

Do Remedies Affect the Efficiency Defence?

An Optimal Merger Control Analysis.

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March 14, 2007‡

Abstract

This paper looks at the optimal use of remedies and efficiency defence for merger control. We develop a framework where the merger efficiency gains are endogenously obtained and not observed by the Competition Authorities. Firstly, we recall that the adoption of an efficiency defence is likely to push firms to better design the merger, so that it will lead to more efficiency gains. Secondly, we claim that merger remedies interact with the efficiency defence, both regarding the above-mentioned incentive effect, and in terms of the quality of information necessary for the adoption of the efficiency defence. We show that remedies reduce the incentive to achieve the efficiency gains, but can be used as a signal of the actual level of efficiency gains. We examine the interaction between remedies and efficiency defence and conclude on

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‡We are indebted for their helpful remarks to Vianney Dequiedt, David Encaoua, Laurent Linnemer, Massimo Motta, Anne Perrot, Patrick Rey, Jean-Marc Tallon and Bertrand Wigniolle. The usual disclaimer applies.

the opportunity of applying them both depending on the Competition Authorities' focus on inciting more efficient mergers.

Keywords: merger control, efficiency defence, merger remedies

JEL classification: L41, K21, D82

1. Introduction

Merger control aims to screen concentrations, so as to identify and clear competitive mergers, as well as to prohibit or to modify and thus make less harmful the anti-competitive ones. To put it short, this comes down to asking whether a concentration under review represents a threat for competition, and if so, to find how best that threat can be eliminated.

The merger assessment process is devoted to answering the first question. Central to this merger assessment is the appraisal of the potential efficiency gains that the merger can lead to. Merger regulations acknowledge today that efficiency gains are likely to offset the negative impact of a merger project and thus include possible efficiency gains as an element of the competitive balance of a merger. The underpinning theoretical rationale can be traced back Williamson (1968), who developed the concept of a trade-off analysis between losses in allocative efficiency and gains in productive efficiency as a result of a merger. Based on this global competitive assessment, those mergers that are declared to be detrimental to competition and consumers may be prohibited. Nevertheless, competition authorities often make use of remedies instead, so as to modify the potentially harmful impact of mergers. Remedies are structural or behavioural "commitments" offered by the merging parties in order to secure the merger approval. The object of remedies is to reduce the parties' market power and restore conditions for effective competition, lest the merger be detrimental.

Unlike other branches of competition policy, dealing with the ex-post punitive control of illegal conduct, merger control is supposed to assess the merger's consequences, and to remedy them if necessary, before they even take place (Motta (2004)). As a result, since the merger is not completed, the information at the disposal of the competition authority is likely to be poor. For instance, the efficiency gains that the firms argue are hard to verify for the competition authorities, which partly explains why merger control is always prone to type I and II errors. The true challenge for the merger policy is thus to minimize the consequences of the two types of errors. This is not necessarily focusing on a lower number of errors, but rather minimizing type II errors in those cases where significant net harmful effects are likely, and minimizing type I errors in those cases where significant net beneficial effects are likely.

Moreover, beyond this primary purpose of error minimization, the use by competition authorities of both remedies and efficiency gains as part of the competitive assessment modifies the expected profit of a merger project. As a result, the choice to use these tools has an *ex ante* incentive effect on the type of projects that firms decide to carry through. For instance, Seldeslchats et al. (2006) test for the deterrence effect of the increasing use of remedies by the competition authorities, and show that remedies lead firms to notify merger projects that they would have forgone if remedies had not been allowed by the competition authorities¹. Much in the same way, Jorde and Teece (1990) (see also Shapiro and Willig (1990)) claimed that by clearing the R&D joint ventures after a global economic evaluation, the European anti-trust legislation gave higher incentives for firms engaging in innovating cooperative agreements. In the US it was feared that the stricter antitrust control applied there deterred American joint ventures contemplating innovation. From this point of view, one consequence from taking into account efficiencies for the merger assessment is that merging firms can bring forward

¹Aaronson (1992) quotes a case in the UK food industry where a merger refusal deters subsequent merger proposals.

the potential efficiency gains from merger as an argument to increase the probability of merger acceptance, within the so called 'efficiency defence'. We argue here that the latter can provide positive *ex ante* incentives. Indeed, if firms cannot benefit from their achievement of efficiency gains, they have lower incentives to make the effort of carrying them out. Indeed, in practice, planning and achieving an efficient merger is costly. For instance, as a recent Financial Times article ("Clean teams banish acquisition uncertainty", August 8, 2006) argues, an increasingly favoured approach to integrating two disparate companies is "to use a 'clean team' [...]. Clean teams collect and analyze data from both parties, which it then uses to plan how the merger will work - and crucially, where the synergies and cost savings will occur. Such a team starts its work well in advance of the completed deal, setting out a strategy for realizing the claimed 'synergies'²."

The objective of this paper is to examine the optimal combination of remedies and efficiency defence, taking into account the *ex ante* incentives and the information asymmetry between merging firms and the competition authorities. *By so doing, we provide an insight into what should be the best merger policy, considering the relative importance of the two types of merger control errors. We argue that if the benefit expected from an efficient merger is high, the best policy consists in applying an ED without allowing remedies. Instead, if an inefficient merger without remedies is highly harmful, the combination of remedies and ED is more appropriate for maximizing expected welfare.*

To start with, we assume here that a necessary condition for merging firms to achieve the efficiency gains is to exert an *ex ante* designing effort. This effort is costly, it does

²Further quoting Oligopoly Watch (August 12, 2006), "Such teams were used in the initial combination of three firms that formed Arcelor in 2001. It was used by Hewlett-Packard in its acquisition of Compaq in 2002. Cadbury Schweppes followed suit in its buyout of Adams Gum in 2003 from Pfizer. Because of the big expense, the approach is mainly used by big firms for big (billion dollar plus) deals."

not always succeed, and the insiders are privately informed on the result of this *ex ante* planning effort. To account for this information problem, in our framework we consider that the competition authorities receive an observable signal which is only imperfectly correlated with the merger's efficiency gains. This public signal captures the whole verifiable information produced both by firms and the competition authorities. We interpret an efficiency defence (ED henceforth) decision rule as a commitment on behalf of the competition authority (CA henceforth) to take into account this public signal for the merger clearance decision. As a result, under such a decision rule, the two types of error are possible, because a good signal can make the CA accept an inefficient merger, whereas a poor signal can induce the refusal of an efficient merger.

A possible alternative for merger clearance, and the one we consider here, is for the CA is to accept the merger if firms adopt remedies. We model them in accordance with the merger control policy, as commitments undertaken by firms. Remedies imply a private cost for firms, to the extent that the profit thus obtained is lower than it would be without remedy. Nevertheless, a remedy will be effective, and thus ensures a welfare improvement w.r.t. the status-quo if applied to an anti-competitive merger, yet it will write off any private benefit from efficiencies if undertaken by efficient firms.

In this framework, the first step is to determine the opportunity for the CA to adopt the ED decision rule for merger clearance rather than the remedy rule. We show that the CA adopts the ED rule only if the quality of the signal is high enough. The underlying intuition is the following. Applying the ED rule is justified as long as firms exert the costly effort and there are sufficiently rare errors of both types, which leads to obtain in the end a higher expected welfare than with remedies only. Yet, insiders will undertake the effort only if the probability to see the efficient merger accepted is high enough. Similarly, from the CA's standpoint, the expected welfare with the ED is higher than the welfare with remedies if the probability to accept an inefficient merger is low enough. All in all, the application of the ED is justified for the CA basically

as long as the welfare loss due to both types of error is not too important. Thus the adoption of the ED rule stems from the trade-off between the following two effects. On the one hand, the benefit from the ED is the provision of the incentive effect, making firms exert the costly effort to obtain efficiencies, but on the other hand, the cost of the ED is the risk of type II error and the ensuing welfare loss due to the imperfect signal.

The next step is to study the opportunity for the CA to adopt a decision rule that allows both remedies and ED, meaning the commitment to clear a merger either if the signal observed is positive or if firms undertake remedies. We show that when thus allowed for together with the ED, merger remedies affect the previously mentioned trade-off between the incentive and type II error effects. On the one hand, for a substantial range of quality of merger assessment, the remedies lower the *ex ante* effort incentives of firms, because they increase the opportunity cost of the ED for the merging firms since the latter can always propose remedy instead and have their merger cleared. On the other hand, accepting a merger with remedy represents for the CA the opportunity of completely eliminating type II error, because when given the choice between applying for the ED and proposing remedy firms can actually self-select. Indeed, the higher the quality of the signal, the higher the cost to notify an inefficient merger without remedies. Thus, for an accurate signal, an inefficient merger will propose remedies while an efficient merger will call for an ED. Firms truthfully signal the characteristics of their merger through the notification ultimately made, thus eliminating the information asymmetry. This allows us to conclude that if the welfare cost of accepting an inefficient merger is quite high, the CA prefers to allow remedies in addition to the ED rather than an ED decision rule without remedies, so as to lead the firms to self-select according to their level of efficiencies. In turn, the CA may instead privilege the effort incentive provision by applying the ED without allowing remedies, whenever either the welfare loss of an inefficient merger is rather tolerable or whenever the welfare benefit of an efficient merger is highly socially profitable.

The remainder of the paper is organized as follows. Next we present the literature related to our topic. Then we describe the model and we establish a benchmark for our ED analysis, so as to go on to explore the interaction between ED and remedies. Last, we discuss the implications for merger control. We conclude before presenting all technical proofs in a final section.

2. Relationship to the literature

The true novelty of our study is to examine the interaction between remedies and ED in a framework where endogenous efficiency gains are influenced by the merger control decision rule adopted by the CA. To our knowledge no work has been done on this topic. However, there exists a large literature on the two basic ingredients of our paper, namely the *ex ante* impact of the merger control as well as the implications of the information asymmetry for the optimal merger control.

The *ex ante* effects of the merger policy in general have already been pointed out in the literature. Neven et al. (1993) note that merger control may result in "mergers that would otherwise be attractive to firms, but that they do not even try to undertake because of fear that they will not be approved, [...] or in transactions that may take place in a form different from that they would have taken in the absence of regulation". Persson (2004) criticizes the tendency to enforce a stricter merger policy, as he claims it may turn out to be counterproductive, because it can increase the incentive for predation³. In his turn, Ecer (2005) shows that the tendency to apply a stricter merger policy may be instead ineffective, since firms endowed with rational expectations are

³In the field of patent law and innovation policy, Caillaud and Duchene (2004) similarly argue that a stricter regulation is not optimal. The article addresses the overload problem faced by the US patent office, and obtains that the optimal patent assessment process should be rather lenient and accept a number of "bad" patents within a pooling equilibrium, because this encourages the up-stream R&D, so that more "good" patents would eventually be granted.

able to bypass it. Basically, he argues that it does make sense to assume that merging firms react to the existing merger control provisions by designing merger projects accordingly, much in the vein of Besanko and Spulber (1993): "the size and type of firms that contemplate mergers are determined not only by the anticipated returns from the merger but also by antitrust merger enforcement"⁴.

By the same token, the *ex ante* incentive properties of merger remedies have equally been already pointed out. Along with Farrell (2003) and Vasconcelos (2005), we quote the negative effect of remedies on the incentives to look for a more efficient merger. Vasconcelos (2005) obtains this in a model where the competition authority makes use of divestitures to implement its most preferred market structure (i.e. "overfix" the merger, by going beyond the corrective purpose of the remedy), and thereby may actually discourage firms to undertake more efficient mergers, whereas Farrell (p.7,2003) warns that "over-fixing confiscates part of the rents from finding the efficient merger, and thus discourages firms from seeking out and pursuing efficiency-oriented mergers".

In addition, what distinguishes our contribution from others dealing with the ED as an information process is that we do not focus on the implications of the information-related evidence production costs associated with the information asymmetry between merging firms and the CA. The ED is known to give rise to exacting information requirements, and Gonzalez (2004) investigates how antitrust agencies should structure the disclosing of information about efficiency gains from interested parties (merging firms and competitors). Such burden of proof necessarily yields a substantial increase in ad-

⁴See also Barros (2003) for a study of the change in the design of cooperative agreements induced by the shift from an *ex ante* notification regime to one of *ex post* control under the European Commission reform of the Community competition policy. Accordingly, the *ex-post* control of agreements is shown to induce the self-selection of more competitive projects, since partners face a higher opportunity cost than in the case of the *ex ante* notification regime. See also Bergès-Sennou et al. (2004) on the same topic, but from an opposite standpoint (i.e. identifying the optimal strategy in terms of competition policy).

ministrative costs for merger control, and the discussion of its implications is important for the economic analysis of the ED. Not surprisingly, the explicit acknowledgement of the ED in the European Merger Regulation of 2004 was actually long debated because of its associated implementation costs (see Ilzkovitz and Meiklejohn (2001) for a review of this debate). An important argument against the ED was the possibly prohibitive cost of information acquisition due to the context of asymmetric information for the CA, because without perfect information, the ED procedure necessarily raises the question of the costly verification of those alleged efficiency gains. Lagerlöf and Heidhues (2005) explicitly deal with this issue, and identify the conditions under which the cost trade-off does warrant an ED. Their results claim that an ED is not worth while if it is too costly for society as a whole, through the evidence production costs it entails on behalf of the merging firms⁵.

Finally, from a theoretical point of view, our theoretical results are close to Rioridan and Sappington (1988), who develop a Principal-Agent model with public signal. Yet, the moral hazard issue we consider, as well as the specific constraints on transfers between the CA (the principal) and the merging firms (the agent), are important departures from their framework.

3. A simple model of merger control with efficiency defence

Consider the following simple model of merger control, between two economic agents: the CA on the one hand and the merging firms, the insiders, on the other, the latter proposing to merge on an oligopolistic market. We do not explicit the type of competition, because our results do not depend on it. For the purpose of our model, all that is important is that the merger has a twofold effect: it will involve both a market power

⁵However, their model does not consider the possibility of information manipulation or cheating on behalf of mergers that do not qualify for the ED. Medvedev (2004) addresses this topic and explains the application of a fuzzy approval rule (i.e. approval probabilities between zero and one).

increase and some potential efficiency gains (EG henceforth).

The latter, denoted by e , can be either high or low ($e = \bar{e}$) or low ($e = \underline{e}$). In order to achieve the high EG, insiders need to undertake an ex ante effort, requiring a sunk cost F . This costly conception effort to design beforehand their association in a more efficient manner yields an uncertain outcome for the insiders: $\Pr(\bar{e}/\text{effort}) = q \in (0, 1]$, $\Pr(\bar{e}/\text{no effort}) = 0$. If the effort fails or is not made at all, firms are left with the low EG \underline{e} . Basically, this means that integrating two firms in the most effective and pro-competitive manner requires to spend costly resources designing the merger project, and if the effort fails, this may drain all the supposed benefits of the deal.

We assume that whatever the level of these EG, insiders find it always profitable to merge, through the market power increase. The joint profit increases with the level of merger efficiency, so $\Pi(\bar{e}) \geq \Pi(\underline{e}) \geq \Pi_i$, where we denote by Π_i the insiders' overall profit before merger and by $\Pi(\underline{e})$ and $\Pi(\bar{e})$ the post-merger profit depending on the level of EG.

To materialize their merger, insiders need the approval of the CA, which maximizes a social welfare criterion standing for either Consumers' Surplus or Total Welfare - our qualitative results are not sensitive to the explicit definition of the CA's objective function. Actually all that matters is that from the CA's point of view the two possible merger types have opposite welfare effects: $W(\bar{e}) > W_i > W(\underline{e})$, where W_i denotes the initial, status-quo, level of welfare, $W(\bar{e})$ and $W(\underline{e})$ the level of welfare after the merger according to the EG. In other words, allowing a merger only increases welfare if the insiders did succeed in their planning and designing effort, otherwise the CA would fare better by rejecting the merger.

We consider an asymmetric information framework for merger control, and assume that the outcome of the effort is private information of insiders. The CA only observes an exogenous and public signal s , imperfectly correlated with the merger efficiency gains. The signal s stands for all the relevant hard information that the CA can use to make its

decision, which is typically obtained during the merger review process. In practice, the CA gathers information from various sources, its own expertise, the insiders themselves, the outsiders, even consumers. This information comes at a cost, it is certainly not exogenous⁶, and parties are able to manipulate it⁷. Yet, for the purpose and outcome of our analysis, only the quality of this information is relevant. Therefore we summarize all this data in an exogenous costless signal to better highlight our choice not to focus on the evidence-production cost analysis. We denote the signal by $s \in \{\underline{s}, \bar{s}\}$, with $\Pr(\bar{s}/\bar{e}) = \Pr(\underline{s}/\underline{e}) = \sigma \in [\frac{1}{2}, 1]$. Based on this imperfect signal, the CA may very well reject efficient mergers, or, on the contrary, accept mergers that lower the welfare, hence the possibility for both type I and II errors.

The possibility of clearing an inefficient merger can be reduced if, when submitting their merger, the insiders equally propose a merger remedy. Merger remedies are corrective measures in the shape of commitments undertaken by the merging partners. They must prevent the negative market-power effect of the merger, and as such they involve a private cost for the insiders. We model the remedy accordingly, and consequently assume that $\Pi(e) \geq \Pi^R(e)$, $e \in \{\underline{e}; \bar{e}\}$, where $\Pi^R(e)$ denotes the profit that insiders obtain when their merger is subject to remedy. Yet, despite this cost, efficient insiders would make a higher profit than inefficient ones, $\Pi^R(\bar{e}) \geq \Pi^R(\underline{e})$, if it had not been for the private cost of effort and its uncertain outcome: $\Pi^R(\bar{e}) - \Pi^R(\underline{e}) < \frac{F}{q}$. In other words, we assume that the remedy removes any incentive to exert effort - otherwise, making effort would always be a dominant strategy, and there would be no discussion on the optimal CA decision rule. Finally, as far as the CA's objective is concerned, we assume the remedy to be effective, meaning that when applied for an inefficient merger, it will improve welfare: $W^R(\underline{e}) \geq W_i$.

⁶See Lagerlöf and Heidhues (2005) for a model based on endogenous and costly signals.

⁷Bourjade and Jullien (2005) provide a model where the production of information is the result of the merging firms as well as the CA.

The timing of events is the following:

At the first stage, the CA chooses a decision rule for merger clearance, and credibly commits to it by making it public under the form of merger guidelines, which become binding from that moment on. We detail below the decision rules we consider.

At the second stage, insiders make their effort decision and privately observe its outcome.

At the third stage, insiders submit a merger proposal to the CA. Their merger submission may contain remedies, in accordance with the first stage merger policy provisions (i.e. provided the decision rule retained allows for remedy.)

At the fourth stage, the exogenous signal on efficiencies is generated and publicly observed. The merger is then cleared or blocked, according to the decision rule chosen at the first stage.

The decision rules basically specify under which terms the ED and the remedies apply. Allowing an ED will be interpreted here as a decision rule for merger approval which takes into account the exogenous signal received on the mergers' efficiency gains. By the same token, allowing remedies comes down to applying a decision rule according to which a merger is accepted provided it has proposed remedy. More precisely, at the first stage of the game, the CA makes its choice between the following three decision rules:

- a "remedy" decision rule, meaning "allow any merger iff it proposed remedy"
- a "strict ED" decision rule: "allow a merger iff the signal \bar{s} is observed"
- a "flexible ED" decision rule: "allow the merger if the signal \bar{s} is observed or if it proposed remedy".

By assumption, whenever a merger is rejected, under either decision rule, the status-quo is maintained.

Based on these decision rules, we will be able to assess the consequences of allowing remedy together with the ED. We begin by examining the opportunity to allow the

strict ED, then go on to check for the opportunity to allow the flexible ED. Note that the difference between the two ED decision rules consists of the possibility for firms to propose or not remedy when submitting their merger. In other words, by examining the opportunity to allow one or another of the ED decision rules, we will be actually able to conclude on the opportunity for the CA to commit to allowing remedy or not when applying an ED.

4. The efficiency defence as an incentive device

We consider here a benchmark situation, where only the strict ED and the remedy decision rule are available, but mutually exclusive. In other words, if the ED is adopted, the remedy decision rule no longer applies, so the proposal of remedies by merging firms will not influence the decision of the CA.

Basically, the CA decides whether to allow or not the ED based on the expected welfare. The following proposition deals with the opportunity of allowing the "strict ED":

Proposition 1. *The "strict ED" decision rule is chosen against the "remedy" one only for a sufficient quality of information: there exists $\tilde{\sigma}$ such that for $\sigma \geq \tilde{\sigma}$ the CA applies it.*

See proof in the Appendix.

Basically, the ED is chosen only for a sufficient quality of information. This is so because two conditions need to be fulfilled in order for the application of the ED to be preferred to that of remedies, both requiring a sufficient quality of merger assessment. First, firms would exert effort under this decision rule, and second, the resulting expected welfare should be higher than without the ED.

The former condition will yield a certain threshold in terms of signal quality, because firms' incentives to exert effort under the ED decision rule depend on the quality of the subsequent merger assessment. Explicitly, if the signal is very poor, so that the EG are rarely recognized as such, then the effort is not worth while, since it is costly and its outcome uncertain. We denote by σ^* this threshold above which the firms are induced to exert effort with the strict ED rule. From the CA's point of view, firms having exerted effort is a necessary, but not sufficient condition to allow the ED. Indeed, even if the insiders did succeed their costly effort, the expected welfare may still be inferior to that obtained without the ED. If the quality of information is too poor to ensure an accurate assessment of the EG, then the expected welfare may still be inferior to that obtained without the ED, even if the insiders did succeed their costly effort. This occurs when the welfare loss due to both types of errors is too important. These errors may be either unjustified approvals (type II error, "false positive") and unjustified prohibitions (type I-error, "false negative"), and in both cases the potentially achievable level of economic welfare is not attained. Thus this second condition equally yields a threshold in terms of signal quality, such that the welfare improves above this threshold. Proposition 1 fixes the relevant information quality threshold $\tilde{\sigma}$ to be the maximum between the two critical levels thus identified, so as to make sure that both conditions are fulfilled.

Note that the relevant threshold for the strict ED adoption depends directly on the magnitude of the welfare levels corresponding to the two types, $W(\bar{e})$ and $W(\underline{e})$ respectively. More precisely, the lower the welfare loss $W(\underline{e})$, the higher the cost of type II error and therefore the higher the threshold $\tilde{\sigma}$. By the same token, the higher the welfare gain $W(\bar{e})$, the higher the opportunity cost of not allowing the ED, so the lower $\tilde{\sigma}$.

Proposition 1 emphasizes that the higher the quality of information, the more likely is the ED rule, meaning that the latter can be optimal despite the imperfect information and the ensuing possibility to accept some inefficient mergers. Note that even for

extremely precise signals, which guarantee both effort exertion and a higher expected welfare than with remedy, the ED decision rule always leaves open the possibility of a welfare loss. Instead, the remedy decision rule also guarantees a welfare improvement, although potentially lower than the ED since it does not provide effort incentives, but prevents any type II errors. This basically highlights the trade-off for the CA's choice to apply the ED decision rule, between what we call an "incentive effect" and a "type II error effect". On the one hand, by allowing the ED, the CA gives firms incentives to exert effort and thereby to propose an efficient merger. This basically lowers the final cost of type I errors, given the imperfect merger assessment, and represents the "incentive" effect of the ED. On the other hand, by not allowing the ED and instead applying the remedy decision rule, the CA prevents any type II error. This is the "type II error" effect.

Keeping this in mind, the question we ask next concerns the way in which this basic trade-off is affected if remedies are allowed in addition to the ED rule, and the likely consequences in terms of incentive and type II error effect.

5. Merger control with remedies and efficiency defence: the optimal merger control

In this section we aim to determine the opportunity for the CA to use remedies in addition to an ED. In other words, by examining the opportunity of the flexible ED, we can assess the impact of remedy on the way the available information is exploited.

A backwards induction through the game is necessary, but since the last stage of the game contains no strategic move, we begin our analysis at the merger notification stage. At this stage, the essential change with respect to the strict ED rule is that the ED and the remedy are no longer mutually exclusive. Since a merger is cleared either if the signal \bar{s} is observed, or if a remedy is proposed, insiders are basically given the

opportunity to choose their merger notification: it may either contain a remedy, thus guaranteeing its acceptance, or it may not contain a remedy, in which case insiders run the risk of rejection.

The following result details the notification choice of the merging firms:

Lemma 1. *There exist two signal quality thresholds, $\underline{\sigma}$ and $\bar{\sigma}$, $\underline{\sigma} < \bar{\sigma}$, such that the outcome of the submission subgame is as follows:*

- (i) *for low signal quality, $\sigma < \underline{\sigma}$, only efficient insiders (\bar{e} -mergers) propose to undertake remedy;*
- (ii) *for medium quality signals, $\underline{\sigma} < \sigma < \bar{\sigma}$, either all mergers are submitted with remedy, or none;*
- (iii) *for high quality signals, $\sigma > \bar{\sigma}$, only inefficient insiders (\underline{e} -mergers) propose to undertake remedy.*

See proof in the Appendix.

We find that allowing the flexible ED gives insiders the opportunity to self-select by means of the merger notification they make. This outcome of possible self-selection depends on the probability of assessment error, or, equivalently, on the quality of available information. More precisely, for very poor signals such that the probability for the EG to be recognized as such is very low, insiders which did obtain these EG do not run the risk of rejection with the ED, but propose instead remedy with their merger to ensure its approval. In turn, for very good signals, such that the probability of detecting an inefficient merger is very high, inefficient insiders will not run the risk of an ED and prefer to propose remedy. Finally, for intermediate signal qualities, both efficient and inefficient insiders choose the same type of notification, either with remedy or without, so no self-selection occurs, as in the benchmark situation.

The intuition behind this result is simple. For very good signals, the probability of detecting an inefficient merger is very high, thus inefficient insiders prefer to propose

remedy whereas efficient ones propose the merger without remedy. Yet, if the information quality is lower, the opportunity cost of an inefficient firm to propose a merger with remedy increases, because there are less chances for it to be rejected if it attempts the ED. Thus, a lower signal quality gives incentives to inefficient insiders to propose a merger without remedy. As far as the efficient insiders are concerned, the opposite occurs. If the information quality is poor, the probability for a merger without remedy to be rejected is high, so the opportunity cost to go for the ED, without remedy, increases. In short, for low quality signals the efficient insiders prefer to submit a merger with remedy.

At this point, it is worth pointing out that beside its corrective role, the remedy can possibly convey information on the level of merger efficiency gains. As a matter of fact, by making their choice when being given the opportunity to propose or not remedy, merger partners may signal the type of their merger. Thus, for $\sigma > \bar{\sigma}$, the choice to propose or not remedy allows the efficient insiders to signal themselves out and to self-select. From a theoretical point of view, the information disclosure is an illustration of the Riordan and Sappington (1988) theorem according to which a principal can use transfers contingent to an imperfect public signal to implement the optimal decision even though the agent has private information. Here, the remedy can be interpreted as leading to a transfer between consumers and the merging firms. Thus, for some signals, the remedy allows the CA to implement the optimal merger decision. Nevertheless, our model departs from the Riordan and Sappington (1988) result in two important respects. First, the economic context we consider in our paper does not always allow the CA to implement such a decision. Indeed, remedies cannot be shaped in such a way that for any signal, the merging firms reveal the actual efficiency gains. Second, even though remedies were used to reveal efficiency gains, the effort decision stage would impose a trade-off between incentive provision and rent given away to the merging firms.

Finally, at the previous stage, when choosing the type of the merger by deciding to

make effort or not, insiders anticipate the outcome of the notification subgame. Since the possibility to propose remedy gives the opportunity to self-select for certain signal quality ranges, it implicitly affects the firms' expected payoff from making effort over these intervals. Therefore, as compared with the benchmark case, we can see its impact on the effort incentives provided by the ED. This impact also depends on the quality of available information, and is given by the following:

Lemma 2. *Define σ_R^* such that for $\sigma \geq \sigma_R^*$ insiders undertake effort under the "flexible ED"; then $\sigma_R^* \geq \sigma^*$, where for $\sigma \geq \sigma^*$ firms undertake effort under the "strict ED".*

See proof in the Appendix.

Individual rationality requires firms to make the costly effort only for sufficiently accurate signals, because the assessment of efficiency gains is subject to errors. The possibility of proposing remedy when the CA allows the ED has an impact on the signal quality that is deemed sufficient for effort to be made. With this respect, Lemma 2 claims that under the "flexible" ED rule the *ex ante* effort incentives are lower than under the "strict" ED rule⁸. As a result, the information quality requisite is higher than in the benchmark situation.

The result given in lemma 2 is explained by the fact that the remedy basically softens the threat of a merger rejection, and thereby modifies the opportunity cost of the ED. More precisely, from the insiders' point of view, the possibility of proposing remedy increases the opportunity cost of notifying a merger with the ED. To make their effort decision, firms take into account the expected payoff, and implicitly the outcome of the relevant alternative. In the benchmark situation, without remedies, making effort was

⁸This holds actually for sufficiently accurate signals, $\sigma \geq \underline{\sigma}$. We show in the proof that even though the remedy does enhance the effort incentive for the lowest signals, $\sigma < \underline{\sigma}$, this does not alter the firms' ultimate effort decision, which is not to make effort. This is the reason why in the proof of Lemma 2 we stress that $\sigma^* > \underline{\sigma}$.

individually rational as soon as the expected profit outweighed the status-quo profit, which was the relevant alternative payoff in case of merger refusal under the "strict" ED decision rule. In turn, when the decision rule allows for remedy submission, the effort becomes rational provided it yields a higher expected profit than the payoff with remedy. Simply because firms can always choose to propose remedy and thereby avoid the status-quo, the payoff with remedy becomes now the relevant payoff alternative, and this is superior to the status-quo payoff. Insiders might be more easily content with this high alternative payoff, and therefore require a more accurate assessment of the EG in order to give it up and instead run the risk of an uncertain effort to submit afterwards a merger without remedy. As a result, the relevant threshold for effort exertion under the "flexible" ED decision rule is superior to that under the "strict" one. And since the signal quality requisite is higher, the effort incentives are lower under the former regime.

Thus, from the CA's standpoint, simultaneously allowing for both the ED and remedies leads to two opposing effects. On the one hand, the remedy reduces the *ex ante* effort incentive of the merger policy. On the other hand, it can provide a means for firms to self-select, and hence it can dramatically improve the outcome of merger control, by removing completely the possibility of a welfare loss, i.e. making a type II error and accepting inefficient mergers. Therefore, the decision to allow or not simultaneously both remedy and the ED within the "flexible" ED decision rule implies for the CA to choose between minimizing type I errors, and completely avoiding type II errors.

We address next the choice of decision rule at the first stage of the game, for which we obtain the following result:

Proposition 2. (i) If $\tilde{\sigma} < \text{Max}(\sigma_R^*, \bar{\sigma})$, then:

- for $\sigma < \tilde{\sigma}$, the CA does not allow an ED and only applies the remedy decision rule;
- for $\tilde{\sigma} < \sigma < \text{Max}(\sigma_R^*, \bar{\sigma})$, the CA allows the strict ED ;
- for $\sigma > \text{Max}(\sigma_R^*, \bar{\sigma})$, the CA allows the flexible ED.

(ii) If $\tilde{\sigma} \geq \text{Max}(\sigma_R^*, \bar{\sigma})$, then:

- for $\sigma < \text{Max}(\sigma_R^*, \bar{\sigma})$, the CA does not allow an ED and only applies the remedy decision rule;
- for $\sigma > \text{Max}(\sigma_R^*, \bar{\sigma})$, the CA allows the flexible ED.

See proof in the Appendix.

Proposition 2 gives the optimal decision rule according to the quality of information available. This outcome results from the comparison of adoption thresholds for the strict and respectively the flexible ED rules.

Basically, two configurations may arise, depending on the relative position of these two thresholds.

The first one corresponds to a rather low welfare cost of the type II error, which explains that the threshold $\tilde{\sigma}$ for the strict ED adoption, defined in Proposition 1, is low itself: $\tilde{\sigma} < \text{Max}(\sigma_R^*, \bar{\sigma})$. In such a case, the possibility of remedy in addition to the ED does not affect the opportunity to allow an ED rule, because the information quality threshold above which the CA resorts to an ED remains equal to $\tilde{\sigma}$. In other words, there is a range of quality signals for which the CA prefers to refrain from allowing remedies together with the ED. Nevertheless, for high information quality ($\sigma > \text{Max}(\sigma_R^*, \bar{\sigma})$), the CA turns to the flexible ED rule.

The second configuration corresponds to a high cost of the type II error, yielding a high threshold for the strict ED rule adoption: $\tilde{\sigma} \geq \text{Max}(\sigma_R^*, \bar{\sigma})$. In this case, the possibility of remedies in addition to ED 'hastens' the application of the ED, because the CA does so, under the form of the flexible ED rule, as soon as the quality information exceeds $\text{Max}(\sigma_R^*, \bar{\sigma})$, rather than $\tilde{\sigma}$ as in the case of a strict ED rule. In both configurations, for the lowest quality signals, the CA will not allow an ED, but only apply the remedy decision rule.

To better seize the result given in Proposition 2, we remind that the choice between

an ED rule, either strict or flexible and remedy only gives rise to a trade-off between the incentive effect and the type II error effect. The benefit of an ED rule is to provide incentives to exert *ex ante* the effort, while its cost is to lead the CA to accept an inefficient merger because of the signal imperfection. Furthermore, the comparison between the two ED rules given in lemma 2 indicated that while the strict ED rule provides higher effort incentives than the flexible ED rule, the latter can lead insiders to signal their merger type, and thus avoids accepting inefficient mergers. More precisely, the flexible ED rule induces this self-selection for a sufficient signal quality ($\sigma \geq \bar{\sigma}$), thus providing both incentives and improved expected welfare for an information quality above $Max(\sigma_R^*, \bar{\sigma})$. The result in Proposition 2 can be explained based on these two effects as follows.

If the cost of type II error is prohibitive due to a very low level of $W(\underline{e})$, the threshold $\tilde{\sigma}$ is high in itself, meaning that the quality of information required to make tolerable from the welfare viewpoint the risk to accept an inefficient merger is high. In that case, the flexible ED rule is preferable to the strict ED because when applied, it induces insiders to signal their merger type and thus it prevents the clearance of inefficient mergers. That is why whenever $\tilde{\sigma} \geq Max(\sigma_R^*, \bar{\sigma})$, by allowing the flexible ED rule as soon as $\sigma \geq Max(\sigma_R^*, \bar{\sigma})$, the CA actually widens up the interval of signal quality warranting the adoption of an ED. This is strictly preferred by the CA, because throughout this extended ED adoption range, maximizing welfare is obtained while eliminating the very costly type II error.

If instead $\tilde{\sigma} < Max(\sigma_R^*, \bar{\sigma})$, then the incentive effect of the ED dominates the type II error effect for the intermediary range of signal quality $\sigma \in (\tilde{\sigma}, Max(\sigma_R^*, \bar{\sigma}))$. This is the case whenever the potential negative welfare effect $W(\underline{e})$ is actually not too prohibitive in itself. In this configuration the CA prefers to start allowing the ED in the form of the strict ED rule rather than the flexible one, since the former makes firms exert effort for lower information quality than the latter. Still, when the information quality is so

high that under the flexible ED insiders both exert effort as well as signal their type upon notification, i.e. for $\sigma \geq \text{Max}(\sigma_R^*, \bar{\sigma})$, the type II error effect becomes dominant, and leads the CA to adopt the flexible ED rule. That is why in both configurations, whenever σ is higher than $\text{Max}(\sigma_R^*, \bar{\sigma})$, the CA always adopt a flexible ED rule.

The adoption of an ED gives rise to errors, and the commitment to either allow or prohibit remedies is likely to impact on both types of error. We obtain here that the combined application of ED and remedy is relatively more valuable from the point of view of the outcome of merger control when type II errors are particularly costly, whereas the policy aimed at minimizing the cost of type I errors requires to refrain from remedies and adopt a strict ED rule. Incidentally, this responds to the criticism (Christiansen (2006)) of the recent ED adoption by the European Merger Regulation according to which the importance of type II errors will increase following this adoption.

6. Conclusion

This paper draws attention to the likely consequences of the adoption of an ED procedure, given the general current context of its application, i.e. asymmetric information for the CA, and generalized use of merger remedies. The former point was actually invoked to delay the European ED, by arguing costly implementation issues. We claim here that a possible *ex ante* positive effect, in the shape of incentives to encourage more efficient mergers, should equally be accounted for, despite the asymmetric information problem. The second point is intimately related to the first, due to the interaction between remedy and ED. The examination of this interplay is the original and more important contribution of our paper. We study the impact of remedy on the incentive provided by and the outcome of the ED, and conclude on the opportunity of combining the two, depending on the quality of information underlying the merger assessment.

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7. Appendix

Proof of Proposition 1. When the strict ED is allowed, firms have incentives to exert the costly effort as long as

$$q(\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i) + (1 - q)((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i) - F \geq (1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i$$

Define σ^* such that $((\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i) - ((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i)) = \frac{F}{q}$.

The LHS term being increasing with σ , for $\sigma \geq \sigma^*$ firms exert effort under the strict ED rule.

From the CA's point of view, the strict ED decision rule yields a higher expected welfare than the alternative, remedy decision rule, iff

$$q(\sigma W(\bar{e}) + (1 - \sigma)W_i) + (1 - q)(\sigma W_i + (1 - \sigma)W(\underline{e})) \geq W^R(\underline{e})$$

Define $\hat{\sigma}$ such that $q(\sigma W(\bar{e}) + (1 - \sigma)W_i) + (1 - q)(\sigma W_i + (1 - \sigma)W(\underline{e})) = W^R(\underline{e})$

The LHS term is increasing with σ , so for $\sigma \geq \hat{\sigma}$, the strict ED decision yields a higher expected welfare.

Define $\tilde{\sigma} = \max(\sigma^*, \hat{\sigma})$; for $\sigma \geq \tilde{\sigma}$ the CA is better off allowing the strict ED; otherwise, it prefers to stick to the remedy decision rule and does not allow the strict ED. ■

Proof of Lemma 1. At the 3rd stage, insiders having succeeded the effort to achieve the EG will submit merger with remedy iff

$$\sigma \Pi(\bar{e}) + (1 - \sigma)\Pi_i < \Pi^R(\bar{e}) \Leftrightarrow \sigma < \frac{\Pi^R(\bar{e}) - \Pi_i}{\Pi(\bar{e}) - \Pi_i} = \hat{\sigma}^e$$

Insiders without EG will submit merger with remedy iff

$$\sigma \Pi_i + (1 - \sigma)\Pi(\underline{e}) < \Pi^R(\underline{e}) \Leftrightarrow \sigma > \frac{\Pi(\underline{e}) - \Pi^R(\underline{e})}{\Pi(\underline{e}) - \Pi_i} = \hat{\sigma}$$

Define $\underline{\sigma}$ such that $\underline{\sigma} = \min(\hat{\sigma}^e; \hat{\sigma})$ and $\bar{\sigma}$ such that $\bar{\sigma} = \max(\hat{\sigma}^e; \hat{\sigma})$

For $\sigma < \underline{\sigma}$, only the efficient insiders propose remedy with their merger, whereas for $\sigma > \bar{\sigma}$ only the inefficient do so. For intermediate quality signals, either both types propose remedies, or neither. ■

Proof of Lemma 2. Effort choice (Stage 2)

Following Lemma 1, for $\sigma < \underline{\sigma}$, only the efficient insiders propose remedy with their merger, therefore effort is made iff

$$\begin{aligned} q\Pi^R(\bar{e}) + (1-q)((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) - F &\geq ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) \\ \Leftrightarrow q(\Pi^R(\bar{e}) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)) &\geq F \end{aligned}$$

For $\underline{\sigma} < \sigma < \bar{\sigma}$, either all mergers are submitted with remedy or none;

- if both types propose remedy, effort is made whenever

$$q\Pi^R(\bar{e}) + (1-q)\Pi^R(\underline{e}) - F \geq \Pi^R(\underline{e}) \Leftrightarrow q(\Pi^R(\bar{e}) - \Pi^R(\underline{e})) \geq F$$

but this contradicts the initial assumption, so effort is never undertaken!

- if neither type proposes remedy, then effort is made iff

$$\begin{aligned} q(\sigma\Pi(\bar{e}) + (1-\sigma)\Pi_i) + (1-q)((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i) - F &\geq (1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i \\ \Leftrightarrow q[(\sigma\Pi(\bar{e}) + (1-\sigma)\Pi_i) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)] &\geq F \end{aligned}$$

Finally, for $\sigma > \bar{\sigma}$ only the inefficient firms propose remedy (and thereby self-select), so effort is made iff

$$\begin{aligned} q(\sigma\Pi(\bar{e}) + (1-\sigma)\Pi_i) + (1-q)\Pi^R(\underline{e}) - F &\geq \Pi^R(\underline{e}) \\ \Leftrightarrow q(\sigma\Pi(\bar{e}) + (1-\sigma)\Pi_i) - \Pi^R(\underline{e}) &\geq F \end{aligned}$$

Comparison of effort incentives w.r.t. the benchmark situation, i.e. between the "flexible" and the "strict" ED:

(i) $\sigma < \underline{\sigma}$. The condition ensuring effort is given by:

For the flexible ED rule, effort is exerted iff

$$q(\Pi^R(\bar{e}) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)) \geq F$$

For the strict ED rule, effort is exerted iff

$$q[(\sigma\Pi(\bar{e}) + (1-\sigma)\Pi_i) - ((1-\sigma)\Pi(\underline{e}) + \sigma\Pi_i)] \geq F$$

The flexible regime yields higher effort incentive than the strict one because the corresponding condition is less strict, due to $\Pi^R(\bar{e}) > (\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i)$ for $\sigma < \hat{\sigma}$ (see Lemma 1). However, for $\sigma < \hat{\sigma}$, one equally has $(1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i > \Pi^R(\underline{e})$, therefore $(\Pi^R(\bar{e}) - ((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i)) < (\Pi^R(\bar{e}) - \Pi^R(\underline{e}))$ which in its turn is inferior to $\frac{F}{q}$ by assumption.

The bottom line is that effort is never undertaken for $\sigma < \underline{\sigma}$, and consequently we can state that $\underline{\sigma} < \sigma^*$, where σ^* was defined as the threshold for effort exertion under the strict ED (see the proof of Proposition 1).

(ii) $\underline{\sigma} < \sigma < \bar{\sigma}$. The condition ensuring effort is:

For the flexible ED rule, if firms propose to remedy their merger, then effort is exerted if

$$q(\Pi^R(\bar{e}) - \Pi^R(\underline{e})) \geq F$$

Since $q(\Pi^R(\bar{e}) - \Pi^R(\underline{e})) \geq F$ is impossible, no effort is made in this case.

For the strict ED rule, effort is exerted iff

$$q[(\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i) - ((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i)] \geq F$$

Thus, we conclude that the two ED decision rules are equivalent in terms of incentives, provided that under the flexible ED types do not pool on proposing remedy; otherwise, the strict ED yields higher effort incentives than the flexible one.

(iii) $\sigma > \bar{\sigma}$. The conditions ensuring effort exertion are respectively

For the flexible ED rule, effort is exerted iff

$$q(\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i) - \Pi^R(\underline{e}) \geq F$$

For the strict ED rule, effort is exerted iff

$$q[(\sigma\Pi(\bar{e}) + (1 - \sigma)\Pi_i) - ((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i)] \geq F$$

Given that $\Pi^R(\underline{e}) > ((1 - \sigma)\Pi(\underline{e}) + \sigma\Pi_i)$ for $\sigma > \bar{\sigma}$ (see Lemma 2 for the self-selection effect), we conclude that the flexible regime provides lower effort incentives than the strict one.

Conclusion: denoting by σ_R^* the signal quality threshold such that for $\sigma \geq \sigma_R^*$ insiders undertake the effort under the flexible ED, the outcome of the above incentive comparison can be summarized as follows: $\sigma_R^* \geq \sigma^*$ throughout $\underline{\sigma} < \sigma < \bar{\sigma}$, and for $\sigma > \bar{\sigma}$, $\sigma_R^* > \sigma^*$. To sum up, we obtain that $\sigma_R^* \geq \sigma^*$. ■

Proof of Proposition 2. To conclude on the optimal decision rule to adopt, depending on the quality of available information, we compare the expected welfare levels. Hence we need first compare the relevant threshold for the adoption of the strict, and respectively flexible, ED decision rules.

Following Proposition 1, the adoption threshold for the strict ED rule is $\tilde{\sigma}$. By the same token, the relevant threshold for the adoption of the flexible ED rule is $Max(\sigma_R^*, \bar{\sigma})$, because under this rule firms exert effort for σ_R^* , (see Lemma 2), whereas for $\sigma > \bar{\sigma}$ the self-selection effect (see Lemma 1) guarantees that no inefficient merger is accepted. Therefore, for $\sigma \geq Max(\sigma_R^*, \bar{\sigma})$ the flexible ED is optimal from the point of view of the expected welfare, because it actually yields the highest possible expected welfare (thanks to both effort exertion and elimination of type II errors).

The adoption thresholds for the strict and respectively flexible ED rules are entirely independent/unrelated, therefore two cases are possible and need to be considered: either $\tilde{\sigma} < Max(\sigma_R^*, \bar{\sigma})$, or $\tilde{\sigma} \geq Max(\sigma_R^*, \bar{\sigma})$

In terms of expected welfare, when the CA applies the remedy decision rule it obtains $W^R(\underline{e})$. As soon as the strict ED rule is allowed, it yields an expected welfare of $q(\sigma W(\bar{e}) + (1 - \sigma)W_i) + (1 - q)(\sigma W_i + (1 - \sigma)W(\underline{e}))$, whereas the flexible ED improves the expected welfare to $q(\sigma W(\bar{e}) + (1 - \sigma)W_i) + (1 - q)W^R(\underline{e})$ whenever adopted. ■