Do Remedies Affect the Efficiency Defence? An Optimal Merger Control Analysis.

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Abstract

This paper examines 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. The adoption of an efficiency defence can push firms to better design the merger, leading to more efficiency gains. However, the merger remedies interact with the efficiency defence: although they reduce the incentive to enhance the efficiency gains, they can be used to signal the actual level of efficiency gains. Our results deal with the opportunity of applying both instruments, depending on the Competition Authorities' focus on inciting more efficient mergers.

Keywords: merger control, efficiency defence, merger remedies

JEL classification: L41, K21, D82

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1. Introduction

Merger control aims to screen concentrations, so as to clear competitive mergers and prohibit the anti-competitive ones. It is supposed to assess the merger's consequences before they even take place. As a result, the information available to the competition authority is likely to be poor. This may explain why merger control is prone to type I and II errors (see Duso et al. (2007)), and that the true challenge of the merger control is to minimize the effects of both types or errors. For this purpose, the assessment process includes in particular the appraisal of the *potential merger's efficiency gains* and the *merger fixes or remedies*.

Merger remedies are structural or behavioral "commitments" offered by the merging parties and meant to restore conditions for effective competition after the merger. Accordingly, the European Merger Control Regulation (ECMR) claims that "where the undertakings modify a notified concentration [...] rendering the concentration compatible with the common market, the Commission should declare the concentration compatible with the common market". In addition, the ECMR states that "in order to determine the impact of a concentration on competition, it is appropriate to take into account of any substantial efficiencies put forward by the undertakings" and thus acknowledges that efficiency gains can offset the negative impact of a merger project and thus include possible efficiency gains as part of the competitive balance of a merger[1]. This has not been always the case. The ECMR experienced a dramatic change in January 2004 with the introduction of the efficiency gains assessment.

Any change in the merger control procedure, such as the mere use of merger remedies, or the possibility to clear a merger without them, thanks only to the future efficiency gains, modifies the expected profit of any given merger project. Merging firms will react by designing and submitting a possibly different merger project from that considered in the beginning. Furthermore, their choice to propose remedies or to claim high efficiency gains within the so called 'efficiency defence' (ED henceforth), will have a certain signalling value, which is useful given the imperfect information framework of merger control. This paper discusses both the *ex ante* incentive effect and the signalling value of choices made by merging firms in response to a given merger control procedure

[1] The underpinning theoretical rationale can be traced back to Williamson (1968), who developed the trade-off analysis between losses in allocative efficiency and gains in productive efficiency as a result of a merger.

that is adopted.

The objective of this paper is to examine the optimal combination of remedies and efficiency defence, taking into account the provision of ex ante incentives and the information asymmetry between merging firms and the competition authorities. In that sense, we provide a normative analysis of the current merger control, by considering only its existing features, i. e. the assessment for the final merger decision the possible efficiency gains and the proposal of remedies by the merging firms.

The role of the enforced procedure in terms of incentives is widely recognized. Practitioners acknowledge that they are likely to counsel modifications of the merging projects according to the assessment procedure announced by the Competition Authorities[2]. This composition effect had already been stressed by Aaronson (1992). The possibility for the efficiency gains to increase the approval probability introduced in 2004 in the ECMR is likely to provide firms with *ex ante* incentives to design more efficient mergers given that planning and achieving an efficient merger are costly in practice. This was emphasized in a different but very similar context by Jorde and Teece (1990) (see also Shapiro and Willig (1990)). They claimed that in the early 1990s, by clearing the R&D joint ventures after a global economic evaluation, the European antitrust legislation gave higher incentives to 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.

We might add that the introduction of the efficiency defence in the ECMR in 2004 resulted in an apparently lower use of remedies: the conditional approval rate in phase 2 fell from 60% over the period 1991-2003 to 50% from 2004 onwards, with a clear break in the trend in 2003. These changes express the impact of the existing procedure on merging firms' behavior regarding both the design of mergers and the notification strategy adopted.

Overview of results

To start with we consider a very simple framework where the merger project is pro-competitive only if it entails efficiency gains. We assume that the probability of efficiency gains can be improved

[2] According to the 2007 Deloitte report for the OFT, 8% of mergers submitted in the UK between 2004 and 2006 had been modified on competition grounds before the OFT actually became aware of it. The 2005 Twynstra Gudde report commissioned by the Dutch NMa obtained 12% for the same category over the period 2000-2003. .

by an *ex ante* designing effort undertaken by the merging firms. This planning effort is costly, does not always succeed, and the insiders are privately informed of its outcome, unlike the CA. Explicitly, we consider that the CA receives a signal on the level of efficiency gains with a certain probability that captures the quality of information available to the Authority. We interpret an efficiency defence decision rule as one that takes into account the expected level of efficiency gains in the merger assessment by the CA.

A possible alternative for merger clearance, and the one we consider here, is for the CA to accept the merger if the merging firms undertake merger remedies. These imply a private cost for firms, to the extent that the profit thus obtained is lower than it would be without remedies. Moreover, the remedies will write off some private benefits from efficiencies if undertaken by efficient merging firms. Nevertheless, the remedy will be assumed to be effective, i.e. ensuring a welfare improvement w.r.t. the status-quo if applied to an anti-competitive merger.

In this framework, the first step will be to determine the opportunity for the CA to adopt the "strict ED decision rule" that consists in assessing efficiency gains without allowing remedies, rather than the "remedy rule" where the CA ignores efficiency gains. We show that the CA will adopt the "strict ED rule" only if the quality of information is high enough.

Indeed, applying the "remedy rule" ensures merger clearance but the induced profit decrease reduces the incentives to exert effort. In contrast, the "strict ED rule" leads the CA to prohibit some efficient mergers (type I error) since the CA lacks information on efficiency gains. Nevertheless, for high enough information quality, the incentive to exert effort becomes high because thanks to these efficiency gains, the merger will be cleared.

Basically, the optimal adoption of the ED rule stems from the trade-off between the benefit expected from the ED, namely the provision of effort incentives, making firms exert the costly effort to obtain efficiencies, and the cost of the ED, i.e. the risk of type I errors. The outcome of this trade-off depends on the quality of available information.

The next step is to study the opportunity for the CA to adopt a decision rule that allows both the remedies and the ED (the so-called "flexible ED"). We show that in this case, the merger remedies affect the above mentioned trade-off. On the one hand, everything else equal, the remedies lower the ex ante effort incentives for firms. On the other hand, accepting a merger with remedy

and allowing an ED represents for the CA the opportunity of completely eliminating type I and II errors, because when given the choice between applying for the ED and proposing remedy, we show that efficient insiders may signal accurately their actual level of efficiency gains by notifying a merger project without remedies, while inefficient ones propose remedies. The signalling process is based on a higher cost to notify a merger without remedies for an inefficient merger than for an efficient one, for a high enough quality of information at least. Moreover, this signalling process even increases the incentives for the insiders to exert effort as compared with the "strict ED rule". In that case the mix of an ED and remedies within the "flexible ED rule" combines the benefit of the ED, i.e. high incentives to provide efficiency gains, and the benefit of the remedy rule, i.e. avoiding decision errors. For extreme ranges of the information quality, the benefit of the "remedy rule" or the "strict ED" dominate. For very low information quality, the signalling is no longer perfect and thus the "remedy rule" reduces even more the errors in the decision process, whereas for almost perfect information, the incentive to exert effort is higher under the "strict ED rule" because of the absence of remedies.

Through this analysis we provide an insight into what should be the best merger policy. We show that for very good information available on the efficiency gains, the best policy consists in applying an efficiency defence without allowing remedies. Instead, if the quality of information about the efficiency gains is lower, the combination of remedies and efficiency defence is more appropriate for maximizing expected welfare. For very poor information it could be even optimal for the CA to give up the assessment of efficiency gains and only consider the submission of remedies.

Related literature

The novelty of our study is twofold. First, we examine the interaction between remedies and ED. Secondly, this is performed in a framework where the efficiency gains are endogenous, i.e. chosen by the merging firms following the merger control decision rule adopted by the CA. To our knowledge this is the first contribution on this double topic. However, the two basic ingredients of our paper, namely the *ex ante* impact of the merger control and the design of merger control with imperfect information have been already tackled in the literature.

The *ex ante* deterrent effects of merger control in general have already been pointed out. 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 incentives for predation[3]. In short, merging firms react to the existing merger control provisions by designing merger projects accordingly, as argued also by 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]. Still, the merger design incentives provided by a possible efficiency defence have not yet been studied.

In turn, those given by the merger remedies have more or less been addressed. In a perfect information Cournot-model with discrete structural remedies, Vasconcelos (2007) explicitly considers the CA's incentives to implement by means of divestitures its most preferred market structure instead of merely 'remedying' the post-merger competition. He thus models 'over-fixing' merger control, where the CA goes beyond the corrective purpose of merger remedies. Their result in terms of incentives is a hold-up effect on possibly efficient but not yet submitted mergers, which Farrell (2003) had argued first in a purely informal and general discussion of merger-related topics needing further examination: "over-fixing confiscates part of the rents from finding the efficient merger, and thus discourages firms from seeking out and pursuing efficiency-oriented mergers". On the other hand, remedies as compared with prohibitions do not really deter firms from submitting mergers, as found by Seldeslachts et al (2008)[5]. In turn, they obtain that remedies lead firms to notify merger projects that they would have forgone if remedies (conditional approval) had not

[3] Ecer (2005) shows instead that the tendency to apply a stricter merger policy may be purely ineffective, since firms endowed with rational expectations are able to bypass it.

[4] Barros (2003) investigates 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 Communitary 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. Bergès-Sennou et al. (2004) deal with the same topic, but from the opposite standpoint (i.e. identifying the optimal strategy in terms of competition policy).

[5] See also the studies by Deloitte for the Brtitish OFT in 2007 and that by Twynstra Gudde for the Dutch NMa in 2005 for evidence that merger prohibitions discourage subsequent merger notifications.

been possible. This is basically a frequency-type impact of remedies on the incentives to submit or not mergers, whereas we focus on a composition-based effect in terms of type of merger selected for notification.

Finally, concerning the information asymmetry on efficiency gains between merging firms and the CA, we take a different stand than usually in the literature. We neither deal with the evidence production costs associated with the ED as an information-based procedure, nor provide a revelation mechanism to extract the private information[6]. The ED gives 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). He finds for instance that the insiders should bear the burden of proof for the ED, whereas the outsiders that of any efficiency offence. Such burden of proof necessarily yields a substantial increase in administrative costs for merger control, and the discussion of its implications is important for the economic analysis of the ED[7]. 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 firms. In contrast, we argue the ED is worth while whenever deterring highly efficient mergers is socially costly.

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

2. 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 propose to merge on

[6] This was achieved by Cosnita and Tropeano (2009) in a unified setting allowing for both merger divestitures and efficiency gains.

[7] 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 oligopoly 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 increase and some potential efficiency gains (EG henceforth).

The latter, denoted by e, can be either low ($\underline{e}$) or high ($\overline{e}$). In order to achieve the high EG, insiders need to undertake an *ex ante* effort E, $E \in \left[0, \overline{E}\right]$, requiring a sunk cost $F(E)$, increasing and convex with the level of effort ($F'(E) > 0$ and $F''(E) > 0$). Basically, integrating two firms in the most effective and pro-competitive manner requires to spend costly resources designing the merger project[8]. Moreover, this costly conception effort to design beforehand their association in a more efficient manner yields an uncertain outcome for the insiders: let $\Pr(\overline{e}/E) = q(E) \in [0,1]$, with $q'(E) > 0$, $q''(E) < 0$ and $q(0) = 0$. Let $\Pi(e)$ denote the joint profit variation due to merger, assumed to be increasing with the level of efficiency gains: $\Pi'(e) > 0$. We suppose that whatever the level of these EG, insiders find it always profitable to merge: $\Pi(e) > 0$.

To materialize their merger, insiders need the approval of the CA, which clears a merger if the expected the consumer surplus (CS) variation is positive. The two possible merger types have opposite CS effects: $W(\overline{e}) > 0 > W(\underline{e})$, where $W(e)$ denotes the CS variation, which depends on the level of efficiency gains. In other words, allowing a merger only increases CS if the insiders did succeed in their planning and designing effort, otherwise the CA would be better off rejecting the merger.

The point is that the outcome of the planning effort in terms of efficiency gains is the insiders' private information. The CA performs an investigation in order to gather information on these efficiency gains. We model this through the following information signal: with a probability $\beta \geq 0$, the CA observes the true level of e (signal s^H if $e = \overline{e}$ and signal s^L if $e = \underline{e}$) and with probability $1 - \beta$ the CA does not observe the level of e (signal s^M)[9]. The level of parameter β indicates the information quality. Furthermore, this information is essential for the CA's decision making, to the

[8] The Financial Times ("Clean teams banish acquisition uncertainty", August 8, 2006) reports that 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 it work well in advance of the completed deal, setting out a strategy for realizing the claimed 'synergies'.

[9] See chapter 5 "Information and informational decision" in Hirshleifer and Riley (1992) for such information technology, as well as Laffont and Tirole (1993) p.480.

extent that without information on e, even though the effort is at $\overline{E}$, the expected CS variation is supposed to be negative[10]: $q(\overline{E})W(\overline{e}) + (1 - q(\overline{E}))W(\underline{e}) < 0$.

The anticompetitive impact of the inefficient merger can be corrected if, when submitting their merger, the insiders equally propose an effective 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. Denote by $\Pi^R(e)$ the joint profit increase from merger when remedies apply. Then $\Pi(e) \geq \Pi^R(e) > 0, \forall e$, meaning that the merger is still profitable. However, we also assume that $\frac{\Pi(\overline{e})}{\Pi^R(\overline{e})} > \frac{\Pi(\underline{e})}{\Pi^R(\underline{e})}$, i.e. the remedies are costlier for the more efficient merger entity.

As far as the CA's objective is concerned, denote by $W^R(\overline{e})$ and $W^R(\underline{e})$ the CS variations when remedies apply, depending on the possible levels of efficiency gains. We assume the remedy is effective, meaning that when applied for an inefficient merger, it will improve CS: $W^R(\underline{e}) \geq 0$. In addition, when applied to the more efficient merged entity, the remedy does not write off too much of the merger's social gain as compared with the low efficiency type[11]: $W^R(\overline{e}) > W^R(\underline{e})$. Understandably, we consider here a very simple representation of remedies, since the only remedy available is also effective in terms of CS. Nevertheless, this assumption basically amounts to considering the least costly remedy that fixes the anticompetitive impact of the inefficient merger[12]. The CA clears a merger only if the expected CS variation is positive.

The timing of events is the following:

At the first stage, the CA chooses a decision rule for merger clearance. 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, with or without remedies.

[10] This assumption is not crucial but simplifies the exposition of the results.

[11] It is important to note that in the Cournot model à la Farrell and Shapiro (1990), there exist asset divestitures that keep the price unchanged even without efficieny gains as long as the cost function exhibits increasing returns to scale.

[12] This is precisely what the European Commission recommends in its Notice on remedies acceptable under Council Regulation (EC) No 139/2004, although greatly restraining as a consequence the range of remedies acceptable for a given merger (see § 9 to 14).

At the fourth stage, the merger is then cleared or blocked, according to the decision rule chosen at the first stage and also the observed signal.

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 expected level of efficiency gains. 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 "assess the merger ignoring any possible efficiency gains but considering the submitted remedies"

- a "strict ED" decision rule: "assess the merger taking into account the expected level of efficiency gains and ignoring any remedies"

- a "flexible ED" decision rule: "assess the merger taking into account both the expected level of efficiency gains and submitted remedies".

The best way to interpret this timing is to consider our game as a phase 2 detailed merger assessment that follows a non modelled phase 1 which led the CA to believe that the merger project is likely to raise anticompetitive issues and as such requires an in-depth examination. During this phase 2, the CA suggests that firms could either propose remedies to secure the merger decision, if allowed by the merger rule adopted, or argue that efficiency gains are sufficient[13].

By assumption, whenever a merger is rejected, under either decision rule, the status-quo is maintained. At stage 4, the merger assessment consists in comparing the expected CS variation with that without merger.

We determine the Perfect Bayesian Equilibrium of this game given that the CA selects at stage 1 the decision rule that gives the highest expected CS.

Based on these decision rules, we will assess the consequences of allowing remedies 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

[13] Basically, this replicates the current two-phase merger control procedure applied by the European Commission.

will actually conclude on the opportunity for the CA to commit to allowing remedy or not when applying an ED.

3. The efficiency defence as an incentive device

We consider here a benchmark situation, where only the strict ED and the remedy decision rules are available, but mutually exclusive. This means that whenever 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. 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* $\widetilde{\beta} \in (0,1]$ *such that for* $\beta \geq \widetilde{\beta}$*, the CA applies the "strict ED".*

In short, the ED is chosen only for a sufficient quality of information, as indicated by a cost-benefit comparison for both decision rules. Under the "remedy" rule the CA will always accept the merger, since by assumptions the remedies applied are sufficient to preserve the expected CS with an inefficient merger. Without the possibility of remedies, the CA will optimally accept a merger only if it receives a good signal. Otherwise, the lower expected CS leads to prohibit the merger[14]. Thus, under this decision rule, the CA may prohibit CS enhancing projects when the information available is poor and thereby makes type I errors (false prohibitions). In terms of incentive-provision, the "strict ED" rule is likely to increase the incentives to exert effort since the high efficiency gains represent the only way for the merger to be accepted. Moreover, the higher the quality of information, i.e. the probability for the CA to receive a good signal if the actual efficiency gains are high (β), the higher the effort exerted. In contrast, the remedy rule undermines these incentives to exert effort by requiring remedies and accepting thereby inefficient mergers in this manner.

[14] Here, the assumption $q(\overline{E})W(\overline{e}) + (1 - q(\overline{E}))W(\underline{e}) < 0$ matters and simplifies our results since otherwise there would exist an equilibrium where the CA would clear the merger with a positive probability in case of signal s^M. Nevertheless, the comparison between the three decision rules would be roughly unchanged.

In other words, the CA's basic trade-off for the ED rule comes down to avoiding type I errors or providing incentives to increase efficiency gains. The result depends on the magnitude of errors, which in turn depends on the quality of information. Thus, whenever the probability β is high enough, the "strict ED" dominates the alternative remedy rule. Note also that the relevant threshold for the "strict ED" adoption depends directly on the CS level $W(\overline{e})$. In case of high EG, $W(\overline{e})$ captures the magnitude of the social benefit to provide incentives to exert effort. More precisely, the higher $W(\overline{e})$, the lower $\widetilde{\beta}$.

Proposition 1 emphasizes that the higher the quality of information, the more likely the ED rule. The latter can be optimal despite the imperfect information and the ensuing possibility to reject efficient mergers. Instead, the remedy decision rule also guarantees a CS improvement, although potentially lower since it provides low effort incentives, but prevents in return any type I 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 I errors" effect. By allowing the ED, the CA gives firms incentives to exert effort and thereby to propose more efficient mergers. This 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 I errors. This is the "type I errors" effect.

Keeping this in mind, the next question raised concerns the way in which this basic trade-off is affected if remedies are allowed in addition to the ED. To put it differently, we investigate next the possible complementarity between remedies and the ED, and the likely ensuing consequences for the expected CS.

4. Merger control with remedies and efficiency defence: do remedies complement the Efficiency Defence?

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

We first determine in the next lemma the insiders' optimal submission strategy when the CA adopts a "flexible ED", i.e. the CA always accepts a merger for which remedies have been proposed, but only clears a merger without remedies with probability $d(s)$, where s is the signal received.

Basically, under the "flexible ED", the insiders may either propose remedies with their merger or not, in which case they attempt the ED by claiming that EG are high.

Lemma 1. *Under the flexible ED rule, given the CA's strategy set* $d(s^H) = 1$, $d(s^L) = 0$ *and* $d(s^M) = d$, *there exist two thresholds* $d_{\overline{e}}(\beta)$ *and* $d_{\underline{e}}(\beta)$ *with* $d_{\overline{e}}(\beta) < d_{\underline{e}}(\beta)$ *such that the optimal choice of the merging firm is the following:*

(i) for $d < d_{\overline{e}}(\beta)$ *both types of merging firms propose remedies*

(ii) for $d_{\overline{e}}(\beta) < d < d_{\underline{e}}(\beta)$, *the efficient merging firms do not propose remedies but the inefficient merging firms do so*

(iii) for $d > d_{\underline{e}}(\beta)$, *neither type of merging proposes remedies.*

In addition $d_{\underline{e}}(\beta) = 1$ *iff* $\beta \geq 1 - \frac{\Pi^R(\underline{e})}{\Pi(\underline{e})} = \underline{\beta}$ *and* $d_{\overline{e}}(\beta) = 0$ *iff* $\beta > \frac{\Pi^R(\overline{e})}{\Pi(\overline{e})} = \overline{\beta}$.

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 quality of available information as well as on the probability for the CA to clear the merger if it receives no signal whatsoever.

More precisely, for a very low probability to clear a merger without information on e, insiders do not run the risk of rejection under the ED, but propose instead remedy with their merger, so as to ensure its approval. In turn, for a very high such a probability, neither type of insiders propose remedies and both choose instead the ED. Finally, for intermediate levels of that probability, there is self-selection since the efficient insiders run the risk of the ED whereas the inefficient merger type proposes remedies.

Moreover, for very good signals, the probability of detecting an inefficient merger is very high, thus the inefficient insiders always prefer to propose remedies whereas the efficient ones propose none. In such a case, for any probability d, there is self-selection. On the contrary, a lower information quality (worse signal) increases the opportunity cost for the inefficient firms to propose a merger with remedy, because there are less chances for it to be rejected if it attempts the ED. To sum up, a lower signal quality gives incentives to inefficient insiders to propose a merger without remedy as long as d is high enough.

At this point, it is worth mentioning that here we model a situation where besides its corrective role, the merger remedy may possibly convey information on the level of efficiency gains from the

merger. This is possible however because the CA's decision rule allows this type of behavior. 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.

We study next the role of this signaling behavior on the optimal decision made by the CA under the "flexible ED" rule.

Lemma 2. *Under the flexible ED rule:*

(i) for $\beta > \underline{\beta}$ *there exists a separating equilibrium where the efficient insiders choose to submit no remedies while the inefficient ones propose remedies and where the strategy set for the CA is* $d(s^H) = d(s^M) = 1$ *and* $d(s^L) = 0$;

(ii) for $\beta < \underline{\beta}$ *there exists a semi-separating equilibrium where the efficient insiders choose to submit no remedies while the inefficient ones choose remedies with a positive probability and where the strategy set for the CA is* $d(s^H) = 1$, $d(s^L) = 0$ *and* $d(s^M) = d_{\underline{e}}(\beta)$;

(iii) for $\beta < \overline{\beta}$ *there exists a pooling equilibrium where both the efficient and inefficient firms choose remedies and where the strategy set for the CA is* $d(s^H) = 1$, $d(s^L) = 0$ *and* $d(s^M) \in [0, 1]$. *This equilibrium does not satisfy the Cho and Kreps criterion whenever* $\beta > \underline{\beta}$.

Lemma 2 states that if the quality of information is high enough, a separating equilibrium exists under the "flexible ED" rule for which self-selection occurs. For intermediate and low levels of information quality, there is a semi-separating one where the inefficient type randomizes between proposing or not remedies. Note at this point that the probability of acceptance increases with the information quality, since better information quality reduces the incentives for the inefficient merger type to argue high EG, and thus allows the CA to raise the probability of acceptance even without signal. For low quality of information a pooling equilibrium also exists, where both types of insiders propose remedies.

These equilibria result from the optimal behavior of the merging firms described in the previous lemma. Indeed, if the information quality is high, the self-selection of insiders induces the CA to optimally clear a merger which argues EG. For lower levels of information quality, the incentives for the inefficient merger to choose the ED if the probability of clearing is high makes the CA reduce the probability of acceptance to the level where the inefficient insiders are indifferent between proposing

or not remedies. Hence the semi-separating equilibrium. The pooling equilibrium also exists for lower information quality, because if the CA sets a low probability of approval, it is optimal for the insiders to propose remedies whatever the level of efficiency gains, and there exist beliefs for the CA to support such a low probability of acceptance.

Turning now to the first stage, when choosing the merger control rule, the CA evaluates the induced expected CS which basically depends on the probability the merger results efficient and on the rate of type I errors. Therefore we examine next the impact of the flexible ED rule on the effort incentives as compared with the strict ED rule.

Lemma 3. *(i) There exists a threshold $\widehat{\beta}$ such that the effort exerted is higher with the "flexible ED" than with the "strict ED" if $\beta < \widehat{\beta}$ and the opposite holds if $\beta > \widehat{\beta}$.*

(ii) The effort exerted under the "remedy rule" is always lower than the effort exerted under the "flexible ED rule".

We show in this lemma that for low levels of quality of information, the "flexible ED" gives more incentives to exert effort than the "strict ED".

The effort incentives depend on two basic elements: the importance of type I errors, which lower them, and the opportunity cost not to exert effort, which increases them. Both decision rules that take into account efficiency gains affect both elements.

The "strict ED" leads to a high such opportunity cost, since the profit in case of merger prohibition is lower than with conditional approval. Yet, the "strict ED" leads to type I errors in the decision making process. The magnitude of errors under the "strict ED" depends on the available information.

The "flexible ED" avoids any type of errors whenever β is high enough ($\beta > \underline{\beta}$), since any inefficient merger is induced to propose remedies over this range of information quality. Moreover, even for lower levels of β, if the semi-separating equilibrium prevails, the importance of type I errors is reduced with respect to the "strict ED" since the CA clears mergers with positive probability even without information on e (the signal s^M). Nevertheless, the opportunity cost of exerting no effort is lower, since remedies guarantee approval in case of low efficiency gains.

As a result, as long as the magnitude of type I errors remains high under the "strict ED", the "flexible ED" gives more incentives to exert effort.

Thus, from the CA's standpoint, simultaneously allowing for both the ED and remedies can dramatically improve the decision process: for certain levels of information quality, the self-selection potentially leads to an increase in the effort exerted, but also avoids any type of errors. Nevertheless, for other levels of information quality, either the self-selection does not occur, or the possibility of remedy reduces the *ex ante* effort incentives. In that case, the decision to allow or not simultaneously both the remedy and the ED within the "flexible" ED decision rule implies for the CA the choice between reducing errors in the decision process and increasing the probability of efficient mergers.

The determination of the optimal decision rule resulting from this trade-off follows below:

Proposition 2. *The optimal decision rule depends on the quality of information β as follows:*

(i) there is a unique and uniquely defined threshold β^{***} such that for $1 \geq \beta \geq \beta^{***}$ the "strict ED" is optimal;

(ii) there is a threshold β^{**} such that for $\beta^{***} \geq \beta > \beta^{**}$, the "flexible ED" is optimal;

(iii) there is a threshold β^{*} such that for $\beta^{*} \geq \beta > 0$, the "remedy" is optimal.

In this proposition, we show that the optimal decision rule depends on the quality of information. A low quality induces the CA to use the remedy rule. A higher quality should induce to add ED to remedy, and eventually, for high enough information quality, the strict ED rule is the most efficient rule.

The choice of the optimal decision rule amounts to a trade-off, between the "flexible ED" which likely leads the insiders to reveal information on their efficiency gains, the "strict ED" which possibly gives higher incentives to exert effort, and the remedy rule which avoids any type of errors. Thus the trade-off balances the low level of errors against the high expected level of efficiency gains.

Let us first explicit this trade-off whenever the quality of information is high enough to lead the inefficient insiders to actually signal their low efficiency gains by proposing remedies.

Lemma 3 showed that the "flexible ED" can be the decision rule that maximizes the incentives to exert effort, in which case there is actually no trade-off and the "flexible ED" dominates. Instead, for higher information quality (higher β), the level of effort exerted will be higher under the "strict ED". Hence the trade-off between higher expected efficiency gains and type I errors. The key

parameter here is the CS level if the efficiency gains are high. Indeed, the higher $W(\overline{e})$, the higher the benefit to provide high incentives and thereby to adopt the strict ED rule. Moreover, the higher the quality of information, the lower the number of errors under the "strict ED". As a result, if the quality of information is high enough (for β beyond β^{***}, where $\beta^{***} < 1$ iff $W(\overline{e})$ is high enough), giving up remedies within the strict ED encourages more efficient mergers.

Second, for lower levels of information quality, two possibilities arise. If the semi-separating equilibrium prevails under the "flexible ED" rule, the latter ensures a higher effort than the "strict ED" as well as a lower level of type I errors. Nevertheless, the decision rule does not avoid completely type I errors as the remedy rule does. Hence a trade-off between the inefficiency of type I errors and a higher effort. Again, the result depends on the level of the information quality since a decrease in the quality of information reduces the expected CS under the flexible ED rule and leads the CA to prefer the remedy rule (for β lower than β^*). Instead, if the pooling equilibrium prevails, the flexible ED rule leads to the same expected CS as the remedy rule, and thus the comparison amounts to balancing the remedy rule against the strict ED rule as in Proposition 1.

In other words we show that there exists a range of intermediate information quality where the combination of both procedures, the remedy and the ED, is optimal. If we turn back to our benchmark case where only one procedure was allowed, we observe that slightly above the threshold $\widetilde{\beta}$, the combination of both is preferred because together they lead to a reduction in type-I errors without diminishing the effort incentives. Similarly, slightly below $\widetilde{\beta}$ they provide higher incentives to implement an efficient merger without increasing type-I errors.

Our model provides a possible interpretation for the introduction of the ED procedure in addition to remedies within the ECMR. The improvement in the ability of the Commission to assess efficiency gains represents an increase in the quality of information available. According to our model, this may have led merging firms to self-select according to the "procedure" chosen. As a result, the combination of remedies with the ED is now optimal against the remedy rule on its own. In addition, a further increase in the information quality may lead in the future to have the remedies removed from the tool-kit of merger control so as to provide even higher incentives to look for efficiency gains.

5. 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 the remedies and the ED. The study of this interplay is the original and more important contribution of our paper. We examine the impact of remedies on the incentives provided by the ED, and conclude on the opportunity of combining them with the ED, depending on the quality of information underlying the merger assessment.

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6. Appendix

6.1. Proof of Proposition 1

- **Under the strict ED rule**

Denote by $d(s)$ the probability of acceptance according to the signal s received.

We have $d(s^H) = 1$ and $d(s^L) = 0$. Denote $d(s^M) = d$. If s^M is observed, and the merger is cleared, the expected CS is $q(E)W(\overline{e})+(1-q(E))W(\underline{e})$, which is negative by assumption. Therefore $d(s^M) = 0$.

The effort $E^{SED}(\beta)$ is such that $q'(E^{SED})(\beta\Pi(\overline{e})) = F'(E^{SED})$. It is increasing with β due to $q'(E) < 0$ and $F'(E) > 0$. The expected CS increases with β as well, ranging from 0 if $\beta = 0$ to its maximum: $q(E^{SED}(1))W(\overline{e})$ for $\beta = 1$.

- **Under the remedy rule**

The merger is cleared iff remedies are proposed.

Thus the effort E^R is such that $q'(E^R)(\Pi^R(\overline{e})-\Pi^R(\underline{e})) = F'(E^R)$ with a corresponding expected CS of $q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$.

- **Comparison of both expected CS**

For $\beta = 0$, the expected CS under the remedy rule is higher.

For $\beta = 1$, since $\Pi(\overline{e}) > (\Pi^R(\overline{e}) - \Pi^R(\underline{e}))$ then $E^{SED}(1) > E^R$.

Therefore $q(E^{SED}(1))W(\overline{e}) > q(E^R)W^R(\overline{e})+(1-q(E^R))W^R(\underline{e})$, as long as $W(\overline{e})$ is high enough. In this case, there exists $\widetilde{\beta}$ such that both expected CS are equal:

$q(E^{SED}(\widetilde{\beta}))W(\overline{e}) = q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$.

For $\beta > \widetilde{\beta}$, the SED rule yields a higher expected CS than the remedy rule. Otherwise, $\widetilde{\beta} = 1$.

6.2. Proof of Lemma 1

- **The efficient merger type:**

The profit under remedies is lower than the expected profit with ED iff
$\Pi^R(\overline{e}) \leq \beta\Pi(\overline{e}) + (1-\beta)d\Pi(\overline{e}) \Leftrightarrow d \geq Max(\frac{\Pi^R(\overline{e})-\beta\Pi(\overline{e})}{(1-\beta)\Pi(\overline{e})}, 0) = d_{\overline{e}}(\beta)$.
Moreover $d_{\overline{e}}(\beta) > 0 \Leftrightarrow \beta < \frac{\Pi^R(\overline{e})}{\Pi(\overline{e})} = \overline{\beta}$.

- **The inefficient merger type:**

The profit under remedies is lower than the expected profit with ED iff
$\Pi^R(\underline{e}) \leq (1-\beta)d\Pi(\underline{e}) \Leftrightarrow d \geq Min(\frac{\Pi^R(\underline{e})}{(1-\beta)\Pi(\underline{e})}, 1) = d_{\underline{e}}(\beta)$.
Furthermore $d_{\underline{e}}(\beta) < 1$ iff $\beta < 1 - \frac{\Pi^R(\underline{e})}{\Pi(\underline{e})} = \underline{\beta}$.
Finally, $d_{\overline{e}}(\beta) < d_{\underline{e}}(\beta)$ since by assumption $\frac{\Pi^R(\underline{e})}{\Pi(\underline{e})} > \frac{\Pi^R(\overline{e})}{\Pi(\overline{e})}$.

6.3. Proof of Lemma 2

Let us determine the Perfect Bayesian equilibria following the decision rule set at stage 1.

- **For** $\beta > \underline{\beta}$, i.e. $d_{\underline{e}}(\beta) = 1$

The inefficient insiders always submit remedies with their merger. Consider the situation where the efficient merging firms choose the ED. These are equilibrium strategies together with the following reaction on behalf of the CA: $d(s^H) = d(s^M) = 1$ and $d(s^L) = 0$. Indeed, given the firms' self-selection, approval is the optimal response to s^M. Moreover it is optimal for the efficient merger not to propose remedies if $d(s^M) = 1$.

This is a **separating equilibrium**.

- **For** $\beta > \overline{\beta}$ **and** $\beta < \underline{\beta}$.

The efficient insiders always choose no remedies for their submission. We denote by δ the probability the inefficient type chooses remedies. Let us identify the equilibrium.

Consider an equilibrium where $d(s^M) < d_{\underline{e}}(\beta)$. In that case, according to Lemma 1, $\delta = 1$. Thus it would be optimal for the CA to choose $d(s^M) = 1$, which contradicts the initial assumption.

Consider an equilibrium with $d(s^M) > d_{\underline{e}}(\beta)$. Then according to Lemma 1, $\delta = 0$. Thus the optimal choice for the CA would be $d(s^M) = 0$, contradicting the initial assumption.

Finally, consider an equilibrium with $d(s^M) = d_{\underline{e}}(\beta)$. Then the inefficient insiders are indifferent between remedies and ED. Let us find δ such that the expected CS is equal to 0 if s^M is observed. This δ is defined by $W(\overline{e})q(E^{FED}) + (1 - q(E^{FED}))\delta W(\underline{e}) = 0$, and always exists, since for $\delta = 1$, $W(\overline{e})q(E^{FED}) + (1 - q(E^{FED}))W(\underline{e}) < 0$, whereas for $\delta = 0$, $W(\overline{e})q(E^{FED}) > 0$.

Thus, for this δ, the CA is indifferent between clearing the merger and prohibiting the merger. As a result, the strategy $d = d_{\underline{e}}(\beta)$ is optimal.

This is a **semi-separating equilibrium.**

- **For** $\beta < \overline{\beta}$

In that case the semi-separating equilibrium described above exists.

Let also study a **pooling equilibrium** where both types of insiders submit remedies with their merger.

It is optimal for both types to submit remedies as long as $d < d_{\overline{e}}(\beta)$.

Note that the CA's beliefs if no remedies and s^M are both observed are not defined, since they are out of the equilibrium path. Denote x the belief of the CA the merging firms are efficient when s^M and ED are observed. Let x be such that $W(\overline{e})x + (1 - x)W(\underline{e}) < 0$. Then for such a belief, $d(s^H) = 1$, $d(s^L) = 0$ and $d(s^M) = 0 < d_{\overline{e}}(\beta)$, is an optimal response for the CA.

To sum up, the existence of this pooling equilibrium is ensured whenever there are no incentives for the efficient insiders to deviate towards the ED (no remedy submission), i.e. as long as $d < d_{\overline{e}}(\beta)$. Thus the pooling equilibrium exists as long as $d_{\overline{e}}(\beta) > 0 \Leftrightarrow \beta < \overline{\beta}$.

However, the belief $0 < x < 1$ satisfies the Cho and Kreps criterion as long as there exists $d(s^M)$ such that it could be profitable for the inefficient insiders to choose ED (no remedies). It is the case as long as $d_{\underline{e}}(\beta) < 1 \Leftrightarrow \beta < \underline{\beta}$.

Thus, hereafter, we will consider the pooling equilibrium only if $\beta < Min(\overline{\beta}, \underline{\beta})$.

6.4. Proof of Lemma 3

6.4.1. Proof of part (i)

Denote "Strict efficiency defence" by SED, "Flexible efficiency defence" by FED and "remedy" by R.

Under the SED rule the effort $E^{SED}(\beta)$ is such that $q'(E^{SED})(\beta\Pi(\overline{e})) = F'(E^{SED})$.

- **The case where** $\beta \leq \underline{\beta} \Leftrightarrow d_{\underline{e}}(\beta) < 1$.

Under the FED rule if the semi-separating equilibrium prevails the effort exerted is $E^{FED}(\beta)$ and defined by $q'(E^{FED})(\beta\Pi(\overline{e}) + (1-\beta)\Pi(\overline{e})d_{\underline{e}}(\beta) - \Pi^R(\underline{e})) = F'(E^{FED})$.

Thus $E^{FED}(\beta) > E^{SED}(\beta)$ iff $(1-\beta)\Pi(\overline{e})d_{\underline{e}}(\beta) - \Pi^R(\underline{e}) > 0$.

This inequality always holds since $(1-\beta)\Pi(\overline{e})d_{\underline{e}}(\beta) - \Pi^R(\underline{e}) > (1-\beta)\Pi(\underline{e})d_{\underline{e}}(\beta) - \Pi^R(\underline{e}) = 0$. Note here that $E^{FED}(\beta)$ increases with β since $d_{\underline{e}}(\beta)$ increases with β.

Under the FED, the pooling equilibrium can also prevail if $\beta < Min(\underline{\beta}, \overline{\beta})$. In that case the effort exerted under the FED is equal to E^R. Then $E^R > E^{SED}(\beta)$ iff $\Pi^R(\overline{e}) - \Pi^R(\underline{e}) > \beta\Pi(\overline{e})$, which is true since we consider $\beta < \underline{\beta}$.

- **The case where** $\beta > \underline{\beta} \Leftrightarrow d_{\underline{e}}(\beta) = 1$

Under the FED rule, only the separating equilibrium prevails and thus the effort exerted, denoted $E^{FED}(\beta)$, satisfies the following: $q'(E^{FED})(\Pi(\overline{e}) - \Pi^R(\underline{e})) = F'(E^{FED})$. Note that here the effort does not depend on β. Then $E^{FED}(\beta) > E^{SED}(\beta)$ iff $\Pi(\overline{e})(1-\beta) - \Pi^R(\underline{e}) > 0$, which is the case iff $\beta \leq \frac{\Pi(\overline{e}) - \Pi^R(\underline{e})}{\Pi(\overline{e})} = \widehat{\beta}$. This is compatible with the initial condition $\beta > \underline{\beta} = 1 - \frac{\Pi^R(\underline{e})}{\Pi(\underline{e})}$, since $1 - \frac{\Pi^R(\underline{e})}{\Pi(\underline{e})} < \frac{\Pi(\overline{e}) - \Pi^R(\underline{e})}{\Pi(\overline{e})}$.

- **Conclusion**: $E^{FED}(\beta) > E^{SED}(\beta)$ iff $\beta \leq \widehat{\beta}$.

6.4.2. Proof of (ii)

To prove that $E^R \leq E^{FED}(\beta)$, we need to show that $E^R \leq E^{FED}(0)$ since $E^{FED}(\beta)$ increases with β whenever the semi-separating equilibrium prevails and is constant and higher than E^R for the separating equilibrium.

One has that $E^R \leq E^{FED}(0)$ iff $\Pi^R(\overline{e}) - \Pi^R(\underline{e}) \leq \left[(\beta\Pi(\overline{e}) + (1-\beta)\Pi(\overline{e})d_{\underline{e}}(\beta) - \Pi^R(\underline{e})\right]_{\beta=0}$. This inequality holds since $d_{\underline{e}}(0)\Pi(\overline{e}) = \frac{\Pi^R(\underline{e})}{\Pi(\underline{e})}\Pi(\overline{e}) > \Pi^R(\overline{e})$.

6.5. Proof of Proposition 2

Let us compare the expected CS depending on the equilibria identified in Lemma 2 and the effort comparison established by Lemma 3.

- **Consider first that** $\beta \geq \underline{\beta}$

In that case, the separating equilibrium prevails under the FED rule since the pooling equilibrium does not meet the Cho and Kreps criterion, so is not retained as relevant.

The expected CS are the following under each decision rule:
Under the "remedy" rule the expected CS is $q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$
Under the "strict ED" the expected CS is $\beta q(E^{SED}(\beta))W(\overline{e})$
Under the "flexible ED" the expected CS is: $q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta)) \cdot W^R(\underline{e})$

First of all, the expected CS under the FED is larger than under the remedy rule:
$\left\{q(E^{FED}(\beta))W(\overline{e}) + (1 - q(E^{FED}(\beta))W^R(\underline{e})\right\} - \left\{q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})\right\}$
$> \left[q(E^{FED}(\beta)) - q(E^R)\right]\left[W^R(\overline{e}) - W^R(\underline{e})\right] > 0$, since $E^{FED}(\beta) > E^R, \forall\beta$.

Secondly, we compare the expected CS under the SED with the expected CS under the FED:
>From Lemma 3 $E^{FED}(\beta) < E^{SED}(\beta)$ for $\beta > \widehat{\beta}$ (where $\widehat{\beta} > \underline{\beta}$).
Thus for $\underline{\beta} < \beta < \widehat{\beta}$, the FED dominates the SED since one has
$\beta q(E^{SED}(\beta))W(\overline{e}) < q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta)) \cdot W^R(\underline{e})$.
Moreover, for $\beta > \widehat{\beta}$, the expected CS under SED increases with β while the expected CS is constant under the FED.

Thus, there exists a unique β^{***} with $\widehat{\beta} < \beta^{***} < 1$ such that:
$\beta^{***}q(E^{SED}(\beta^{***}))W(\overline{e}) = q(E^{FED}(\beta^{***}))W(\overline{e}) + (1 - q(E^{FED}(\beta^{***}))W^R(\underline{e})$ iff
$q(E^{SED}(1))W(\overline{e}) > q(E^{FED}(1))W(\overline{e}) + (1 - q(E^{FED}(1))W^R(\underline{e})$. Otherwise $\beta^{***} = 1$.

To sum up, for $\beta > \beta^{***}$, the SED is optimal, and for $\underline{\beta} < \beta < \beta^{***}$, the FED is optimal.

- **Consider now the case where $\beta < \underline{\beta}$**

For $\beta < \underline{\beta}$, under the FED rule both the pooling and the semi-separating equilibria obtain.

(i) If the **semi-separating equilibrium** prevails under the FED, then the expected CS are:

Under the "remedy" rule the expected CS is:$q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$

Under the "strict ED" the expected CS is: $\beta q(E^{SED}(\beta))W(\overline{e})$

Under the "flexible ED" the expected CS is: $\beta \cdot q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta))) \cdot W^R(\underline{e}) \cdot (1 - \delta)$

From Lemma 3 one has that $E^{FED}(\beta) > E^{SED}(\beta)$ for $\beta < \underline{\beta}$. As a result, the expected CS under the FED rule is higher than under the SED rule:

$\beta \cdot q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta))) \cdot W^R(\underline{e}) \cdot (1 - \delta) > \beta \cdot q(E^{SED}(\beta)) \cdot W(\overline{e})$.

One needs therefore to compare the expected CS under the FED and under the remedy rules:

First, the term $\beta \cdot q(E^{FED}(\beta)) \cdot W(\overline{e})$ is increasing with β because $E^{FED}(\beta)$ increases with β

Second, for $\beta = 0$, the expected CS under the FED is lower than under the remedy rule:

$\left[\beta \cdot q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta))) \cdot W^R(\underline{e}) \cdot (1 - \delta)\right]_{\beta=0} < q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$.

Thus, there exists a unique $\beta \in \left[0, \underline{\beta}\right]$ such that:

$\beta \cdot q(E^{FED}(\beta)) \cdot W(\overline{e}) + (1 - q(E^{FED}(\beta))) \cdot W^R(\underline{e}) \cdot (1 - \delta) = q(E^R)W^R(\overline{e}) + (1 - q(E^R))W^R(\underline{e})$.

In that case, for any β lower than this threshold, the remedy rule is optimal.

(ii) If for $\beta < Min(\underline{\beta}, \overline{\beta})$, the **pooling equilibrium** prevails, then the FED rule leads to the same outcome as the remedy rule. Following Proposition 1, for β lower than $Min(\underline{\beta}, \overline{\beta}, \widetilde{\beta})$, the remedy rule is the optimal rule.

In short, for both types of equilibria, there exists β^* below which the remedy rule is optimal.

- **To sum up:**

(i) For any $\beta > \beta^{***}$, the SED is the best decision rule

(ii) There exists β^{**} such that for $\beta^{**} < \beta < \beta^{***}$, the FED is the best decision rule.

(iii) There exists β^* such that for $\beta < \beta^*$, the remedy rule is optimal.

The point is that if the semi-separating equilibrium prevails under the FED rule, then $\beta^* = \beta^{**}$.