monopoly was based on both evidence of a lack of anticompetitive effects and of synergies made possible by the merger during the two years that followed the merger[2]. Had the merger been examined before consummation, the mere fact that it led to monopoly would have recommended its prohibition[3]. In the UK, where merger notification is not mandatory and roughly half of the mergers are not notified, the Competition Commission concluded ex post that the Tesco/Co-op merger had led to a substantial lessening of competition after consummation, and then ordered the full unscrambling[4]. In most jurisdictions however, the pre-merger notification is mandatory, and thus the likely competitive effects must be assessed ex ante. Thus the very timing of merger assessment determines the quality of the evidence available, and therefore the outcome of merger control. To a certain extent, this idea underlies the appeal judgement by the European Court of First Instance in the General Electric/Honeywell merger. In

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[1]See details at http://www.ftc.gov/opa/2004/01/genzyme.shtm.

[2]See Chairman's Muris statement, available at http://www.ftc.gov/os/2004/01/murisgenzymestmt.pdf.

[3]See Commissioner's Thompson dissenting statement, available at
http://www.ftc.gov/os/2004/01/thompsongenzymestmt.pdf.

[4]See details at http://www.competition-commission.org.uk/assets/competitioncommission/docs/pdf/non-inquiry/rep_pub/reports/2007/fulltext/534.pdf.

dealing with the vertical and conglomerate aspects of the case, the Court stressed that although the EC was entitled to base its merger control decision on the evidence available ex ante on the future consequences of the merger, the fact that the foreseen conduct of the parties could have been challenged ex post as an abuse of dominant position (in case it actually materialized) called for a high standard of proof and sufficiently convincing evidence within the prospective analysis of the EC[5].

The above examples illustrate the very purpose of our paper, which is to study the role of the timing of merger control enforcement for the evidence provision by the parties, and thereby for the final outcome of merger policy. We aim to determine which timing of merger control performs better, the pre- or the post-closing enforcement.

We base our analysis on a simple model where the merger has both pro- and anti-competitive effects, but this is the firms' private information. The key assumption is that the enforcement stems from the confrontation of hard evidence on both market power and efficiency gains, and this confrontation takes place either before (ex ante) or after the closing (ex post). In order for the merger to be cleared unconditionally, *i.e.* without remedies, the merging firms must in their turn provide verifiable evidence of efficiency gains high enough to offset the anticompetitive effect argued by the CA. We assume that the hard evidence is costly to provide, and that the timing of the assessment has an impact on the availability of this evidence and its production cost. Later on we interpret the level of this cost as the result of the standard of proof required. We also assume that a set of feasible remedies always exists and that they write off the full anticompetitive impact of the merger, although at the cost of sacrificing some efficiency gains. Moreover, the remedies are less costly for the merging firms if they are undertaken before rather than after the merger.

We show that the ex post merger control is optimal in two polar cases: if the evidence production cost for the pro-competitive merger effect is high, and if the evidence produc-

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[5]See in particular recitals 74 to 76 of the Court judgement - case T-210/01, December 14, 2005.

tion costs for both anticompetitive and pro-competitive effects are low. We also show that if overfixing is costlier than clearing anticompetitive mergers from the welfare-loss point of view, then the ex post control performs better. Instead, and more surprisingly, whenever clearing anticompetitive mergers causes a higher welfare loss than overfixing pro-competitive ones, the ex post merger control performs worse, except in the case of very low or very high evidence production costs on the merger's pro-competitive effect. Basically, if the cost of evidence production on the pro-competitive merger effect is moderate, then a kind of countervailing incentive effect arises, according to which the firms undertaking an anticompetitive merger have more incentives to invest in evidence provision on efficiency gains than those engaging in pro-competitive mergers. In this case, the CA will find it harder to fight against the anticompetitive mergers ex post rather than ex ante. Finally, we also consider the case where the firms do not know ex ante their true type. Then the post-closing enforcement is likely to induce the firms to overfix the merger ex ante, so as to avoid the costlier ex post remedies. We thus amend our initial results, and show that only the low cost of evidence provision makes the post-closing enforcement perform better than the ex ante control.

The literature dealing with the optimal timing of competition policy is quite small and recent. Barros, 2003, and Berges et al., 2008, study the opportunity of mandatory notifications for the agreement exemptions under Art.101 TFEU in the EU. Choe and Shekhar, 2009, consider the same question, of compulsory ex ante notifications, for mergers. Our paper departs from these articles in two main aspects: we focus on the role of evidence provision, both before and after consummation, while the existing papers ignore this point, and moreover, we endogenize the evidence available. To our knowledge, there is only one paper (Ottavianni and Wickelgren, 2011) dealing with the impact of the information available on the timing of merger control. Their paper shows that the ex post enforcement is better as long as the quality of the information available to CA allows

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it to avoid relying ex post on the costly remedies to screen the mergers[6]. We take one step further, by studying the role of the endogenous asymmetric information between the firms and the competition authority through the evidence production process[7].

The paper proceeds as follows: the model is presented next, and the main results derived in Section 3. We then discuss possible policy implications in Section 4, before concluding in Section 5.

2   The model

We consider a merger control game between two agents: the merging firms and the competition authority. The merger leads to an anticompetitive effect of size x^A (the market power increase) and also to a pro-competitive effect of size x^P (the efficiency gains).

The payoffs

The profit earned from merger depends on both effects and is denoted $\pi(x^A, x^P)$. The profit increases in both variables. The net impact of the merger on the consumer surplus also depends on these two opposite competitive effects. Let it be denoted $W(x^A, x^P)$, where the function W stands for the consumer surplus variation due to the merger. We assume that the merger projects are heterogenous in terms of the efficiency gains that they generate. Let then x^P be either high ($\overline{x}$), with probability p, or low ($\underline{x}$), with probability $1-p$, and let x^A be equal to $\overline{x}$. A given merger project is welfare increasing only if $x^P \geq x^A$. Thus the population of merger projects actually exhibits two different types, depending on the level of pro- and anticompetitive effects. We call merger type ($x^A = \overline{x}, x^P = \underline{x}$) "anticompetitive" or welfare-decreasing, and denote it type B henceforth. On the contrary, the merger type ($x^A = \overline{x}, x^P = \overline{x}$) is called "pro-competitive", and denoted type G in

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[6]To the extent that the remedies may dampen the ex ante incentives to merge.

[7]Lagerlöf and Heidhues, 2005, also discussed the costly evidence production, but in order to establish the desirability of an efficiency defense in merger control.

what follows[8].

The CA applies a consumer surplus welfare standard. So as to avoid clearing anticompetitive mergers, the CA may condition its approval on the adoption of some corrective remedies (we assume that they always exist). Denote them R and assume they completely fix the anticompetitive effect of the merger. Nevertheless, they also reduce the efficiency gains. Hence the joint payoff from merger writes $\pi(x^A - R, x^P - R)$. In addition, if the firms undertake the remedies after the consummation of their merger, they incur an additional fixed cost equal to $k > 0$. The joint payoff from merger writes in this case $\pi(x^A - R, x^P - R) - k$. If the CA imposes remedies on the merger, the expected welfare change is equal to $\Delta = p\left(W(\overline{x} - R; \overline{x} - R) - W(\overline{x}; \overline{x})\right) + (1-p)\left(W(\overline{x} - R; \underline{x} - R) - W(\overline{x}; \underline{x})\right)$. We do not make any specific assumptions on the sign of this parameter. We interpret $\Delta < 0$ as the situation where the overfixing concern dominates (*i.e.* type I errors, or imposing remedies on pro-competitive mergers, are/is relatively costlier), whereas the anticompetitive concern is dominant otherwise (*i.e.* type II errors, or clearing anticompetitive, welfare-reducing mergers, are/is costlier).

The information available and the production of evidence

The merger type is the firms' private information. As a result, the final decision to either clear a merger or impose remedies will be made based on the hard evidence presented on its two opposite welfare effects. We assume that it is costly for the parties to produce this hard evidence, and that this cost differs according to the timing of the merger control. We denote by X^i the hard information provided on the variable x^i (where $i = A, P$).

Ex ante there is no hard evidence available on x^P, as opposed to x^A. We assume that the provision of $X^A = x^A - x$, where x is a positive parameter, is free. The provision

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[8]We do not tackle the effect of the firms' post-closing behavior on the type of their merger, however likely that may be. We thus restrict in this paper to the study of exogenous types of mergers to be challenged, or not, by the competition agency.

of $X^A = x^A$ costs c^A. Ex post, *i.e.* after the completion of the merger, the provision of $X^P = x^P - x$ comes at no cost, whereas that of $X^P = x^P$ costs c^P. To avoid trivial cases, we assume that $x > \overline{x} - \underline{x}$.

The firms provide information on x^P and the CA provides information on x^A. This assumption implies no loss of generality because the firms have no incentive to invest in evidence provision on x^P, and the CA has no access to evidence on efficiency gains and is thus constrained to ask the firms to provide it.

Our framework aims to replicate the present provision of evidence in merger control. Ex ante, the CAs use various methods to predict the probable price increase[9]. If the latter is high enough, it is practically impossible for firms to produce ex ante convincing evidence on future efficiency gains[10]. On the contrary, ex post the firms may have the opportunity and ability to provide convincing evidence on actual efficiency gains.

The merger control

The CA is able to challenge a merger project and impose corrective remedies on it based on the hard evidence on its anticompetitive effect. This burden of proof lies with the CA.

In order to avoid the remedies imposed by the CA, the firms need to provide enough hard information on x^P to make up for the alleged anticompetitive effect argued by the CA. Otherwise, meaning if the hard evidence on x^A exceeds that on x^P, *i.e.* $X^A > X^P$, the CA may impose remedies so as to avoid clearing an anticompetitive merger.

The merger control consists of the simultaneous provision of evidence by the CA and the firms, as well as a possible remedy request from the CA[11]. We consider two

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[9]See for instance the Upward Price Pressure in the case of differentiated products' industries - Farrell and Shapiro, 2010.

[10]See for instance the recent Deutsche Börse/NYSE-Euronext (M.6166) and TNT/UPS (M.6570) cases in the EU.

[11]The simultaneity is justified by the absence in the procedure of a clear leader for the provision of evidence. For instance, the European Merger Regulation requires firms to notify their merger. Only then

possible timings for this control process: before the completion of the merger (ex ante) and afterwards (ex post).

The game

Stage 1: The CA decides to control or not the merger ex ante.

The firms observe their merger type.

Stage 2: If no merger control takes place ex ante, the firms decide to undertake (or not) remedies before the merger. This decision is not observed by the CA.

Stage 3: The merger control takes place: the merging firms (or insiders) and the CA produce evidence, and the CA decides to impose remedies or not.

In what follows we determine the Perfect Bayesian Equilibrium of this game. The detailed proofs are provided in the final Appendix.

3 The optimal timing of merger control

We consider first the case of the ex ante merger control, and below we provide the optimal CA decision in this case.

Proposition 1 *If the ex ante merger control applies, the CA does not invest in further evidence production and requires remedies iff $\Delta > 0$.*

Proof. Ex ante there is no hard information on x^P, therefore full information on x^A is not needed for the CA to require remedies. Thus the CA imposes remedies iff the corresponding expected welfare is higher than without remedies, *i.e.* iff $\Delta > 0$.
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Let us explain this result. Ex ante, the merging firms have no access to verifiable information on the efficiency gains. Therefore the minimum available hard evidence on
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may the Commission initiate an in-depth examination of the project and ask for additional evidence from the firms.

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the anticompetitive effects of the merger is sufficient to justify the request of remedies. But if remedies are imposed, so as to avoid clearing the potential anticompetitive mergers, then the CA runs the risk of overfixing the pro-competitive ones. Thus the CA needs to balance the social cost of clearing anticompetitive mergers and the social cost of overfixing the pro-competitive ones. The CA's decision will depend on the magnitude of both, as captured by the sign of Δ. In short, since firms cannot provide ex ante any information on the merger type, the CA makes its decision based on its priors.

We turn now to the ex post merger control. The merger consummation will enable the production of hard evidence on the pro-competitive effect x^P. The main question is to what extent the hard information available on x^P will relax the trade-off between both types of merger control errors.

The following proposition gives both the CA' and the firms' strategies at the ex post merger control equilibrium.

Proposition 2 *If the ex post merger control applies, three possible types of equilibria may occur:*

- for $c^P > \bar{c}$, neither the merging firms nor the CA invest in further evidence production; the CA requires remedies (imposed if $X^A > X^P$), and type B merger undertakes remedies ex ante;

- for $\underline{c} < c^P < \bar{c}$, as well as for $c^A > \Delta$ and $c^P < \underline{c}$, type B invests in further evidence production with probability $b \in (0, 1]$, type G does not, whereas the CA invests with probability $a \in [0, 1)$ and requires remedies (imposed if $X^A > X^P$);

- for $c^P < \underline{c}$ and for $c^A < \Delta + p(W(\bar{x}; \bar{x}) - W(\bar{x} - R; \bar{x} - R))$, type G invests in further evidence production, type B does so with probability $b \in (0, 1)$ and the CA as well with probability $a \in (0, 1)$ while requiring remedies (imposed if $X^A > X^P$).

See proof in the Appendix.

Proposition 2 states that the cost of producing hard evidence on the merger's efficiency gains plays a key role for the merger assessment performed by the CA, as well as for the firms' choice to invest in the production of further evidence and to undertake remedies before the merger. We explain and discuss below the three types of equilibria identified in Proposition 2.

For a high cost of evidence production on efficiency gains, all parties refrain from the investment in further evidence provision and the type B merger will always undertake remedies ex ante. Let us explain why this is an equilibrium. The type B firms are certain to be imposed remedies ex post because of the prohibitive cost to produce ex post sufficient hard evidence on efficiency gains to counterbalance the CA's initial hard evidence on their anticompetitive effect. This expectation forces type B to undertake the remedies ex ante, and as a result, the CA has no incentives to invest in further hard evidence production on x^A. Type G insiders do not run the risk of costlier ex post remedies, precisely because the CA does not invest in further evidence production. In the end, there is neither clearing of anticompetitive mergers nor overfixing of pro-competitive ones in equilibrium, and the CA does not invest in further information. The additional cost of ex post remedies is sufficient to give incentives to the anticompetitive insiders to undertake them. Thanks to this screening effect, the CA avoids overfixing pro-competitive mergers without running the risk of clearing anticompetitive ones.

For a lower cost of evidence production on the merger's efficiency gains, a second type of equilibrium arises: the B merger type will have incentives to invest in further evidence production, and thus will no longer choose to undertake remedies ex ante, while the G merger type still does not invest in evidence production. It is worth stressing that this corresponds to a case of countervailing incentives, due to the fact that the opportunity cost of not investing in evidence production is higher for the B type. To see this, note

that as long as the hard information available on x^A is only partial, the B type may avoid the costlier remedies ex post by investing in evidence production on x^P, whereas the G type does not need this investment to avoid the ex post remedies. The mere fact that the B type invests in further evidence provision makes the merger harder to ban, and the lack of further evidence from the G type complicates the CA strategy even more. Actually, the CA may find itself ex post in a worse position than ex ante, since the firms' production of hard evidence on efficiency gains does not allow the screening of merger types. This would imply for the CA to base its decision on its priors, as ex ante. Therefore, so as to remedy the type B mergers, the CA is now constrained to invest in further evidence production on x^A, because ex post the B type provides evidence on efficiency gains. But then it will also have to impose remedies on type G mergers: indeed, the latter lack full hard information on x^P, since they do not invest in further evidence production. In fact, the CA will invest in further evidence production on x^A only if the welfare cost of clearing anticompetitive mergers is higher than the cost of overfixing the pro-competitive ones (in other words, the probability a is strictly positive only if $\Delta > 0$). Otherwise, the CA will not pay the cost of having hard evidence on the whole anticompetitive effect, and thus some anticompetitive mergers will be cleared.

A short comparative statics exercise on the incentives to invest in evidence provision highlights the substitutability between the investment strategies of the CA and the B type, as well as the complementarity between those of the CA and the G type. As the cost of evidence production on x^P goes down, the CA finds it optimal to increase its probability a of investing in hard evidence on x^A, so as to counteract the incentive of the B type to provide hard evidence on x^P. But this increase in the probability a will eventually trigger in return the investment in evidence provision by the G type, whom it will enable to avoid the increasing probability to face costly remedies ex post. Hence the third type of equilibrium for a low enough level of c^P, which we detail below.

When the costs of evidence production on both types of merger effects are low, all parties are induced to process and produce hard information, leading to the third type of equilibrium. For such low cost of evidence production on x^P, the G type will also find it interesting to invest in hard evidence and thereby avoid the costly ex post remedies. But since the B type already does so, then actually both types provide hard evidence on their full efficiency gains. Therefore the CA is now able to observe the true type of merger. This increases the returns from further evidence production for the CA itself, as compared with the previous type of equilibrium: by producing further hard evidence on x^A, the CA is now able to prevent welfare losses from the B type mergers by imposing remedies on them, without running the risk of overfixing the G type mergers, precisely because the latter also present hard evidence.

Before going on, let us make an additional point. The complementarity of investment in evidence production between the CA and the G type is illustrated by the very multiplicity of mixed-strategy equilibria: for a low cost of evidence production on x^P, the G type is induced to provide it if the CA itself produces hard evidence. In turn, and for the same cost of evidence production, if the probability for the CA to invest in evidence production is low, then the G type is not induced to invest, which comforts the CA in its choice of a low probability of evidence investment.

Based on the equilibria identified in Proposition 2, we determine below the optimal merger control decision.

Proposition 3 *The expected welfare comparison between the ex ante and the ex post settings leads to the following:*

   - if $c^P > \bar{c}$, the ex post merger control is optimal;

   -if $\underline{c} < c^P < \bar{c}$, the ex ante control is optimal;

   -if $c^P < \underline{c}$, the ex post control is optimal if c^A is low enough.

See proof in the Appendix.

Proposition 3 presents the optimal merger control timing to be adopted by the CA, depending on the cost of evidence production on efficiency gains and the dominant welfare concern.

First of all, if this evidence production cost is high, then the ex post merger control is optimal. This follows from Proposition 2, since in that case the insiders make a better choice regarding remedies than they do under the ex ante control, and consequently the CA can save on the evidence production cost. The high cost of evidence production on x^P prevents the B type from presenting verifiable information on the full efficiency gains, which explains why the B type is induced to undertake remedies beforehand, whereas the G type avoids them ex post. All in all, the decisions made by all players are efficient.

Instead, a lower evidence production cost on x^P may lead to some inefficient decisions as stressed in Proposition 2. Indeed, the countervailing incentive situation, *i.e.* the fact that type B invests in hard evidence production with a strictly positive probability whereas type G does not, constrains the CA to face a trade-off between clearing anticompetitive mergers and overfixing pro-competitive ones. If overfixing matters most, then ex post the CA will refrain from investing in the production of further evidence on x^A, and thus will clear anticompetitive mergers. Basically, this leaves the ex ante and ex post settings equivalent in terms of expected welfare. However, if clearing the anticompetitive mergers is the main concern, then ex post the CA is induced to invest in the production of further evidence on x^A to challenge them. But the additional cost of evidence prevents the CA to always block anticompetitive mergers. As a result, the ex ante assessment is optimal.

Finally, for a low cost of evidence production on x^P, Proposition 2 established that both merger types present verifiable information on their x^P. This clearly relaxes the trade-off of the CA, since the latter also invests in the production of full hard information on x^A so as to challenge the B mergers, but the hard evidence investment made by the

type G insiders will enable it to avoid overfixing. In other words, the enhanced hard evidence unambiguously improves the outcome of the ex post merger control, and makes it optimal as soon as the cost of hard evidence production for the CA is low enough. Note however that this optimality of the ex post settings comes at the cost of evidence production investments undertaken by both the CA and the firms. In other words, the two circumstances that we identify as justifying the optimality of the ex post assessment, *i.e.* when the evidence production cost on x^P is very high or very low, are not equivalent: there is no investment in evidence production in the former case. Equivalently, the ex post optimality is more cost-efficient when the evidence production cost on efficiency gains is high.

4 Policy implications

Proposition 3 provides insight on the optimal design of a potential ex post merger control. If one interprets the cost of evidence production as the consequence of a standard-of-proof setting, then Proposition 3 recommends to accompany the ex post merger control by a high standard of proof on the merger's efficiency gains (hence a high c^P) and a much lower standard of proof on its anticompetitive effects (hence a low c^A). To see this, note that a high standard of proof on efficiency gains forces the anticompetitive mergers to undertake remedies ex ante.

For instance, one may interpret the cost of evidence production on the pro-competitive effects as the weight put on post-merger information: the lower this weight, the higher the cost to provide convincing evidence on efficiency gains. This idea may have been subject to some debate within the FTC, with Chairman Muris reminding in the Genzyme/Novazyme case that the FTC may choose to discount certain post-merger evidence (especially if the firms have the ability of controlling this evidence), while Commissioner Rosh argued in favor of a widespread use of post-merger information as allowed by the 2010 Merger

Guidelines in the Polypore merger decision[12]. In this respect, Proposition 3 emphasizes the positive role of a high standard of proof on efficiency gains in case of consummated merger control.

One may also interpret the cost of hard evidence provision as resulting from the length of the period enabling the processing of information. Explicitly, the longer the time gap between the merger completion and the ex post assessment, the lower the cost of hard evidence production on x^P, and thus the higher the likelihood of the countervailing incentives case[13]. In this context, Proposition 3 urges the ex post control to take place relatively shortly after the merger, because this would keep the cost of evidence production on x^P sufficiently high, and this would eventually push the anticompetitive insiders to adopt the remedies ex ante, before the control takes place[14].

Finally, one ought to check the robustness of the policy implications when the merging firms do not know ex ante their true type. The risk of incurring costly ex post remedies combined with a high cost of evidence production may instead induce insiders to undertake remedies ex ante. In that case, the benefit of ex post information on the pro-competitive merger effect would be wasted. It is in order to capture this possible perverse effect of the ex post enforcement that we consider below that ex ante the merging firms do not know their true merger type. We also focus on the case where the overfixing dominates the

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[12]Polypore International, Inc. v. FTC (No 11-10375, 2012 U.S. App. LEXIS 14195 (11th Cir. July 11, 2012)).

[13]Remember though that we do not deal with the firms' capacity to manipulate the evidence during this period, which may lead to enhanced screening difficulties for the CA.

[14]Incidently, this apears to be quite close to the recommendation of Commissionner Thompson when discussing the Genzyme/Novazyme case: "To ensure adequate opportunity for the Commission to obtain meaningful relief for consumers, it is critical that the Commission promptly review problematic consummated transactions that are not reported under the Hart-Scott-Rodino Act..." - see footnote 31 of the dissenting statement previously quoted.

anticompetitive concerns ($\Delta > 0$), so as to discuss the possible deterrent effect of having better information ex post[15].

The game is amended as follows. Ex ante, the firms do not observe their true type, but ex post the merger type is the firms' private information. By considering the case where $\Delta > 0$, the CA clears the merger without remedies in case of ex ante enforcement. In this context, the ex post enforcement may be better only to the extent that, thanks to the better information available ex post, the CA would clear pro competitive mergers and block anticompetitive mergers.

We thus need to determine the equilibrium strategies in case of ex post control and the optimal CA decision. We do so below, and then conclude on the welfare comparison between the ex ante and ex post enforcement.

Proposition 4 *(i) If the firms do not know ex ante their merger type, and if the CA adopts the ex post control, the firms decide to undertake remedies ex ante for $c^P > c(c^A, k)$.*

(ii) The ex post control becomes optimal whenever $c^P < c(c^A, k)$ and $c^A < \Delta$. Otherwise, the ex ante control dominates.

See proof in the Appendix.

We first show that the firms are induced to undertake remedies ex ante if the cost of evidence on efficiency gains is high. Indeed, the insiders may reduce the risk of costly ex post remedies by investing in further evidence on efficiency gains. If this cost is excessively high, it is less costly to undertake remedies ex ante. We therefore conclude that the ex post control is worse than the ex ante control when it induces the merging firms to undertake remedies ex ante[16].

For a lower cost of evidence production on efficiency gains, the insiders take the risk of refraining from ex ante remedies, because ex post the bad merger type may avoid

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[15]This is actually the same starting point as Ottaviani and Wickelgren (2011).

[16]This is a similar conclusion to the one reached by Ottavianni and Wickelgren (2011).

the costlier remedies by investing in further evidence provision on efficiency gains. If combined with a low cost of evidence on anticompetitive effects, the ex post control may become optimal. The intuition is straightforward: if the cost of producing evidence on the anticompetitive effects is high, the CA will not block anticompetitive mergers. As a result, the outcome of the ex post control is the same as ex ante. Instead, if the cost of evidence production on the anticompetitive effects is low enough, the CA invests in further evidence provision with a positive probability and requires remedies. Then, the G-merger type also invests in further evidence and avoids remedies, but so does the bad merger type with a positive probability. In this case, the ex post control is clearly optimal, because it reaps both benefits from the better ex post information on pro-competitive effects: screening and clearing the good merger type, while imposing remedies to the bad one[17]. Nevertheless, so as to provide incentives for insiders to run the risk of costly ex post remedies, the bad type must be cleared with a positive probability. This happens whenever the cost of evidence production on efficiency gains is low enough. In other words, some inefficiency in the ex post control is necessary in order to leave ex ante a rent to the merging firms and induce them to merge without undertaking remedies. Thus the presence of the ex ante risk on the true level of merger type ought to make the CA set a lower standard of proof on both pro- and anticompetitive effects.

5   Conclusion

This paper sheds some light on the optimal timing to be adopted by merger control, before or post closing. This trade-off depends on the main welfare cost of the merger policy, either clearing anticompetitive deals or overfixing pro-competitive ones, and also on the parties' endogenous hard evidence on the merger competitive effects. Our policy recommendations

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[17]This outcome cannot be obtained in Ottaviani and Wickelgren's model due to the lack of endogenous information through evidence production.

ultimately hinge upon the cost of hard evidence provision on the merger's competitive effects. For instance, the ex post enforcement turns out optimal whenever the costs of providing verifiable information on both efficiency gains and market power increase are sufficiently low, regardless of whether the firms know ex ante or not their true merger type. We leave however for future research the issue of the opportunity to simultaneously allow for both ex ante and ex post enforcement, or that of endogenizing the ex post merger type through the post closing behavior of the merging firms.

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6 Appendix

Proof of Proposition 2.

We determine here the Perfect Bayesian Equilibrium of the game where the CA controls mergers ex post. The strategy of each type of firm consists of undertaking or not remedies ex ante and investing in further evidence on x^P. The CA decides whether to invest in further evidence on x^A.

We adopt the following notations:

-type B invests in evidence production with probability b,

-type G invests with probability g,

-the CA invests with probability a.

We detail below the possible equilibrium strategies.

The CA

We determine below the best strategy for the CA.

Note that the CA has always incentives to require remedies if $X^A > X^P$. Indeed, to reduce the probability of imposing remedies to type G, it is more profitable to decrease the probability of investing in evidence production on x^A rather than to decrease the probability of requiring remedies.

If type B does not undertake remedies and invests in further evidence with probability b and type G does not invest and does not undertake remedies, then the CA invests in further evidence iff:

$$pW(\overline{x} - R; \overline{x} - R) + (1-p)W(\overline{x} - R; \underline{x} - R) - c^A \geq$$
$$pW(\overline{x}; \overline{x}) + (1-p)\left((1-b)W(\overline{x} - R; \underline{x} - R) + bW(\overline{x}; \underline{x})\right)$$
$$\Leftrightarrow b \geq \frac{p(W(\overline{x};\overline{x}) - W(\overline{x}-R;\overline{x}-R)) + c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R) - W(\overline{x};\underline{x}))}.$$

If type B does not undertake remedies and invests with probability b and type G invests with probability 1, the CA invests iff:

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$$pW(\overline{x};\overline{x}) + (1-p)W(\overline{x}-R;\underline{x}-R) - c^A \geq$$
$$pW(\overline{x};\overline{x}) + (1-p)\left((1-b)W(\overline{x}-R;\underline{x}-R) + bW(\overline{x};\underline{x})\right)$$
$$\Leftrightarrow b \geq \frac{c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R) - W(\overline{x};\underline{x}))}.$$

If type B does not invest and type G invests with a positive probability, then the CA does not invest either.

Type B

The firms have no incentives to undertake remedies and then invest in evidence production. Also, we can exclude the case where the firms do not undertake remedies and do not invest. Indeed, the CA always require remedies and then the firms would always pay the extra cost k. Thus, we consider only the two non-dominated strategies:

-not undertaking remedies ex ante and investing in further evidence

-undertaking remedies ex ante.

Type B is indifferent between both iff:

$$a(\pi(\overline{x}-R;\underline{x}-R) - k) + (1-a)\pi(\overline{x};\underline{x}) - c^P = \pi(\overline{x}-R;\underline{x}-R)$$
$$\Leftrightarrow a = \frac{\pi(\overline{x};\underline{x}) - \pi(\overline{x}-R;\underline{x}-R) - c^P}{\pi(\overline{x};\underline{x}) - \pi(\overline{x}-R;\underline{x}-R) + k} \equiv a^B.$$

We have $a^B > 0$ iff $c^P < \pi(\overline{x};\underline{x}) - \pi(\overline{x}-R;\underline{x}-R) \equiv \overline{c}$.

Type G

has three non-dominated strategies:

-undertaking remedies ex ante: $\pi(\overline{x}-R;\overline{x}-R)$;

-not undertaking remedies and investing in further evidence: $\pi(\overline{x};\overline{x}) - c^P$;

-not undertaking remedies and not investing: $a(\pi(\overline{x}-R;\overline{x}-R) - k) + (1-a)\pi(\overline{x};\overline{x})$.

If type G does not undertake remedies, it is indifferent between investing and not investing in further evidence iff $\pi(\overline{x};\overline{x}) - c^P = a(\pi(\overline{x}-R;\overline{x}-R) - k) + (1-a)\pi(\overline{x};\overline{x})$

This is the case for $a = \frac{c^P}{\pi(\overline{x};\overline{x}) - \pi(\overline{x}-R;\overline{x}-R) + k} \equiv a^G.$

There exists a unique $\underline{c}$ such that $a^B > a^G$ iff $c^P < \underline{c}$, where $\underline{c} = \frac{\overline{c}}{2}$.

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Perfect Bayesian Equilibria

Let us now consider the different equilibria according to the levels of c^i $(i = A, P)$:

(i) $c^P > \bar{c}$:

The cost c^P induces the B type to adopt the dominant strategy $b = 0$ and undertake remedies. Thus the CA adopts the strategy $a = 0$. It follows that type G adopts $g = 0$ and does not undertake remedies.

(ii) $\underline{c} < c^P < \bar{c}$:

If $\frac{p(W(\bar{x};\bar{x}) - W(\bar{x} - R;\bar{x} - R)) + c^A}{(1-p)(W(\bar{x} - R;\underline{x} - R) - W(\bar{x};\underline{x}))} > 1$, which is equivalent to $c^A > \Delta$, the CA does not invest in further evidence. Then, there is a unique equilibrium where $a = 0$, $g = 0$ and $b = 1$.

If $c^A < \Delta$, there is no equilibrium where type B invests in further evidence with a positive probability and the CA does not invest. Thus, we look for an equilibrium where the CA invests in further evidence. There is no equilibrium in pure strategies where $a = 1$ and $b = 1$ because then type B deviates and does not invest. Then type B and the CA adopt a mixed strategy with $a = a^B$ and $b = \frac{p(W(\bar{x};\bar{x}) - W(\bar{x} - R;\bar{x} - R)) + c^A}{(1-p)(W(\bar{x} - R;\underline{x} - R) - W(\bar{x};\underline{x}))}$. As a result type G does not invest $(g = 0)$ because $c^P < \bar{c}$.

(iii) $c^P < \underline{c}$:

The previous equilibrium with $b = 1$, $g = 0$ and $a = 0$ still exists if $c^A > \Delta$.

If we look for an equilibrium where the CA does invest, then the unique candidate is an equilibrium where $a = a^B$ and $b = \frac{c^A}{(1-p)(W(\bar{x} - R;\underline{x} - R) - W(\bar{x};\underline{x}))}$. As a result, we have $g = 1$. This is an equilibrium as long as $c^A < (1 - p)(W(\bar{x} - R;\underline{x} - R) - W(\bar{x};\underline{x}))$.

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Proof of Proposition 3.

Here we compare the expected consumer surplus net of the cost of evidence production for the CA.

(1) For $c^P > \bar{c}$: it is straightforward that the ex post merger control is optimal, since it induces optimal ex ante remedy choices on behalf of the firms.

(2) For $\underline{c} < c^P < \overline{c}$:

If $c^A < \Delta$, implying that $\Delta > 0$:

In case of ex post control, the expected welfare is equal to:

$(a + (1-a)(1-b))\left((1-p)W(\overline{x} - R; \underline{x} - R) + pW(\overline{x} - R; \overline{x} - R) - c^A\right)$

$+ (1-a)\, b\left((1-p)W(\overline{x}; \underline{x}) + pW(\overline{x}; \overline{x})\right)$

$= b(1-a)(c^A - \Delta) + (1-p)W(\overline{x} - R; \underline{x} - R) + pW(\overline{x} - R; \overline{x} - R) - c^A.$

In case of ex ante control the expected welfare is:

$(1-p)W(\overline{x} - R; \underline{x} - R) + pW(\overline{x} - R; \overline{x} - R)$, which is higher.

If $c^A > \Delta$, for which it is possible to have $\Delta < 0$, then $a = 0$ and only the B type invests in further evidence ($b = 1$), and thus the ex ante and ex post settings lead to the same expected welfare (equal to $pW(\overline{x}; \overline{x}) + (1-p)W(\overline{x}; \underline{x})$).

(3) For $c^P < \underline{c}$ and $c^A < (1-p)(W(\overline{x} - R; \underline{x} - R) - W(\overline{x}; \underline{x}))$:

The expected welfare in case of ex post control writes

$pW(\overline{x}; \overline{x}) + (1-p)\left((1-b)W(\overline{x} - R; \underline{x} - R) + bW(\overline{x}; \underline{x})\right).$

With ex ante control, it writes $(1-p)W(\overline{x} - R; \underline{x} - R) + pW(\overline{x} - R; \overline{x} - R)$ if $\Delta > 0$, whereas if $\Delta < 0$ it is equal to $pW(\overline{x}; \overline{x}) + (1-p)W(\overline{x}; \underline{x})$.

In both cases the ex post control is better.

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Proof of Proposition 4.

We determine here the Perfect Bayesian Equilibrium of the game where the CA controls mergers ex post. The strategy of the firms consists in undertaking or not remedies ex ante and investing in further evidence on x^P according to their type. The CA decides whether to invest in further evidence on x^A.

Let us adopt the following notations:

-type B invests in further evidence production with probability b,

-type G invests with probability g,

-the CA invests with probability a.

We first consider the case where the merging firms do not undertake remedies ex ante.

Type B

It has two strategies ex post:

-investing in further evidence: $a(\pi(\overline{x} - R; \underline{x} - R) - k) + (1 - a)\pi(\overline{x}; \underline{x}) - c^P$

-not investing: $\pi(\overline{x} - R; \underline{x} - R) - k$.

Type B is indifferent between both iff:

$a(\pi(\overline{x} - R; \underline{x} - R) - k) + (1 - a)\pi(\overline{x}; \underline{x}) - c^P = \pi(\overline{x} - R; \underline{x} - R) - k$

$\Leftrightarrow c^P = (1 - a)(\pi(\overline{x}; \underline{x}) - \pi(\overline{x} - R; \underline{x} - R)) + (1 - a)k$, leading to a cut-off probability

$a = \frac{\pi(\overline{x}; \underline{x}) - \pi(\overline{x} - R; \underline{x} - R) - c^P + k}{\pi(\overline{x}; \underline{x}) - \pi(\overline{x} - R; \underline{x} - R) + k} \equiv a^B$. Note that $a^B > 0$ iff $c^P < \pi(\overline{x}; \underline{x}) - \pi(\overline{x} - R; \underline{x} - R) + k = \overline{c} + k \equiv \overline{c}^r$.

Type G

It has two strategies ex post:

-investing in further evidence: $\pi(\overline{x}; \overline{x}) - c^P$

-not investing: $a(\pi(\overline{x} - R; \overline{x} - R) - k) + (1 - a)\pi(\overline{x}; \overline{x})$.

Type G is indifferent between them iff

$\pi(\overline{x}; \overline{x}) - c^P = a(\pi(\overline{x} - R; \overline{x} - R) - k) + (1 - a)\pi(\overline{x}; \overline{x})$

$\Leftrightarrow c^P = a(\pi(\overline{x}; \overline{x}) - \pi(\overline{x} - R; \overline{x} - R)) + ak$.

This is the case for $a = \frac{c^P}{\pi(\overline{x}; \overline{x}) - \pi(\overline{x} - R; \overline{x} - R) + k} \equiv a^G$.

Therefore there exists a unique $\underline{c}^r$ such that $a^B > a^G$ iff $c^P < \underline{c}^r = \frac{\overline{c}^r}{2}$.

The CA

As proved before, the CA always requires remedies if $X^A > X^P$.

Moreover, if type B invests in further evidence with probability b but type G does not, then the CA invests iff:

$pW(\overline{x} - R; \overline{x} - R) + (1 - p)W(\overline{x} - R; \underline{x} - R) - c^A \geq$

$$pW(\overline{x};\overline{x}) + (1-p)\left((1-b)W(\overline{x}-R;\underline{x}-R) + bW(\overline{x};\underline{x})\right)$$

$$\Leftrightarrow b \geq \frac{p(W(\overline{x};\overline{x})-W(\overline{x}-R;\overline{x}-R))+c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R)-W(\overline{x};\underline{x}))}.$$

If type B invests with probability b and type G invests with probability 1, the CA invests iff:

$$pW(\overline{x};\overline{x}) + (1-p)W(\overline{x}-R;\underline{x}-R) - c^A \geq$$

$$pW(\overline{x};\overline{x}) + (1-p)\left((1-b)W(\overline{x}-R;\underline{x}-R) + bW(\overline{x};\underline{x})\right)$$

iff $b \geq \frac{c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R)-W(\overline{x};\underline{x}))}$

If type B does not invest but type G invests, then the CA does not invest either.

If the firms decide to undertake remedies ex ante, they do not invest in evidence production and thus earn $p\pi(\overline{x}-R;\overline{x}-R) + (1-p)\pi(\overline{x}-R;\underline{x}-R)$.

Perfect Bayesian Equilibria

To determine the equilibria, we first look for equilibria candidates where the firms do not undertake remedies ex ante:

(i) $c^P > \overline{c}^r$:

There is a possible equilibrium where the firms do not undertake remedies and neither type invests in further evidence production: $b = g = 0$ and thus $a = 0$. The expected profit is then equal to $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x}-R;\underline{x}-R) - k)$. The firms can deviate by undertaking remedies.

(ii) $\underline{c}^r < c^P < \overline{c}^r$:

There exist two possible equilibria:

$a = a^B$, $g = 0$ and $b = \frac{p(W(\overline{x};\overline{x})-W(\overline{x}-R;\overline{x}-R))+c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R)-W(\overline{x};\underline{x}))} < 1$ iff $c^A < \Delta$,

and $b = 1$, $g = 0$ with $a = 0$ if $c^A > \Delta$.

In both cases the expected profit is equal to $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x};\underline{x}) - c^P)$.

The firms can also deviate and undertake remedies ex ante.

(iii) $c^P < \underline{c}^r$:

There exist two possible equilibria:

$a = a^B$, $g = 1$ and $b = \frac{c^A}{(1-p)(W(\overline{x}-R;\underline{x}-R)-W(\overline{x};\underline{x}))}$ if $c^A < (1-p)(W(\overline{x}-R;\underline{x}-R) - W(\overline{x};\underline{x}))$; the expected profit is then equal to $p(\pi(\overline{x};\overline{x})-c^P)+(1-p)(\pi(\overline{x}-R;\underline{x}-R)-k)$.

and $b = 1$, $g = 0$ with $a = 0$ if $c^A > \Delta$; the expected profit is then $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x};\underline{x}) - c^P)$.

Again, the firms can deviate by undertaking remedies.

Let us now determine the optimal strategy ex ante.

The expected profit depends on the strategy adopted:

-if the firms undertake remedies ex ante, the expected profit is equal to $p\pi(\overline{x}-R;\overline{x}-R) + (1-p)\pi(\overline{x}-R;\underline{x}-R)$, as before mentioned;

-if the firms do not undertake remedies ex ante, then following the above discussion, the expected profit, denoted below $\Pi(k, c^P, c^A)$, is equal to:

(i) $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x}-R;\underline{x}-R)-k)$ if $c^P > \overline{c}^r$

(ii) $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x};\underline{x}) - c^P)$ if $\underline{c}^r < c^P < \overline{c}^r$;

(iii) $p(\pi(\overline{x};\overline{x}) - c^P) + (1-p)(\pi(\overline{x}-R;\underline{x}-R)-k)$ if $c^P < \underline{c}^r$ and if $c^A < (1-p)W(\overline{x}-R;\overline{x}-R) - W(\overline{x};\overline{x})$ and equal to $p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x};\underline{x}) - c^P)$ if $c^P < \underline{c}^r$ and if $c^A > \Delta$.

The profit $\Pi(k, c^P, c^A)$ is a decreasing function of c^P and c^A. In addition, if $c^A \geq (1-p)W(\overline{x}-R;\overline{x}-R) - W(\overline{x};\overline{x})$, for c^P low enough we have $\Pi(k, c^P, c^A) > p\pi(\overline{x}-R;\overline{x}-R) + (1-p)\pi(\overline{x}-R;\underline{x}-R)$.

Thus there exists a threshold of c^P denoted $c(c^A, k)$ such that the firms undertake remedies ex ante iff $c^P > c(c^A, k)$.

Note that $c(c^A, k) > 0$ for any k and for $c^A \leq \Delta$:

$\Pi(k, c^P, c^A = \Delta) = p\pi(\overline{x};\overline{x}) + (1-p)(\pi(\overline{x};\underline{x}) - c^P) >$
$p\pi(\overline{x}-R;\overline{x}-R) + (1-p)\pi(\overline{x}-R;\underline{x}-R)$ for c^P low enough.

Welfare comparison between the ex post and ex ante control:

If $c^P > \bar{c}^r$, the ex ante control leads to a higher welfare.

If $c^P < \bar{c}^r$:

(i) As long as the firms undertake remedies ex ante $(c^P > c(c^A, k))$, the ex ante control is better than the ex post control.

(ii) If $c^P < c(c^A, k)$ and if the CA does not invest in further evidence $(a = 0)$, the ex post control and the ex ante control are equivalent.

(iii) If $c^P < c(c^A, k)$ and if the CA invests in further evidence $(a > 0)$ which is always the case for $c^A < \Delta$, the ex post control is better than the ex ante control, since the expected welfare comparison writes: $pW(\bar{x}; \bar{x}) + (1-p)\left((1-b)W(\bar{x} - R; \underline{x} - R) + bW(\bar{x}; \underline{x})\right) > pW(\bar{x}; \bar{x}) + (1-p)W(\bar{x} - R; \underline{x} - R)$.

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