On the Desirability of an Efficiency Defense in Merger Control*

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Abstract

We develop a model in which two firms that have proposed to merge are privately informed about merger-specific efficiencies. This enables the firms to influence the merger control procedure by strategically revealing their information to an antitrust authority. Although the information improves upon the quality of the authority's decision, the influence activities may be detrimental to welfare if information processing/gathering is excessively costly. Whether this is the case depends on the merger control institution and, in particular, whether it involves an efficiency defense. We derive the optimal institution and provide conditions under which an efficiency defense is desirable. We also discuss the implications for antitrust policy and outline a three-step procedure that takes the influence activities into consideration.

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"[A] policy of approving anticompetitive mergers for efficiency reasons is likely to promote a dissipation of resources into rent seeking." Franklin M. Fisher (1987, p. 39)

1 Introduction

The appropriate regulation of mergers is an important policy issue in the U.S. as well as in Europe, and the question whether efficiency gains (either proven or only claimed) should constitute a reason not to challenge an otherwise anticompetitive merger is much debated.[1] Williamson (1968) was the first to stress that the decision whether to permit a merger potentially involves a welfare tradeoff: whereas permitting the merger is likely to increase the merged unit's market power, as doing this reduces the number of rivals competing in the market, it may also allow the newly created firm to realize efficiency gains. One strand of the theoretical literature on mergers has investigated this tradeoff in various oligopoly models; see, for example, Williamson (1968), Deneckere and Davidson (1985), Farrell and Shapiro (1990), and Spector (2003).

While these contributions can inform an antitrust authority's decision whether to permit a proposed merger and, for example, provide reasons to be very skeptical, they do not explain why an antitrust authority *as a matter of principle* should rule out the possibility that an anticompetitive merger may be permitted for efficiency reasons: rules and guidelines that do exactly this (like the previous ones used in the U.S. and the E.U.) cannot be justified by the literature cited above. However, one conceivable benefit with making an irreversible commitment not to permit mergers for efficiency reasons is that this may discourage rent seeking or other forms of influence activities. This point has indeed often been made in the literature; see, for example, the above quotation by Fisher.[2]

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[1] Currently, the American policy allows for an explicit efficiency defense. Until fairly recently, however, the U.S. policy, as expressed by the Horizontal Merger Guidelines issued by the Department of Justice and the Federal Trade Commission, placed much less weight on the efficiency criterion; for a discussion and evaluation of these changes of the Guidelines, in particular with respect to the treatment of efficiencies, see for example Farrell and Shapiro (2001) and several of the contributions in the Spring 1999 issue of the George Mason Law Review. The European Commission has also just recently made a move toward taking possible efficiencies into account when assessing proposed mergers; for discussions, see Röller, Stennek, and Verboven (2001), Ilzkovitz and Meiklejohn (2001), and European Commission (2001). One reason why the European Commission decided to make this move was that the increased frequency of cross-border mergers raised the question whether American and European rules should be harmonized.

[2] The argument can be found also in Neven et al. (1993, p. 213, footnote 41) and in Röller

Yet it is not clear whether all kinds of influence activities should count as a social cost of allowing for an efficiency defense. For if the activities take the form of outright monetary bribes, then they merely represent a transfer of wealth between different economic agents. Similarly, one often-mentioned reason why allowing for an efficiency defense may make the merger control procedure easier to influence is that the merging firms (hereafter called the *insiders*) typically have superior access to information about any efficiencies;[3] hence, by strategically transmitting such information to the antitrust authority, the insiders may be able to achieve a favorable decision. The welfare effects of such influence activities could be either positive or negative, depending on whether the cost of gathering, processing, and transmitting the information is offset by its social benefits.[4,5]

Thus, in order to better understand under what circumstances influence activities may serve as a reason not to allow for an efficiency defense, it is important to model the reason why they may be influential and then, in an equilibrium analysis, investigate the welfare effects of different merger control institutions, with and without an efficiency defense. To the best of our knowledge, there is no attempt in the literature to do this. The present paper tries to fill this gap. Although the model we develop is relatively simple, it captures three important

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et al. (2001, p. 117-118).

[3] The Horizontal Merger Guidelines (U.S. Department of Justice and U.S. Federal Trade Commission, 1997, Section 4) state explicitly that "[...] much of the information relating to efficiencies is uniquely in the possession of the merging firms." Yao and Dahdouh (1993) discuss the problem of informational asymmetries in merger control at length and argue that asymmetries in the access to information are particularly important for efficiencies.

[4] An early paper that explicitly interprets rent-seeking expenditures as costs of information gathering is Tullock (1975). Later work that has provided informational foundations to the rent-seeking theory, by showing that there may be overinvestment in information acqusition from a social welfare point of view, includes Shavell (1994) and Lagerlöf (1997). More generally, lobbying as a form of strategic information transmission has been modeled in, for example, Austen-Smith and Wright (1992) and Grossman and Helpman (2001).

[5] Recently, the consulting firm PricewaterhouseCoopers (2003) conducted a survey that estimates the costs to business of multi-jurisdictional merger reviews. It shows that, in cases that led to an in-depth review, an acquiring company's external costs (e.g., hiring consultants) amounted to on average 5.4 million euros, and the average internal costs (use of own personnel), measured in person weeks, were 120. For some companies in the sample the numbers are much higher: the corresponding averages for the top quartile are 15 million euros and 389 person weeks (or around 8 person years). There are also quite large differences across jurisdictions, with filings in the U.S. leading to significantly higher costs than filings in the E.U.

Even though the survey suffers from a low response rate (14 percent), which might have led to a selection bias, we take these numbers as an indication that costs of merger enquiries can be quite substantial. We also want to emphasize, however, that some of our arguments do not rely on merger reviews being excessively costly. In our model, an efficiency defense can be suboptimal with a large margin and at the same time induce very low costs. When this happens, the reason why an efficiency defense is bad is that it makes it too difficult, also from society's point of view, for the firms to merge (see the example in the end of Section 4).

aspects of a merger control procedure: Williamson's tradeoff between increased market power and possible efficiency gains, the insiders' having superior access to information about any efficiencies, and these firms' vested interest in having the merger permitted.

In particular, we model the merger control procedure as an interaction between two economic agents: the insiders (acting as one unit) and society. The efficiency gains due to the merger may be "low" or "high." Whereas the insiders want to merge regardless of the size of the efficiencies, society wants the merger to take place only if they are high. Initially, the insiders know only whether the efficiencies are high or low. This information, however, is soft (i.e., non-verifiable), which means that in order to be able to credibly transmit it to society, the insiders must first invest resources in evidence production. If they do this and if they are successful, they find hard (i.e., verifiable) information about the size of the efficiency gains, which they (if this is in their interest) can disclose to society.[6] The role of society is to choose a merger control institution, by which we mean a rule whether to permit the proposed merger conditional on whether the insiders have submitted a report and whether this report showed that the efficiencies are high or low. We assume that society commits to such a rule at an ex ante stage. A merger control institution that "allows for an efficiency defense" is understood as a rule where the fact that the insiders have provided hard information about the size of the efficiencies (instead of not having done this) affects the probability that the merger is permitted.

In an equilibrium of this model, the insiders will never invest in evidence production when having soft information that the efficiencies are low. When they have soft information that the efficiencies are high, whether and to what extent they invest depend on what institution society has chosen. An institution that does not allow for an efficiency defense will not induce any evidence production at all. Two examples of such institutions that are important in our analysis are what we call the *laissez-faire regime* (LF) and the *strict regime* (SR): under LF, a merger is always permitted while under SR it never is.[7] By committing to an

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[6]Hence, we assume that the insiders incur costs because they must *process* their information (i.e., transform it from soft to hard) before being able to communicate it. We would get almost the same results if we instead assumed that the insiders' costs concerned the *acquisition* of information; see our discussion in the concluding section. One may argue about which assumption is the most plausible; perhaps it is something in between those two polar cases.

[7]The important feature of these institutions is that the decision whether to permit the

institution that to some extent indeed allows for an efficiency defense, society can induce a positive amount of evidence production. One such institution is the one where a merger is *not* permitted if society receives a report saying that the efficiencies are low or if it does not receive any report at all, and the merger is permitted with a probability γ if society receives a report saying that the efficiencies are high. Here, the larger is γ the more the insiders will invest. In the extreme, when the probability γ equals unity, we obtain the *hard evidence regime* (HE): a merger is permitted if and only if society receives a report saying that the efficiencies are high.

Hence, in our model, a possible cost of allowing for an efficiency defense is that this encourages the insiders to spend resources in order to influence the decision whether to allow the merger. The resource costs enter the social welfare function and may thus, in principle, be wasted. On the other hand, the information that the insiders report might be useful for society, in which case there also are benefits with an efficiency defense. Society thus faces a tradeoff. It turns out that even though society has an opportunity to fine tune the insiders' incentives for evidence production by choosing an institution that gives rise to a positive amount of evidence production but still less than under HE, this is never optimal. That is, the institution that maximizes expected social welfare is either SR, LF, or HE. One reason for this result is that society can choose the insiders' amount of evidence production only indirectly, through its choice of the merger control institution. Thus, society's ability to choose investment incentives is limited by the insiders' optimal response. In addition, institutions whose outcomes differ from the outcomes of SR, LF, and HE require society to commit to an ex post merger decision that uses the available information suboptimally.

Finding the socially optimal institution thus amounts to comparing LF, SR, and HE, of which only HE involves an efficiency defense. We show that, depending on the parameters of our model, any one of these three institutions can be optimal. By inspecting the conditions needed for a particular institution to be the best one, we arrive at some non-trivial and sometimes rather subtle

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merger is not made contingent on the insiders' reports about *efficiencies*. The decision could, however, very well be contingent on other circumstances, as long as these are publicly known. See our discussion in Section 5.

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conclusions about the desirability of an efficiency defense and the optimal design of a merger control procedure. First, as the arguments above suggest, an efficiency defense is indeed sometimes desirable. When this is the case, however, the merger should be allowed if and only if high-efficiency evidence is provided. Second, an efficiency defense is more likely to be optimal (from a total surplus point of view) when "high" efficiencies are so high that they would give rise to a lower market price. This is because then the insiders' incentives to invest are such that society should encourage evidence production as much as it can. Third, there is an important asymmetry between situations with a low respectively high prior probability that a merger would increase total surplus: when the prior is relatively low, the problem of the insiders' dissembling can be dealt with very easily and at no real cost, whereas this is not true for the case when the prior is relatively high. As a consequence, an efficiency defense is more desirable when the merger is unlikely to be welfare enhancing.

Although this paper is, to the best of our knowledge, the first one to investigate the desirability of an efficiency defense using an equilibrium analysis, there are some other papers that also study institutional design in the context of merger control. Besanko and Spulber (1993) and Neven and Röller (2000), for example, study the relative merits of a welfare standard and a consumer standard. Similarly, Lewis and Poitevin (1997) investigate the desirability of mandatory disclosure rules in regulatory proceedings. Laffont and Tirole (1993, ch. 15) develop a model of regulatory capture and institutional design, although not in the context of merger control. Our paper is also related to a literature that models evidence production in trials or regulatory proceedings; see, for example, Legros and Newman (1999) and Sanchirico (2001). Similarly, information acquisition and institutional design has also been studied by, for example, Aghion and Tirole (1997) and Dewatripont and Tirole (1999).[8]

The remainder of the paper is organized as follows. Next, in Section 2, we present the model. In Section 3 we begin the analysis and show that the optimal merger control institution is either LF, SR, or HE. Then, in Section 4, we compare these three institutions and find the optimal one. In Section 5 we discuss the implications of our results for antitrust policy. In particular we sketch

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[8] Other related papers include Corchón and Faulí-Oller (2003), Daughety and Reinganum (2000), Froeb and Kobayashi (2001), and Shin (1998).

a three-step merger control procedure that takes the influence activities into consideration. Section 6 concludes by briefly discussing some possible extensions and variations of our model. An Appendix contains mathematical derivations relating to one of these extensions.

2 A Model of Merger Control and Influence Activities

Consider the following simple model of a merger control process. There are two economic agents: on the one hand society and on the other two firms that have proposed to merge (acting as one unit). The two firms, which are hereafter called the *insiders*, should be thought of as producing and selling a good on an oligopolistic market, although the market interaction will not be explicitly modeled here. The other firms in that market (the *outsiders*), as well as the consumers, are passive in that they do not attempt to influence the merger control process.[9]

The efficiency of the new firm that is created if the merger takes place, denoted e, is either "low" ($e = e_L$) or "high" ($e = e_H$). Initially, e is private information to the insiders: society places the prior probability p on the event that the post-merger efficiency is high, where $p \in (0, 1)$. Although the insiders know the true post-merger efficiency from the outset, the information they have is assumed to be soft (i.e., non-verifiable). This means that, given the preferences that we will specify shortly, the insiders will not be able to credibly transmit their information to society—for that they will first have to invest resources in evidence production (more on this later).

We assume that regardless of whether the post-merger efficiency is low or high, it is profitable for the insiders to merge; that is,

$$\pi_H > \pi_L > \pi_N, \tag{1}$$

where π_H (respectively, π_L) is the insiders' profit if the merger is permitted and the post-merger efficiency turns out to be high (respectively, low), and π_N is the insiders' (joint) profit if the merger is blocked. Moreover, permitting the

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[9]In the concluding section we briefly discuss how our analysis would be affected if the outsiders or a consumer group were also taking part in the influence activities.

merger increases social welfare if and only if the post-merger efficiency turns out to be high; that is,

$$W_H > W_N > W_L, \tag{2}$$

where W_H (respectively, W_L) is the unweighted sum of consumer surplus and industry profits if the merger is permitted and the post-merger efficiency turns out to be high (respectively, low), and W_N is the unweighted sum of consumer surplus and industry profits if the merger is blocked.

Let us for notational ease write $\Delta \pi_i \equiv \pi_i - \pi_N$ and $\Delta W_i \equiv W_i - W_N$ (for $i = L, H$). In terms of this notation, (1) and (2) amount to saying that $\Delta \pi_H$, $\Delta \pi_L$, and ΔW_H are all positive, whereas ΔW_L is negative. Borrowing terminology from Farrell and Shapiro (1990), we will refer to the case where $\Delta W_H < \Delta \pi_H$ as a situation with *negative externalities*, and the case where $\Delta W_H > \Delta \pi_H$ as a situation with *positive externalities*. All our analysis will cover both these cases. The distinction between positive and negative externalities will be helpful in understanding the results to be derived.

Although our proofs do not rely on it, we use the following assumption to interpret our results:

$$\Delta W_H > \Delta \pi_H \Leftrightarrow \Delta CS_H > 0,$$

where ΔCS_H is the gain in consumer surplus if the merger is permitted instead of blocked, given that the post-merger efficiency is high. That is, the assumption states that if there are positive externalities, then also the consumers (not only society at large) gain from a high-efficiency merger. Notice that as long as consumer surplus is affected by the merger only through its effect on market price and as long as consumer surplus is decreasing in market price, a statement that ΔCS_H is positive is tantamount to saying that "high" efficiencies are so high that they induce a lower post-merger than pre-merger market price.

//FIGURE 1 ABOUT HERE//

Figure 1 shows how, for different values of the efficiency parameter e, the gains and losses that accrue to the various parties if a merger takes place typically relate to each other.[10] The figure is derived from a homogenous-good

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[10] Figure 1 is inspired by a similar figure in Neven and Röller (2000).

Cournot model with at least three symmetric firms prior to the merger, where demand and cost functions are linear, and where the efficiency parameter e is subtracted from the marginal cost of the insiders. Although this is only a very simple example, we expect the qualitative features of the figure to hold true for a much larger family of oligopoly models.[11] From the figure we see that the insiders would themselves lose by merging if e did not exceed a threshold e°. Moreover, for the effect on welfare to be positive, e must exceed a threshold $e^{'}$, where $e^{'} > e^{\circ}$. Thus, in terms of these threshold values of e, (1) and (2) amount to assuming that $e_L \in \left(e^{\circ}, e^{'}\right)$ and $e_H > e^{'}$. We also see from the figure that the outsiders' gain in profits and the gain in consumer surplus always have opposite signs, and these signs change at a threshold $e^{''}$, where $e^{''} > e^{'}$; this is the level of e above which market price becomes lower thanks to the merger. At the same threshold level of e, society's gain from having the merger starts to exceed the insiders' gain. Thus, there are negative externalities if $e_H \in \left(e^{'}, e^{''}\right)$, whereas there are positive externalities if $e_H > e^{''}$.

The timing of events is as follows. (i) Society commits to a merger control institution, $z = (z_L, z_H, z_N) \in [0, 1]^3$. We will shortly explain exactly what it means to choose a particular z. (ii) The insiders observe z and then "invest in evidence production;" that is, conditional on knowing that the true state is $i \in \{L, H\}$, they choose a probability $\tau_i \in [0, 1]$, thereby incurring a cost $C(\tau_i)$. By picking a particular τ_i, the insiders will with that probability find hard (i.e., verifiable) information that the post-merger efficiency is e_i; with the complementary probability, $1 - \tau_i$, the insiders do not find any hard information. (iii) If having found hard information, the insiders choose whether to "submit a report," that is, whether to disclose this information to society. If they do this, also society learns the true state (since the information is verifiable). (iv) Society decides whether to permit or block the merger, following the previously chosen rule $z = (z_L, z_H, z_N)$. The component z_L (respectively, z_H) of this vector is a probability with which society permits the merger if the insiders have submitted a report saying that the post-merger efficiency is low (respectively, high), and

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[11] For example, we have verified that all the qualitative features of Figure 1 can be derived also from a differentiated-goods Bertrand model with three symmetric firms prior to the merger, linear demand and cost functions, and the efficiency parameter e being subtracted from the marginal cost of the insiders. The only thing that changes in such a setting is that the insiders gain from the merger even if $e = 0$ (which is a well-known result).

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z_N is a probability with which society permits the merger if the insiders have not submitted a report.

Hence, stage (iv) is simply an implementation of the rule that society has committed to at stage (i).[12] Notice that the set of instruments that society has access to when it chooses an institution does not include monetary transfers between society and the insiders.[13] Otherwise, however, society has a great deal of freedom in its choice of an institution. For at the stage where society implements the rule z it will either know the true state (L or H) or it will not have received a report (N), and we assume that society can commit to any probability of allowing the merger conditional on any one of these three events.

In terms of these merger control institutions, what does it mean to say that society "allows for an efficiency defense"? We interpret this as a situation where a report submitted by the insiders affects the probability with which the merger is permitted. That is, we say that society allows for an efficiency defense if either $z_L \neq z_N$ or $z_H \neq z_N$. Within the set of merger control institutions that society can choose among there are three ones that will be of particular interest to us. The first is the institution where a merger is always permitted, $z = (1, 1, 1)$; we call this the *laissez-faire regime* (LF). The second one is the institution where a merger is never permitted, $z = (0, 0, 0)$, which we call the *strict regime* (SR). The third institution of special interest is the one where a merger is permitted if and only if society receives a report from the insiders showing that the post-merger efficiency will be high, $z = (0, 1, 0)$; we dub this the *hard evidence regime* (HE). Clearly, neither LF nor SR involves an efficiency defense, whereas HE does.

As for the cost function for evidence production, C, we assume that this is twice continuously differentiable, increasing, and convex ($C' > 0$, $C'' > 0$), with

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[12] There may of course be a credibility problem associated with choosing some particular z, perhaps especially for "mixed" z's. One way to implement the desired z-institution in practice may be to delegate the job to an antitrust official who has the right private preferences; cf. the literature on strategic delegation (to an independent central banker, for example). A mixed z-institution could also correspond to a set of guidelines that to some extent are open to interpretation and which therefore make it difficult to predict perfectly the decision whether to challenge the merger. Yet another reason that we are not too worried about the credibility problem is that, as we will see later, it will never be optimal for society to choose the mixed z's anyway.

[13] We find this assumption reasonable in the context of merger control. For a paper that does allow for such transfers and which models the merger control procedure as an implementation problem, see Corchón and Faulí-Oller (2003).

$C(0) = 0$, $C'(0) = 0$, and $C'(1) > \Delta\pi_H$. Also, the cost elasticity is weakly increasing: $\eta'(\tau_i) \geq 0$ for all $\tau_i \in [0, 1]$, where $\eta(\tau_i) \equiv C'(\tau_i)\tau_i / C(\tau_i)$.[14]

The cost of evidence production incurred by the insiders enters with full weight in society's payoff. Hence, given an outcome j (for $j = L, H, N$) of the merger control procedure and given that the insiders have soft information that $e = e_i$ (for $i = L, H$), the insiders' payoff is $\pi_j - C(\tau_i)$ and society's payoff is $W_j - C(\tau_i)$. We also assume that the insiders as well as society are risk neutral and thus maximize their expected payoffs given the information they have access to at the time of their decisions. Society's expected payoff ("expected welfare") is also the welfare standard that we employ for our normative theory.[15]

3   Influence Activities and Institutional Choice

We will solve the model using backward induction. Since the last stage is just a mechanical implementation of the rule society chooses at stage (i), we are left with three stages where actual decisions are made: the choice-of-institution stage (i), the evidence-production stage (ii), and the reporting stage (iii).

Recall that the insiders want the merger to be permitted regardless of whether the post-merger efficiency is low or high. Hence, at stage (iii), given that they have found hard information that $e = e_i$, the insiders will submit a report for sure if $z_i > z_N$; if $z_i = z_N$ they are indifferent between submitting and not submitting; and if $z_i < z_N$ they will not submit. Similarly, at stage (ii), given that they have soft information that $e = e_i$, the insiders will invest in evidence production (i.e., choose a $\tau_i > 0$) if and only if $z_i > z_N$. Clearly, however, society will never choose $z_L > z_N$. For if society knows that the post-merger efficiency is low, it is in its interest to block the merger. (Moreover, setting $z_L > z_N$ would encourage costly evidence production under circumstances where this is not valuable for society.) As a result, if the institution z is optimally chosen, the insiders will set $\tau_L = 0$.

When having soft information that $e = e_H$, the insiders face the following

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[14] For some results in the end of the paper we will need the stronger assumption that the cost elasticity is constant. We will make this clear when we get there.

[15] In the concluding section we will discuss the implications for our results of using a consumer standard instead.

problem:

$$\max_{\tau_H \in [0,1]} \left[\tau_H z_H + (1 - \tau_H) z_N\right] \pi_H + \left[\tau_H (1 - z_H) + (1 - \tau_H)(1 - z_N)\right] \pi_N - C(\tau_H),$$

the solution of which, τ_H^*, equals zero if $z_H \leq z_N$ and is implicitly defined by

$$\Delta \pi_H (z_H - z_N) = C'(\tau_H^*) \tag{3}$$

otherwise. The left-hand side of this first-order condition is the insiders' marginal benefit from evidence production when knowing that $e = e_H$. The first factor of the marginal benefit, $\Delta \pi_H$, is the insiders' gain in profits from having the merger permitted instead of blocked given that $e = e_H$. The second factor, $(z_H - z_N)$, is the amount with which the probability of having the merger permitted increases if the insiders provide hard information that the post-merger efficiency is high. The magnitude of this latter factor is determined by society's choice of institution. In particular, $(z_H - z_N)$ will take its largest possible value under the institution HE, since then $z_H = 1$ and $z_N = 0$. Hence, the insiders' incentives for evidence production when knowing that $e = e_H$ will be the strongest possible under HE.[16] Similarly, under LF and SR, the insiders will have no incentives at all to invest in evidence production ($\tau_H^* = 0$), since then $z_H = z_N$.

What is society's optimal choice of institution at stage (i)? To answer this question, let us first formulate expressions for expected welfare at stage (i) under LF, SR, and HE, which we denote by EW^{LF}, EW^{SR}, and EW^{HE}, respectively. Since under LF and SR the insiders will not invest in evidence production, we almost trivially have $EW^{LF} = pW_H + (1 - p)W_L$ and $EW^{SR} = W_N$. Denoting the insiders' choice of τ_H under HE by τ_H^{HE},[17] we can write

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\begin{aligned}
EW^{HE} &= p\tau_H^{HE} W_H + (1 - p\tau_H^{HE})W_N - pC(\tau_H^{HE}) \\
&= p\tau_H^{HE} \Delta W_H + EW^{SR} - pC(\tau_H^{HE}). \tag{4}
\end{aligned}
$$

This equation highlights a basic tradeoff in society's choice of institution. By choosing an institution that encourages evidence production, like HE, instead of

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[16] Notice the importance of the qualifier "when knowing that $e = e_H$." The institution that provides the strongest incentives for evidence production more generally is $z = (1, 1, 0)$, since this would make also τ_L^* as large as possible. Of course, however, choosing an institution that induces a $\tau_L^* > 0$ will, as we noted above, never be in society's interest.

[17] Formally, $\tau_H^{HE} = \tau_H^* |_{(z_H, z_N) = (1,0)}$.

one that does not, like SR, society will sometimes be able to avoid the mistake of blocking a welfare enhancing merger; this benefit with HE is captured by the term $p\tau_H^{HE}\Delta W_H$ in (4). Society also cares about the insiders' expected cost of evidence production, however, which is captured by the term $pC\left(\tau_H^{HE}\right)$. The comparison of HE and SR thus amounts to a comparison of $\tau_H^{HE}\Delta W_H$ and $C\left(\tau_H^{HE}\right)$, where τ_H^{HE} is implicitly defined by $\Delta\pi_H = C'\left(\tau_H^{HE}\right)$. Accordingly, which institution society should choose will depend on, among other things, how aligned society's and the insiders' interests are and on the properties of the cost function C.

In order to solve society's problem at stage (i) we will also need a more general expression for expected welfare that holds for any relevant institution z. Recall that choosing $z_L > z_N$ will always be suboptimal for society. Moreover, setting $z_N > z_H$ yields the same outcome as setting $z_N = z_H$ (since for any $z_N \geq z_H$ the insiders will choose $\tau_H^* = 0$ and thus not be able to report when knowing that $e = e_H$). Hence, without excluding any (uniquely) optimal institution we can suppose that

$$z_L \leq z_N \leq z_H.$$

Under this assumption, we can write expected welfare at stage (i) as

$$
\begin{aligned}
EW &= p\left[\tau_H^* z_H + (1 - \tau_H^*) z_N\right] W_H + (1 - p) z_N W_L \\
&\quad + \left\{p\left[\tau_H^*\left(1 - z_H\right) + (1 - \tau_H^*)\left(1 - z_N\right)\right] + (1 - p)\left(1 - z_N\right)\right\} W_N - pC\left(\tau_H^*\right) \\
&= p\tau_H^*\left(z_H - z_N\right)\Delta W_H + (1 - z_N) EW^{SR} + z_N EW^{LF} - pC\left(\tau_H^*\right). \quad (5)
\end{aligned}
$$

Now, rewriting the first-order condition that defines τ_H^* [see (3)] yields

$$\Delta\pi_H\left(z_H - z_N\right) = C'\left(\tau_H^*\right) = \frac{\eta\left(\tau_H^*\right)}{\tau_H^*} C\left(\tau_H^*\right) \Rightarrow \tau_H^*\left(z_H - z_N\right) = \frac{\eta\left(\tau_H^*\right)}{\Delta\pi_H} C\left(\tau_H^*\right). \tag{6}$$

Substituting (6) in (5) and re-arranging, one has

$$EW = pC\left(\tau_H^*\right)\frac{\Delta W_H}{\Delta\pi_H}\left[\eta\left(\tau_H^*\right) - \frac{\Delta\pi_H}{\Delta W_H}\right] + (1 - z_N) EW^{SR} + z_N EW^{LF}, \tag{7}$$

which implies that, for $\eta\left(\tau_H^*\right) < \frac{\Delta\pi_H}{\Delta W_H}$, society is strictly better off by choosing either LF or SR rather than an institution that induces investment in evidence production ($\tau_H^* > 0$). Moreover, if z is an optimal institution and if it gives rise to $\eta\left(\tau_H^*\right) = \frac{\Delta\pi_H}{\Delta W_H}$, then either LF or SR is (also) an optimal institution.

Next, suppose $\eta\left(\tau_H^*\right) > \frac{\Delta\pi_H}{\Delta W_H}$. We then obtain the following result.

Lemma 1. Let $z_L \leq z_N \leq z_H$ and $(z_H - z_N) \in (0,1)$, and suppose that $\eta(\tau_H^*) > \frac{\Delta \pi_H}{\Delta W_H}$. Then $EW < (1 - z_N) EW^{HE} + z_N EW^{LF}$.

Proof. We can write

$$
\begin{aligned}
EW &= (z_H - z_N) \frac{p\tau_H^* \Delta W_H}{\eta(\tau_H^*)} \left[\eta(\tau_H^*) - \frac{\Delta \pi_H}{\Delta W_H} \right] + (1 - z_N) EW^{SR} + z_N EW^{LF} \\
&< (1 - z_N) \left\{ \frac{p\tau_H^{HE} \Delta W_H}{\eta(\tau_H^{HE})} \left[\eta(\tau_H^{HE}) - \frac{\Delta \pi_H}{\Delta W_H} \right] + EW^{SR} \right\} + z_N EW^{LF} \\
&= (1 - z_N) \left[p\tau_H^{HE} \Delta W_H - \frac{p\tau_H^{HE} \Delta \pi_H}{\eta(\tau_H^{HE})} + EW^{SR} \right] + z_N EW^{LF}.
\end{aligned}
$$

Here the first equality follows from (6) and (7); the inequality follows from $\tau_H^* < \tau_H^{HE}$, $z_H \leq 1$, and $\eta' \geq 0$;[18] and the last equality is just a re-arrangement of terms. Making use of (4) and of (6) evaluated at $\tau_H^* = \tau_H^{HE}$, $z_N = 0$, and $z_H = 1$, we have the inequality in the lemma. □

The following proposition follows immediately from Lemma 1 and the preceding analysis.[19]

Proposition 1. *No institution yields a higher expected welfare than the best one of SR, LF, and HE. Moreover, an institution where $z_L > z_N$ is never optimal, and an institution where $(z_H - z_N) \in (0,1)$ is never optimal if $\eta(\tau_H^*) \neq \frac{\Delta \pi_H}{\Delta W_H}$.*

In other words, when society chooses an institution at stage (i), it will optimally select one that either induces no evidence production at all or one where the insiders' incentives for evidence production when knowing that $e = e_H$ are as strong as possible—in that sense society's problem always has a corner solution. What is the reason for this? One economic force that works in favor of a corner solution is that choosing a "mixed" z-institution involves throwing away costly but socially valuable information: by selecting such an institution society will sometimes learn that the true post-merger efficiency is high, but still it does not permit the merger with probability one. The institutions SR, LF and

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[18] Note in particular that $\eta' \geq 0$ implies that the expression on the first line is increasing in τ_H^*.

[19] Note that, even though it involves the endogenous variable τ_H^*, the case we exclude from consideration in the last statement of the proposition is indeed non-generic. This is true because the definition of τ_H^* does not contain ΔW_H, which means that ΔW_H appears only on the right-hand side of $\eta(\tau_H^*) = \frac{\Delta \pi_H}{\Delta W_H}$; hence, this equality holds for one unique value of ΔW_H.

HE, in contrast, do not involve such waste. For under LF and SR there is no investment at all in evidence production. And under HE there is, but then the information is always made use of in the sense that society permits the merger with probability one when having learned that the efficiencies are high.

More generally, important for the corner-solution result is the fact that society cannot choose τ_L and τ_H directly, only indirectly through its choice of a z-institution. This means that society's optimal choice of an institution will depend on the insiders' response. As a consequence, society's objective function is not necessarily a quasi-concave function of the choice variables. Moreover, even when this objective function happens to be quasi-concave, society's limited set of instruments will make an institution where the insiders choose an interior τ_H undesirable.

4   The Optimal Merger Control Institution

It remains to answer the question how the three institutions LF, SR, and HE perform in terms of expected welfare relative to each other. In doing this we will impose a stronger assumption on the cost function C than before. Instead of just assuming that the cost elasticity is everywhere weakly increasing, we will from now on say that the cost elasticity is constant; that is, $C(\tau_i) = k\tau_i^{\eta}$ for $i = L, H$, where $k > 0$ and $\eta > 1$.[20] In order to make the comparisons it will be useful to distinguish between two parameter regimes: $p < \overline{p}$ ("Regime I"), and $p > \overline{p}$ ("Regime II"), where $\overline{p} \equiv (W_N - W_L)/(W_H - W_L)$.[21] Regime I should thus be thought of as a situation where society is relatively skeptical about the possibility of large efficiency gains, whereas in Regime II society is relatively optimistic about this possibility.

First, it is easy to see that SR dominates LF in Regime I, and vice versa in Regime II. Second, it turns out that SR strictly dominates HE if and only if $\eta < \Delta\pi_H/\Delta W_H$. To see this, simply plug $z_N = 0$, $\tau_H^* = \tau_H^{HE}$, and $\eta(\tau_H^*) = \eta$

into (7), which yields

$$EW^{HE} = pC\left(\tau_H^{HE}\right)\frac{\Delta W_H}{\Delta \pi_H}\left(\eta - \frac{\Delta \pi_H}{\Delta W_H}\right) + EW^{SR}.$$

It remains to compare HE and LF. From the above expression for EW^{HE} we see that $EW^{HE} > EW^{LF}$ is equivalent to

$$pC\left(\tau_H^{HE}\right)\frac{\Delta W_H}{\Delta \pi_H}\left(\eta - \frac{\Delta \pi_H}{\Delta W_H}\right) > EW^{LF} - EW^{SR} = p\Delta W_H + (1-p)\Delta W_L, \tag{8}$$

the right-hand side of which is negative in Regime I and positive in Regime II. First suppose we are in Regime I. Then, if $\eta \geq \Delta \pi_H/\Delta W_H$, we clearly have $EW^{HE} > EW^{LF}$. In case $\eta < \Delta \pi_H/\Delta W_H$ there exists a level of k, call it $\widehat{k}$, such that $EW^{HE} > EW^{LF}$ if and only if $k > \widehat{k}$. Using (8), the fact that

$$C\left(\tau_H^{HE}\right) = k^{\frac{-1}{\eta-1}}\left(\frac{\Delta \pi_H}{\eta}\right)^{\frac{\eta}{\eta-1}},$$

and carrying out some straightforward algebra, we obtain

$$\widehat{k} \equiv \left(\frac{\Delta \pi_H}{\eta}\right)^{\eta}\left(\frac{p\frac{\Delta W_H}{\Delta \pi_H}\left(\eta - \frac{\Delta \pi_H}{\Delta W_H}\right)}{p\Delta W_H + (1-p)\Delta W_L}\right)^{\eta-1}.$$

Next suppose we are in Regime II. Then for $\eta \leq \Delta \pi_H/\Delta W_H$ we always have $EW^{HE} < EW^{LF}$. In case $\eta > \Delta \pi_H/\Delta W_H$, we can, similarly to above, verify that $EW^{HE} > EW^{LF}$ if and only if $k < \widehat{k}$.

Let us summarize the above results in the following proposition.

Proposition 2. *Society ranks the three institutions LF, SR, and HE as follows:*

- *$SR \succ LF$ in Regime I, and $LF \succ SR$ in Regime II.*

- *$HE \succ SR$ if and only if $\eta > \Delta \pi_H/\Delta W_H$.*

- *In Regime I, $HE \succ LF$ if and only if either (i) $\eta \geq \Delta \pi_H/\Delta W_H$ or (ii) $\eta < \Delta \pi_H/\Delta W_H$ and $k > \widehat{k}$. In Regime II, $LF \succ HE$ if and only if either (i) $\eta \leq \Delta \pi_H/\Delta W_H$ or (ii) $\eta > \Delta \pi_H/\Delta W_H$ and $k > \widehat{k}$.*

By using Proposition 2 we can easily construct an overall ranking of the three institutions. Figure 2 indicates for what parameter values we obtain particular rankings; Panel A of the figure covers Regime I whereas Panel B covers Regime II. Each panel depicts a diagram with k on the vertical and η on the horizontal

axis, and in each diagram the graphs of two functions are drawn: $\widehat{k}$ defined above and $k^\circ \equiv \Delta \pi_H / \eta$. The latter function gives us a threshold of k above which this parameter must be for the insiders' evidence-production decision under HE to have an interior solution (i.e., for $\tau_H^{HE} < 1$).

//FIGURE 2 (PANELS A AND B) ABOUT HERE//

Before we proceed to discuss the intuition as to why we obtain the various rankings in different parts of the parameter space, let us make the observation that the institution HE, which is the only one of the three institutions that involves an efficiency defense, is indeed sometimes the best one. Hence, Propositions 1 and 2 tell us that an efficiency defense *is* sometimes desirable. When this is the case, however, the merger should be allowed *if and only if high-efficiency evidence is provided*—in a sense, the burden of proof should be placed fully on the insiders.[22] The logic behind this conclusion is that an institution where the burden of proof is placed fully on the insiders will give them strong incentives for evidence production [cf. (3) and the discussion following that equation]. Moreover, encouraging evidence production will under certain circumstances be socially desirable.

It is interesting to note that the argument that the burden of proof as to efficiencies should rest on the insiders has been made before in the literature, although the logic leading up to this conclusion has been quite different from the one here. For example, Fisher (1987, p. 36) writes: "The burden of proof as to cost savings or other offsetting efficiencies [...] should rest squarely on the proponents of a merger, and here I would require a very high standard. Such claims are easily made and, I think, often too easily believed." It seems clear that in making this statement Fisher is concerned about the truthfulness of the insiders' claims, and he thinks of placing the burden of proof on them as a way of controlling this problem. A very similar point is made by Neven et al. (1993, p. 206): "When the burden of proof is on the firm, the knowledge that information that it conceals may count against it in the investigation provides

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[22]We use the expression "burden of proof" with some caution: in our model, the insiders are the only ones who have the opportunity to provide any evidence, so we cannot say anything about whether society should require the insiders in contrast to, say, the outsiders to provide evidence in favor of their case. The sense in which the burden of proof should be placed fully on the insiders is that society should take a skeptical stance and make a decision in favor of the insiders only when they have provided evidence in favor of their case.

a powerful incentive in favour of revelation." This argument goes back to the so-called unraveling result in the disclosure literature, which is due to Grossman (1981) and Milgrom (1981). The argument of the present paper is very different from—and should be thought of as complementary to—the unraveling result. Indeed, updating of beliefs is not an issue here, because of our commitment assumption. Our analysis instead suggests that allowing a merger if and only if the insiders provide high-efficiency evidence may, besides encouraging information revelation, also serve another important purpose, namely to provide the insiders with strong incentives for socially valuable evidence production (or information acquisition).[23]

Next, let us consider the condition HE $\succ$ SR if and only if $\eta > \Delta\pi_H/\Delta W_H$, which we derived above and which plays a particularly important role in Panel A of Figure 2. If there are positive externalities (i.e., if $\Delta W_H > \Delta\pi_H$), then this condition says that we always have HE $\succ$ SR, since $\eta > 1$.[24] This is intuitive, because if having a high-efficiency merger permitted instead of blocked is worth more to society than to the insiders then the merging firms will underinvest, so society should encourage evidence production as much as it can. Recall from Section 2 that having positive externalities means that a "high" post-merger efficiency is so high that it would make consumer surplus increase. Hence, a sufficient condition for HE to dominate SR (and, in Regime I, for HE to be the best institution) is that, conditional on the event that the merger makes total surplus increase, the efficiency gains are so large that they are passed on to consumers in the form of a lower price. The reason why we obtain this result is *not* that we are using a welfare measure that takes into account only changes in consumer surplus—our welfare measure does indeed consider *total*

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[23]Another interesting question concerns the optimal *standard* of proof: how convincing should one should require a given piece of evidence to be and what should be the minimal level of efficiency that must be proven? In our model we have abstracted from these questions since, by assumption, a piece of information either reveals the true state perfectly or not at all and our state space is binary. In a richer model, in which one or both of those assumptions were relaxed, we would be able to derive the optimal standard of proof. If we did that, however, we would not generally expect the highest possible standard to be optimal. For requiring a very high standard of proof would not necessarily create the strongest possible incentives for evidence production. To see this, imagine an example were there are more than two states and where the insiders can get their case through only by finding evidence in favor of the very highest state. This might be so difficult and costly to do that investing in evidence production would not be as worthwhile as under a less stringent standard-of-proof requirement.

[24]Notice that both Panel A and B are drawn for the case where there are negative externalities.

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surplus.[25] Rather, the reason is that when "high" efficiencies are so high that they induce a lower post-merger price, then the relationship between society's and the insiders' interests is such that an efficiency defense will never give rise to overinvestment in evidence production and, hence, investment in evidence production should be fully encouraged.

If there are negative externalities, then HE will dominate SR only if the cost elasticity is large enough. Why does the cost elasticity play such an important role here? One—perhaps rather mechanical—way of seeing this is by noticing that for large elasticities the cost $C(\tau_H)$ is low relative to the amount of information that one gets for these expenditures, τ_H,[26] which clearly makes HE more attractive. Another way of understanding the role of the cost elasticity, which is more in terms of economics, is to make the following observation: in equilibrium, the cost elasticity equals the insiders' "surplus from evidence production"; that is, if we let $B\left(\tau_H^{HE}\right)$ denote the insiders' gross benefit from having HE instead of SR conditional on knowing that $e = e_H$,[27] then we can write[28]

$$\eta = \frac{B\left(\tau_H^{HE}\right)}{C\left(\tau_H^{HE}\right)}. \tag{9}$$

Hence, the larger is η, the more do the insiders' benefits of having HE rather than SR exceed their costs. As a result, for large enough η's, HE will be socially desirable also when there are negative externalities.

Now let us move our attention from Panel A to Panel B. Here, for HE to be the best institution, it does not suffice that $\eta > \Delta\pi_H/\Delta W_H$. As the figure indicates, the requirement on η is stronger than that. Moreover, the other parameter in the cost function, k, must not be too large. Apparently, there is an asymmetry between a situation where society is skeptical about the possibility of large efficiency gains (Regime I) and one where it is more optimistic (Regime II): in the latter case HE (and, hence, an efficiency defense) is less likely to be

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[25]Compare the following statement by Fisher (1987, p. 38), who clearly has a consumer standard in mind: "...I would hesitate to use such efficiencies as an excuse for permitting a merger if those efficiencies are unlikely to be passed on to consumers."

[26]This is a property of the cost function $C(\tau_H) = k\tau_H^\eta$. To see this, the reader may find it helpful to sketch the graph of $C(\tau_H)$ as a function of τ_H for different η's. For η's close to unity the graph is almost linear whereas for larger η's it is more curved, which makes it possible to have relatively large τ_H's and at the same time low levels of $C(\tau_H)$.

[27]Formally, $B\left(\tau_H^{HE}\right) \equiv E\left(\pi^{HE} \mid e = e_H\right) - E\pi^{SR} = \left(\tau_H^{HE}\Delta\pi_H + \pi_N\right) - \pi_N = \tau_H^{HE}\Delta\pi_H$.

[28]To see this, note that, by definition, $\eta = \tau_H C'(\tau_H)/C(\tau_H)$. Moreover, from the first-order condition that defines τ_H^{HE}, we have $\tau_H^{HE}C'\left(\tau_H^{HE}\right) = B\left(\tau_H^{HE}\right)$.

optimal. The basic reason for this asymmetry is that the insiders have a vested interest in having the merger permitted, regardless of whether the efficiency gains are small or large. Moreover, in Regime I this vested interest will be easier to deal with for society than in Regime II. For, in Regime I, if not having received a report it will be optimal for society to block the merger, whereas in Regime II it may in that case be optimal to permit the merger. This means that in Regime I society will need to know about a high state, something it can obtain information about with a relatively large likelihood by choosing the institution HE. In Regime II, however, society would like to know about a *low* state, which they *never* will get information about from the insiders.

The asymmetry between Regime I and II is neatly illustrated by considering the limits $p \to 0$ and $p \to 1$. In the former case we still have the condition that HE is best if and only if $\eta > \frac{\Delta \pi_H}{\Delta W_H}$, since that condition is independent of p. In the latter case, however, LF is *always* the best institution.

Proposition 3 sums up the results.

Proposition 3. *The institution that maximizes expected welfare is:*

- *In Regime I: SR if $\eta < \frac{\Delta \pi_H}{\Delta W_H}$ and HE if $\eta > \frac{\Delta \pi_H}{\Delta W_H}$.*
- *In Regime II: LF if $\eta < \frac{\Delta \pi_H}{\Delta W_H}$, or $\eta > \frac{\Delta \pi_H}{\Delta W_H}$ and $k > \widehat{k}$; and HE if $\eta > \frac{\Delta \pi_H}{\Delta W_H}$ and $k < \widehat{k}$.*

The bottom line message of Proposition 3 and the preceding analysis can be stated as follows. By allowing for an efficiency defense society also encourages costly evidence production (or information acquisition). Doing this may be good or bad, depending on (i) how society's and the insiders' interests relate to each other, (ii) how optimistic or pessimistic society is about the likelihood that the merger will increase total surplus, and (iii) the technology for evidence production (in particular the cost elasticity). An efficiency defense will indeed be optimal under some circumstances—but, when this is the case, the merger should be allowed if and only if the insiders provide evidence of high efficiencies. Moreover, an efficiency defense is more likely to be optimal (from a total surplus point of view) when "high" efficiencies are so high that they would give rise to a lower market price. This is because then the insiders' incentives to invest are such that society should encourage evidence production as much as it can.

Finally, there is an important asymmetry between a situation where society is pessimistic and where it is optimistic about the possibility that total surplus will increase due to the merger: an efficiency defense is more likely to be harmful in the latter case.

We have seen that an efficiency defense can be undesirable because it leads to excessively high spending on evidence production. As the following example shows, it can also be undesirable (relative to LF) if a high (marginal) cost of evidence production deters the production of evidence, which then leads to the blocking of mergers that society would want allowed. When this happens, an efficiency defense is undesirable even though the observed costs of evidence production are negligible.

Example. Suppose $\Delta W_H = \Delta \pi_H = 200$ (which means that there are "no externalities") and $\Delta W_L = -100$. Moreover, let $p = 1/2$, which means that we are in Regime II (i.e., LF $\succ$ SR). Further assume that the cost function is quadratic: $\eta = 2$. We then have that $\widehat{k} = k^\circ = 100$, so the assumption that we have an interior solution to the evidence production decision $(k > k^\circ)$ amounts to $k > 100$. In terms of Panel B of Figure 2, we are now somewhere along the vertical line that crosses the intersection of the graphs of $\widehat{k}$ and k°, but above this intersection. As the figure tells us, in this part of the parameter space LF $\succ$ HE $\succ$ SR; that is, here one should not allow for an efficiency defense but instead allow all mergers.

The investment costs in this example are $C\left(\tau_H^{HE}\right) = 10,000/k$, an expression that is *decreasing* in k; the reason is that, even though k enters directly in the cost function with a positive sign, the endogenously chosen τ_H^{HE} is decreasing in k, and this latter effect dominates the first.[29] Hence, for a fixed ΔW_H, we can make $C\left(\tau_H^{HE}\right)$ very small by increasing k. Yet, LF $\succ$ HE (indeed, the difference $EW^{LF} - EW^{HE}$ is increasing in k).

While the argument that an efficiency defense can be undesirable due to

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[29] Since $C\left(\tau_H^{HE}\right) = k^{\frac{-1}{\eta-1}} \left(\frac{\Delta \pi_H}{\eta}\right)^{\frac{\eta}{\eta-1}}$, the endogenously chosen costs of evidence production are always decreasing in k and hence this fact does not depend on the chosen numerical example.

excessively high costs of evidence production is incomplete, it is not incorrect in general. One can construct a similar example for the case in which SR ≻ LF (so that Panel A of Figure 2 is relevant). Here the excessive-cost intuition as to why an efficiency defense may be bad is indeed correct; the easiest way to see this is from (4) and the discussion following that equation. In particular, in Regime I *both* the (expected) investment costs and the benefit with having an efficiency defense are decreasing in k. Hence, also for a very low level of merger review expenditures, the expenditures may not be worthwhile for society. In contrast to Regime II, however, when in this case an efficiency defense is suboptimal *and* induces very low costs, it is suboptimal only with a small margin.

5 Implications for Antitrust Policy

Our results are, of course, derived from a stylized model, and by studying our particular set-up we have abstracted from many economic phenomena that are important for the choice of a merger control institution but which are not captured here. Still, keeping these limitations in mind, it is useful to spell out what our results imply for antitrust policy and the design of merger control institutions.

Let us first be more specific about how we interpret the institutions LF and SR of our model. We think of these as representing situations where society (or an antitrust authority) has made a commitment not to take *efficiency considerations* into account when deciding whether to permit the merger. Still, these institutions are fully consistent with a merger control procedure in which this decision is contingent on other circumstances, as long as information about these is publicly available. Thus, what we believe is special with efficiency gains is that this is something that the insiders are likely to have (or be able to obtain) private information about.

Another important question is how one should understand the insiders' "influence activities." One interpretation, which is the one we emphasize here, is that this term refers to the insiders' communication with an antitrust authority in a formal regulatory hearing. Another and broader interpretation would be that the influence activities also take place in informal (and perhaps secret) interactions between the insiders and officials from the antitrust authority. As

long as we are willing to make the former interpretation, it seems reasonable that the decision whether to allow for an efficiency defense does not have to be made once and for all, but could be made contingent on information about a particular merger case. If so, then we can make use of the results and insights from the previous section in order to design a merger control procedure that allows for an efficiency defense only when the circumstances are right.

Below we sketch such a procedure. This involves three steps,[30] and it is constructed by means of simply inspecting Panel A and B of Figure 2: first it is determined which panel is the relevant; then it is decided where in a particular panel we are likely to be. As one moves from Step 1 to Step 2 and from Step 2 to Step 3 in the procedure, gradually more information about various parameters is required; for example, when a decision about the merger can be reached already after Step 1 or 2, one does not need access to any information about the evidence production technology. Hence, even though the nature of the tradeoff that we study in this paper is such that the technology for evidence production is bound to matter in at least some situations, the procedure illustrates how the insights from the model can guide an antitrust authority also when such information is unavaliable. Our procedure presupposes that the region in Panel B where HE is optimal is irrelevant in practice. This is always true if society, whenever it is "optimistic" about having high efficiency gains, is sufficiently optimistic (i.e., that p is large enough). If one believes that the HE-region of Panel B *is* sometimes relevant, then the procedure below will be a bit more complex.

Step 1. An antitrust authority that is faced with a proposed merger asks itself the following. Given the information that we have access to at this stage of the procedure (i.e., prior to any reports from the insiders about the size of the efficiencies), do we think that total surplus (*not* including any costs of evidence production) will rise thanks to the merger? If the answer to this question is yes, then the antitrust authority simply permits the merger. If the answer is no, then the antitrust authority proceeds to Step 2.

Step 2. The antitrust authority asks itself the following. Suppose, hypothetically, that we knew that the total surplus gains due to the merger (not including

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[30] The steps should be thought of as "steps of reasoning." There is thus no need to let (a significant amount of) time elapse between one step and the following.

any costs of evidence production) indeed would be positive. Then, conditional on that information, do we think the efficiencies are so high that they would be passed on to consumers (i.e., induce a lower post-merger price)? If the answer to this question is yes, then the antitrust authority asks the insiders to provide it with evidence about the size of the efficiencies. In case the insiders do come up with convincing evidence that the efficiencies are large enough to raise total surplus (not including any costs of evidence production), then the antitrust authority permits the merger; otherwise it does not. If the answer to the question is no, then the antitrust authority proceeds to Step 3.

Step 3. The antitrust authority asks itself the following. Suppose, hypothetically, that we knew that the total surplus gains due to the merger (not including any costs of evidence production) indeed would be positive. Then, conditional on that information, do we think that the insiders' technology for evidence production (or information gathering) is such that the cost elasticity is large relative to the rise in market price due to the merger? If the answer to this question is yes, then the antitrust authority asks the insiders to provide it with evidence about the size of the efficiencies. In case the insiders do come up with convincing evidence that the efficiencies are high enough to raise total surplus (not including any costs of evidence production), the antitrust authority permits the merger; otherwise it does not. If the answer to the question is no, then the antitrust authority blocks the merger without asking for evidence.

A couple of remarks about this three-step procedure are in order. First, even though it may look as if the procedure does not consider other important criteria than the possible existence of efficiency gains, these are indeed captured by Step 1. For when the antitrust authority makes an assessment of the likelihood that total surplus will increase thanks to the merger, it effectively also appraises, for example, the merger's impact on the degree of concentration in the relevant market. Second, if the antitrust authority has to proceed to Step 3, then information about the cost elasticity will be needed. The magnitude of this elasticity may of course be hard to observe in reality. Still, as our procedure indicates, in several cases it will be possible to tell whether or not an efficiency defense is desirable without knowing the elasticity. Inevitably, though, some-

times knowledge about the cost elasticity will be needed. Hopefully, in those cases the interpretation of the elasticity as the "surplus from evidence production," which we provided earlier [see (9)], will be helpful in making informed guesses about its magnitude (or even, after all, estimate it using some observable data).

6   Possible Extensions

In this concluding section we will briefly discuss some possible extensions and variations of our model.

Evidence production vs. information gathering. In our model we have assumed that the insiders know from the outset whether the efficiencies are high or low but must invest resources in order to be able to communicate this information. An alternative assumption would be to say that the insiders at the outset have just as little information about the efficiencies as society, but that they can invest resources in order to find such (hard) information. Hence, the insiders' investment decision would then not be contingent on the true state. We were using this model specification in an earlier version of the paper, and it yields very similar results. In fact, most of the analysis is *identical* to the one here—the only difference is the comparison between HE and LF (in particular, the cut-off value $\widehat{k}$ is slightly differently defined), and even for that comparison the qualitative results remain the same.

A consumer standard instead of a welfare standard. Throughout we have assumed that society maximizes total surplus (including any costs of evidence production). How would the analysis change if we instead assumed a consumer standard? To see this, first notice that if only consumer welfare counts, the costs of evidence production will not enter the social welfare function. Moreover, Figure 1 tells us what the benefits for the consumers of permitting a merger (i.e., ΔCS in the figure) are. We see that as long as there are negative externalities, society will always want to block the merger (thus making SR optimal). If there are positive externalities, then the incentive structure will be similar to what we have under our welfare standard. Since evidence production is "for free," it is fairly easy to see that here SR is always inferior to HE. Moreover, a "mixed" z-institution will never be optimal. The optimal institution is thus either HE

or LF. One can show that there is a cut-off value of p such that below this HE is optimal and above it LF is optimal.[31]

Other parties' trying to influence the merger control procedure. We have assumed that only the insiders can provide society with information and thereby try to influence the decision whether to permit the merger. We think of this as the most natural case, since the insiders should have better access to information about any efficiencies than, for example, the other firms in the market (i.e., the outsiders). Still, one may wonder how the results would be affected if also the outsiders or the consumers could produce evidence. Again, Figure 1 helps us understand the incentives of these other groups. First suppose we have positive externalities (we assume again, as in our main model, a welfare standard). Then we see from the figure that the outsiders' interests are always opposed to society's; hence, the outsiders would not be able to credibly transmit any information. We also see that the consumers' and society's interests are identical; thus, any information that the consumers had access to would also be available to society, which would at least mitigate the informational asymmetries between society and the insiders.

Second, suppose we have negative externalities. Then Figure 1 tells us that the outsiders and the insiders have identical interests. This means that society can receive information from two parties instead of only one, which could make it less attractive to encourage maximal evidence production through HE. On the other hand, there should also be a free-riding problem, and the convex cost functions may make evidence production more worthwhile when it is spread out on two parties. It is thus not clear whether this alternative model would make

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[31] We can write $ECS^{SR} = CS_N$, $ECS^{LF} = pCS_H + (1-p)CS_L$, and $ECS^{HE} = p\tau_H^{HE}\Delta CS_H + CS_N$ (where the notation is self-explanatory). As in the total-welfare-standard model, we can without excluding any optimal institution presume that $z_L \leq z_N \leq z_H$. Hence, analogously to (5), we can write

$$ECS = p\tau_H^* (z_H - z_N) \Delta CS_H + (1 - z_N) ECS^{SR} + z_N ECS^{LF}.$$

An institution where $(z_H - z_N) \in (0,1)$ cannot be optimal. To see this, suppose that we do have $(z_H - z_N) \in (0,1)$ in an optimal institution. Then we can write

$$ECS < p\tau_H^{HE} (1 - z_N) \Delta CS_H + (1 - z_N) ECS^{SR} + z_N ECS^{LF} = (1 - z_N) ECS^{HE} + z_N ECS^{LF},$$

which contradicts the assumption that the institution is optimal. Hence, either HE or LF is optimal (notice that this result holds without any particular assumptions about the cost elasticity). Straightforward algebra shows that the cut-off value of p above which LF is best is given by

$$p = \frac{-\Delta CS_L}{\left(1 - \tau_H^{HE}\right)\Delta CS_H - \Delta CS_L}.$$

an efficiency defense more or less desirable and whether, as before, the answer would depend only on the magnitude of the cost elasticities.[32] Finally, with negative externalities the consumers will always be against the merger. Also here is it rather difficult to know how the results would change: there should be different effects working in opposite directions. We leave this and the other open questions to future research.

The insiders' being able to fabricate evidence. We have assumed that the insiders can, at a cost, obtain hard evidence that confirms their true type. Consider the following alternative assumption: the low-efficiency insiders can in addition obtain (false) evidence showing that the efficiencies are large.[33] Doing this is costly, and it is modeled in the same way as in our original model. To see how will this change the analysis and the results, first note that the antitrust authority very well understands that the evidence may be false and takes this into account when choosing the optimal institution. Moreover, any evidence production costs incurred by the low-efficiency insiders will *always* be wasted from society's point of view: the costs enter society's objective function and (as long as $z_H > z_N$) the false evidence leads to a bad merger being allowed. This social cost, which comes on top of any social costs in the original model, can be avoided only by choosing an institution that does not allow for an efficiency defense (i.e., by setting $z_H = z_N$).

In the Appendix we show that, under the assumption that the cost elasticities are constant and identical across types, the optimal institution in this extension of our model is (again) either SR, LF, or HE. Moreover, the comparison between SR and LF is (trivially) unaffected by the extension. What can and will change, however, are the comparisons between SR and HE and between LF and HE. In both cases, the conditions for HE to be the best institution are more stringent relative to those in the original model, because of the additional social cost associated with any institution that involves an efficiency defense. If, however, HE is strictly optimal in our original model, it remains optimal if the (marginal) cost of fabricating evidence is suffciently large. Furthermore, even

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[32] Such a model would also make the z-institutions more complex, since the decision whether to permit a merger could be made contingent on, for example, whether only one of the interested parties have submitted a particular report or whether both have done this.

[33] This extension has also been studied by Medvedev (2004) in a related model that builds on a discussion paper version of our paper.

if one adopts the extreme view that it is as costly to produce (real) evidence as it is to fabricate evidence, HE (and thus an efficiency defense) can nevertheless be desirable. The reason is that even if the cost functions for producing and fabricating evidence are identical, insiders that anticipate high efficiency gains have a stronger incentive to obtain evidence in favor of their case (recall that $\Delta \pi_H > \Delta \pi_L$). Thus, even if the evidence technology is completely ineffective in distinguishing between high- and low-efficiency firms, in equilibrium, the evidence presented can be helpful in reaching a desirable decision.

The verification of reports being costly for the antitrust authority. We have assumed that the antitrust authority can verify the truthfulness of any claim made by the insiders at no cost. In practice, it may be that the antitrust authority must devote a considerable amount of resources—related to lawyers, economists and other support staff, as well as hiring of external experts—to assess the truthfulness of such claims. If we incorporated such costly verification into our model, how would this affect our results? The answer is likely to depend on exactly how one chose to model the costly verification. Under quite broad circumstances, however, the same basic tradeoff as in our present model should matter also in such an extension. In particular, in an environment where the antitrust authority is forced to (or has an ex post incentive to) incur verification costs each time the insiders make claims about high efficiencies, this will add to the social cost of an efficiency defense. Moreover, since the insiders would not internalize these costs when making their evidence-production decision, we should expect the costs of having an efficiency defense to be larger in such an environment than in our original model. To what extent other insights from our analysis would be altered is more difficult to tell (without a more detailed investigation), and we leave this question to future work.

Appendix

In this appendix we provide calculations that verify the claims made in connection to the penultimate extension discussed in Section 6.

Assume that the insiders, also when knowing that $e = e_L$, can produce (fabricate) "evidence" that the efficiency gains are large. This evidence production is modeled just as in our original model. The cost function for fabricating evi-

dence is denoted $K\left(\tau_F\right)$, where the argument τ_F is the fabricating low-efficiency insiders' investment level, and the corresponding cost elasticity of evidence fabrication is denoted $\eta_F\left(\tau_F\right)$.

When having soft information that $e = e_L$, the insiders face the following problem:

$$\max_{\tau_F \in [0,1]} \left[\tau_F z_H + \left(1 - \tau_F\right) z_N\right] \pi_L + \left[\tau_F \left(1 - z_H\right) + \left(1 - \tau_F\right)\left(1 - z_N\right)\right] \pi_N - K\left(\tau_F\right)$$

(they also choose τ_L, but this will in equilibrium equal zero, so we can safely ignore that choice). The solution to this problem, τ_F^*, equals zero if $z_H \leq z_N$ and is implicitly defined by

$$\Delta \pi_L \left(z_H - z_N\right) = K^{'}\left(\tau_F^*\right) \tag{10}$$

otherwise.

The expression for expected welfare at stage (i) under our alternative assumption can be written as [cf. (5)]

$$
\begin{aligned}
EW &= p\left[\tau_H^* z_H + \left(1 - \tau_H^*\right) z_N\right] W_H + \left(1 - p\right)\left[\tau_F^* z_H + \left(1 - \tau_F^*\right) z_N\right] W_L \\
&\quad + p\left[\tau_H^*\left(1 - z_H\right) + \left(1 - \tau_H^*\right)\left(1 - z_N\right)\right] W_N \\
&\quad + \left(1 - p\right)\left[\tau_F^*\left(1 - z_H\right) + \left(1 - \tau_F^*\right)\left(1 - z_N\right)\right] W_N \\
&\quad - pC\left(\tau_H^*\right) - \left(1 - p\right) K\left(\tau_F^*\right) \\
&= p\tau_H^*\left(z_H - z_N\right) \Delta W_H + \left(1 - p\right) \tau_F^*\left(z_H - z_N\right) \Delta W_L \\
&\quad + \left(1 - z_N\right) EW^{SR} + z_N EW^{LF} - pC\left(\tau_H^*\right) - \left(1 - p\right) K\left(\tau_F^*\right). \tag{11}
\end{aligned}
$$

Note that this expression is larger for $\tau_F^* = 0$ than it is for any $\tau_F^* > 0$: fabrication is *always* bad for welfare.

Restricting attention to the relevant case in which $z_H \geq z_N$, we rewrote the first-order condition that defines τ_H^* in Section 3, obtaining (6). Similarly, for τ_F^* we have

$$\tau_F^*\left(z_H - z_N\right) = \frac{\eta_F\left(\tau_F^*\right)}{\Delta \pi_L} K\left(\tau_F^*\right). \tag{12}$$

Substituting (6) and (12) in (11) and re-arranging, one has

$$
\begin{aligned}
EW &= pC\left(\tau_H^*\right) \frac{\Delta W_H}{\Delta \pi_H} \left[\eta\left(\tau_H^*\right) - \frac{\Delta \pi_H}{\Delta W_H}\right] + \left(1 - z_N\right) EW^{SR} + z_N EW^{LF} \\
&\quad + \left(1 - p\right) K\left(\tau_F^*\right) \frac{\Delta W_L}{\Delta \pi_L} \left[\eta_F\left(\tau_F^*\right) - \frac{\Delta \pi_L}{\Delta W_L}\right]. \tag{13}
\end{aligned}
$$

The last term is negative for any $\tau_F^* > 0$ (recall that $\Delta W_L < 0$ and $\Delta \pi_L > 0$). The first term is non-positive if $\eta \left(\tau_H^* \right) \leq \frac{\Delta \pi_H}{\Delta W_H}$. If the sum of the first and the last term is negative, then society is strictly better off by choosing either LF or SR rather than an institution that induces investment in evidence production.

Let us now prove a result that corresponds to Lemma 1. From now on, we assume that the cost functions have constant and identical elasticities, denoted by η. The first line of the proof of Lemma 1 here becomes

$$EW = \left(z_H - z_N \right) \left\{ \frac{p \tau_H^* \Delta W_H}{\eta} \left[\eta - \frac{\Delta \pi_H}{\Delta W_H} \right] + \frac{\left(1 - p \right) \tau_F^* \Delta W_L}{\eta} \left[\eta - \frac{\Delta \pi_L}{\Delta W_L} \right] \right\}$$
$$+ \left(1 - z_N \right) EW^{SR} + z_N EW^{LF}. \tag{14}$$

We can write the expression on the first line as $\left(z_H - z_N \right) H \left(z_H \right)$, where

$$H \left(z_H \right) \equiv A \tau_H^* + B \tau_F^*,$$

$$A \equiv \frac{p \Delta W_H}{\eta} \left[\eta - \frac{\Delta \pi_H}{\Delta W_H} \right],$$

and

$$B \equiv \frac{\left(1 - p \right) \Delta W_L}{\eta} \left[\eta - \frac{\Delta \pi_L}{\Delta W_L} \right].$$

In order to get the second line of the lemma, it suffices to show that if $H \left(z_H \right) > 0$, then $\left(z_H - z_N \right) H \left(z_H \right)$ is increasing in z_H. Differentiating $\left(z_H - z_N \right) H \left(z_H \right)$ with respect to z_H and requiring the resulting expression to be greater than zero yield

$$A \tau_H^* + B \tau_F^* + \left(z_H - z_N \right) \left[A \frac{\partial \tau_H^*}{\partial z_H} + B \frac{\partial \tau_F^*}{\partial z_H} \right] > 0 \Leftrightarrow$$

$$A \tau_H^* \left[1 + \left(z_H - z_N \right) \frac{\partial \tau_H^*}{\tau_H^* \partial z_H} \right] + B \tau_F^* \left[1 + \left(z_H - z_N \right) \frac{\partial \tau_F^*}{\tau_F^* \partial z_H} \right] > 0. \tag{15}$$

Recall the first-order conditions that define τ_H^* and τ_F^*:

$$\left(z_H - z_N \right) \Delta \pi_H = C' \left(\tau_H^* \right) \tag{16}$$

and

$$\left(z_H - z_N \right) \Delta \pi_L = K' \left(\tau_F^* \right). \tag{17}$$

Using these, one can easily check that

$$\frac{\partial \tau_H^*}{\partial z_H} = \frac{\Delta \pi_H}{C'' \left(\tau_H^* \right)} \tag{18}$$

and

$$\frac{\partial \tau_F^*}{\partial z_H} = \frac{\Delta \pi_L}{K''\left(\tau_F^*\right)}. \tag{19}$$

Using (16)-(19) in (15), we have

$$A\tau_H^* \left[1 + \frac{C'\left(\tau_H^*\right)}{\Delta \pi_H} \frac{\Delta \pi_H}{\tau_H^* C''\left(\tau_H^*\right)}\right] + B\tau_F^* \left[1 + \frac{K'\left(\tau_F^*\right)}{\Delta \pi_L} \frac{\Delta \pi_L}{\tau_F^* K''\left(\tau_F^*\right)}\right] > 0.$$

Under the constant (and identical) elasticity assumption, this simplifies to

$$A\tau_H^* \left[1 + \frac{1}{\eta - 1}\right] + B\tau_F^* \left[1 + \frac{1}{\eta - 1}\right] > 0$$

or equivalently $A\tau_H^* + B\tau_F^* > 0$. Hence, under the assumption that $H\left(z_H\right) > 0$, the first line of (14) is increasing in z_H. This means that we have

$$EW \quad < \quad (1 - z_N) \left\{ \frac{p\tau_H^{HE}\Delta W_H}{\eta} \left[\eta - \frac{\Delta \pi_H}{\Delta W_H}\right] + \frac{(1-p)\tau_F^{HE}\Delta W_L}{\eta} \left[\eta - \frac{\Delta \pi_L}{\Delta W_L}\right] + EW^{SR} \right\}$$
$$+ z_N EW^{LF},$$

which parallels the second line of the proof of Lemma 1. The remaining steps are completely analogous to the ones in the proof of Lemma 1 and therefore omitted.

Thus, allowing for the fabrication of evidence as modeled above, we obtain the following variant of Proposition 1:

Proposition A1. *No institution yields a higher expected welfare than the best one of SR, LF, and HE. Moreover, an institution where $z_L > z_N$ is never optimal, and an institution where $(z_H - z_N) \in (0,1)$ is never optimal except possibly in a knife-edge case.*

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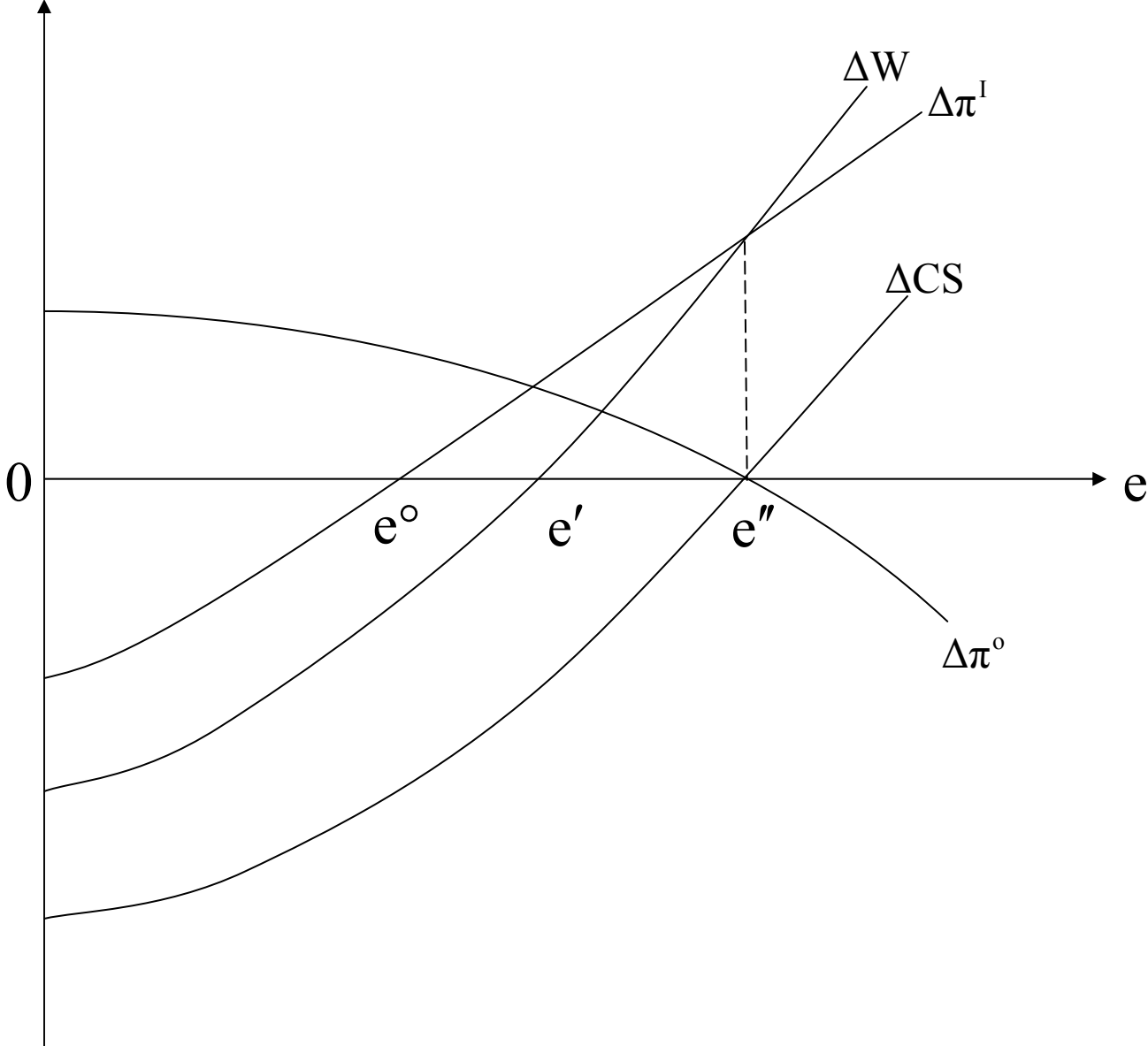Figure 1: Gains and losses for different parties due to the merger.

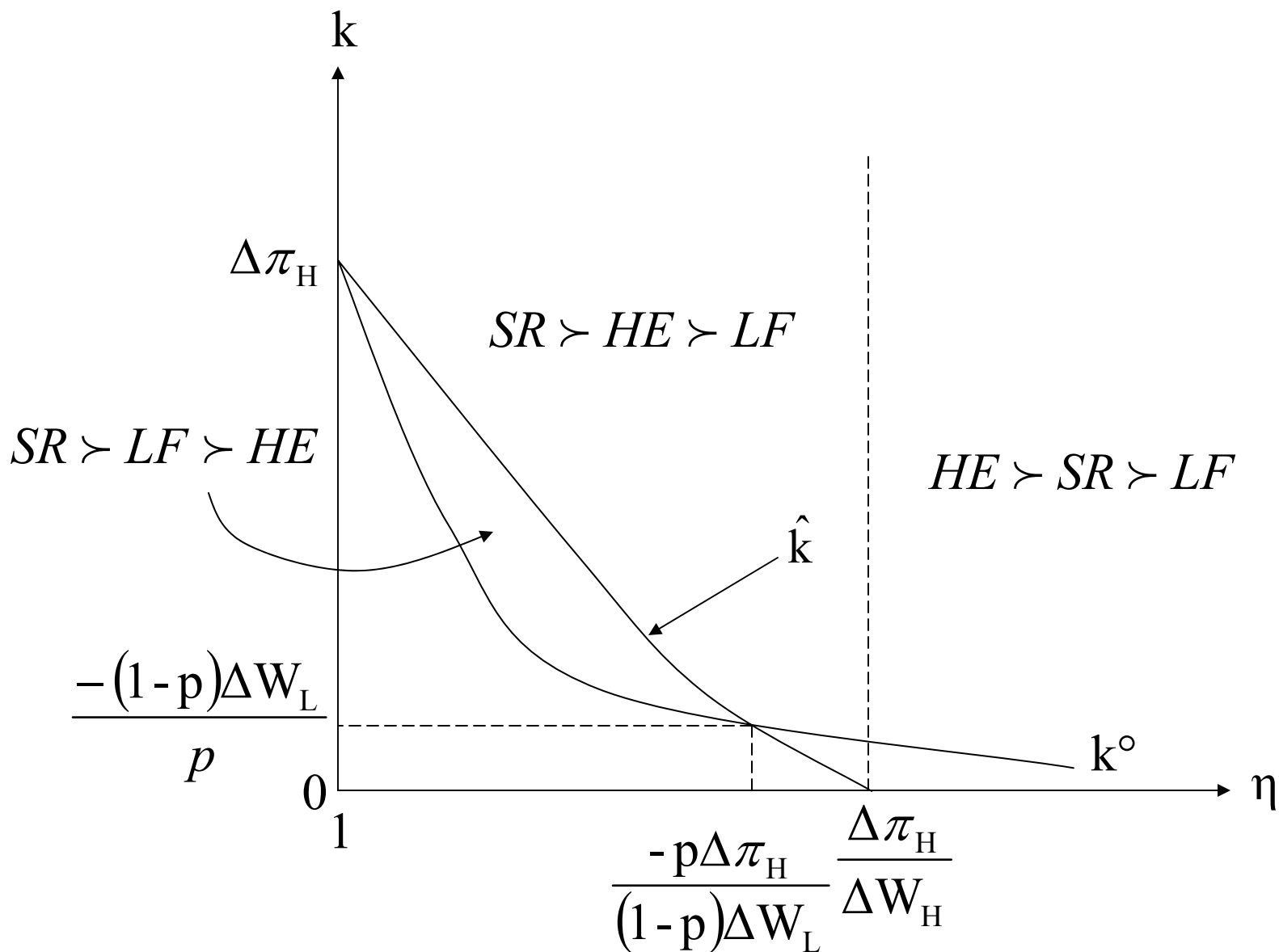# Figure 2: Panel A. Welfare comparison of institutions for Regime I.

Figure 2: Panel B. Welfare comparison of institutions for Regime II.