

On the Optimal Design of Competition Policy Procedures*

by

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Abstract

This paper presents a new formal systematic framework for comparing **Per Se**, **Rule of Reason** and other decision rules (or procedures) used in Competition Policy implementation. We differentiate various decision rules in terms of the quality of the underlying economic/legal model that underpins them. A particular feature of our proposed framework is that it extends the widely-used error-cost decision-theoretic approach by taking into account both the *direct* and the *indirect* effects of a Competition Authority's decisions. Other factors accounted for within our framework are:

- the length of the litigation cycle;
- differing implementation costs of different rules;
- antitrust fines and costs to firms of reversing their actions if these are disallowed;
- legal uncertainty.

Some of the key results and insights that emerge are.

- If **Rule of Reason** is able to effectively discriminate between harmful and benign actions then, contrary to some of the results in the literature, it produces lower decision error costs than any other rule including **Per Se**.
- Otherwise all Rules have the same decision cost errors.
- However **Rule of Reason** has higher *indirect costs* than **Per Se** because it imposes a stronger deterrent than **Per Se** in conditions where it is preferable to have a weaker deterrent effect, and a weaker deterrent effect than **Per Se** in conditions where it pays to have a stronger deterrent effect.

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Section 1 Introduction and Rationale

Throughout the world Competition and Regulatory Authorities have been increasingly active in recent years. Further, Competition Authorities are adopting a more proactive role to ensure the effective functioning of markets through “sector inquiries” or “market investigations”³. Similarly following the liberalization of regulated sectors and the entry of new firms into these sectors Sectoral Regulatory Authorities are now far more involved in competition issues.

In parallel with an increasingly proactive role, there has been a shift towards adopting an approach to implementation that in Europe has come to be termed “economics-(or effects-) based ” and in the US is described as a **Rule of Reason** type of procedure. This is in contrast with relying mainly on **Per Se Rules** (or a formalistic / purely legalistic approach) to implementing Competition Policy – an approach that tends to be favoured by legal experts⁴. In Europe this has been connected to the modernization of the law on Vertical Restraints (in 1999), on Horizontal Agreements (in 2004) and on the Merger Regulation (in 2004)⁵. The recent proposals for a more economics based approach in the treatment of Abuse of Dominance cases (Article 82 cases) is in the same direction⁶. In USA too there has been recently a debate as to what the law against monopolization is and should be and enforcement has been relying increasingly on performing rule-of-reason analysis⁷.

In Competition Law the use of **Per Se rules** implies that certain types of conduct/practices are presumed as illegal (or legal) as such, in that injury (or lack of potential injury) to competition is conclusively presumed⁸. With **Rule of Reason** the effect of the practice on competition has to be established for each case through the use of economic analysis, modeling and statistical/econometric evidence⁹. While decisions

³ Commissioner Nellie Kroes’ recent statement at the 13th International Conference on Competition and the 14th European Competition Day, München, 26th March 2007 provides a good summary of this trend: “Our sector inquiries are unique in covering the whole European market, but several national competition authorities also have similar instruments in various forms. Some authorities even have the power to impose a wide range of remedies directly within the context of a sector inquiry, which is not possible under European competition law. Our sector inquiries, in contrast for example to market investigations conducted by the Competition Commission in the UK, are only a step towards action. They help direct the Commission’s attention to where enforcement cases should be opened by uncovering evidence, and they shine a spotlight on anti-competitive business practices which sometimes is enough to get the companies themselves to solve the problems. There is a further advantage. The improved understanding these inquiries give us also informs the Commission’s policy decisions about the framework for the market concerned, helping us to regulate better.”

⁴ See the EAGCP document (2005), Vickers (2004).

⁵ Vickers (2004) argues that “The result of these developments is a European policy approach towards agreements....that is more economics-based in terms of its priorities, processes and substantive case analysis.... (and a) test for (horizontal) merger appraisal in tune with the economic purpose of merger policy and close to the test in the law of the US...”. See also Waelbroeck, D. (2006), Weitbrecht, A. (2006), Bishop, S., Ridyrd, D. (2002).

⁶ See the Commission Discussion Paper on Reforming Article 82 (2005).

⁷ It is worth remembering that until the 1960s enforcement relied mainly on per se rules while, as noted by Pitofsky (2002) in recent years such rules are essentially not used in any but hard core cartel cases.

⁸ For an early thoughtful exposition see J W Markham (1955) “The Per Se Doctrine and the new Rule of Reason”.

⁹ Though not often made explicit in the debate, proponents of the per se approach also tend to adopt a more general standard than proponents of the rule of reason. The latter stress that the assessment of the effect to competition should be restricted to an assessment of the ultimate effect on a measure of welfare – usually costumers’ welfare, while the

under **Rule of Reason** can be less error prone, the latter have a number of disadvantages that have been recognized in the literature. For example, one disadvantage often stressed, especially for resource constrained Competition Authorities, is that the burden of proof and the cost of litigation are likely to be considerably greater. It is necessary not just to establish occurrence of the event / practice but also to establish its potential effect on competition. Further, there may be additional costs from increased legal uncertainty and from rent-seeking activities (see below).

At a more general level, the debate on the use of the Per Se vs. the Rule of Reason (or effects-based) approaches to Competition Policy implementation is very much related to the literature that has emerged in recent years on the appropriate legal standards and on the optimal complexity of legal rules.¹⁰

In relation to competition policy the literature stresses that its enforcement is bound to be imperfect and costly (Ehrlich and Posner 1974; Easterbrook, 1992; Joskow, 2002; Heyer, 2005; Christiansen, 2006). To start with, *decision errors* will occur as it will usually be practically impossible to differentiate perfectly between cases that are harmful from benign cases of a specific practice. As noted originally by Ehrlich and Posner (1974), “due to the inherent ambiguity of language and the limitations of human foresight and knowledge”¹¹ legal rules will in practice suffer from problems of “overinclusion” (benign actions are prohibited) and “underinclusion” (harmful actions are permitted). The knowledge embodied in rules may not be in tune with the latest advances in economic theory, or, perhaps more importantly, knowledge will be often seriously constrained by incomplete or very costly information, uncertainty and inability to predict future market outcomes¹². To quote Joskow (2002) “any set of legal rules will necessarily lead to “mistakes” of both the type I and type II varieties when applied to particular cases”¹³. Taking into account the possibility of *decision error-costs* and their welfare implications must be a central part of any serious analysis of the optimal design of Competition Policy procedures, as the Decision Theoretic Approach makes clear.

Important analyses espousing a Decision Theoretic Approach to formulating legal standards in Competition Policy have been undertaken in a number of papers following the seminal contribution of judge Easterbrook (1992). He put forward an error-cost framework – proposing the idea that legal standards should minimise the sum of the welfare costs caused by decision errors of type I (false positives or false acquittals) and type II (false negatives or false convictions)¹⁴.

former adopt a less strict standard in which, for example, the effect on competitors is taken also into account in forming per se rule presumptions.

¹⁰ Contributions that can be mentioned here include Ehrlich and Posner (1974), Diver (1983), Polinsky and Shavell (1989), Ogus (1992), Kaplow (1995, 2000), Mahoney and Sanchirico (2005), and Christiansen, A. and Kerber (2006).

¹¹ Page 268.

¹² US DOJ economist K. Heyer (2005) writes that while “the past quarter century has witnessed dramatic advances in the application of microeconomic theory and empirical techniques to antitrust analysis ...this has hardly eliminated what continues to be considerable uncertainty and imprecision surrounding particular case decisions” (p. 1-2), this been the outcome of economists’ been able to confidently predict very little “when making recommendations on specific cases in the real world” (p.2).

¹³ Page 99.

¹⁴ See Beckner and Salop (1999), Tom and Pak (2000), Joskow (2002), Evans and Padilla (2004, 2005), Hylton and Salinger (2004), Ahlborn, Evans and Padilla (2005), Christiansen, A. and W. Kerber (2006), Salinger (2006).

While the costs of decision-errors are important, the *Indirect Effects* caused by alternative procedures may well be equally or even more important. This has been recognised by Joskow (2002) who argues that they are more important than the costs of decision-errors as they include the (cost of) the responses and adaptations that target firms as well as other “firms and markets in *general* make to antitrust rules and (the effect of these) on prices, costs and innovation throughout the economy”¹⁵.

Despite the rich literature on various aspects of decision rules in Competition Policy implementation, no formal framework has yet been developed for systematically comparing various decision rules/procedures, taking into account all or most of the relevant factors. As a consequence, the debate often appears incoherent and confused as it is conducted on the basis of mostly informal arguments stressing one or another subset of potentially relevant factors.

In this paper we provide a formal general framework for systematically comparing various decision rules/procedures for dealing with competition issues. We distinguish decision rules in three related dimensions:

- the quality of the economic/legal model that underpins the rule;
- the costs of implementing the rule;
- the delay in reaching decisions under the Rule.

In general more sophisticated models will require more costly investigations to collect and analyse the relevant information, and lengthier delays in reaching a decision. As in Christiansen et.al (2006) our model allows for a continuum of different rules, with **Per Se** and **Rule of Reason** located at the two ends of the spectrum.

Other factors accounted for within our framework are:

- antitrust fines;
- costs to firms of reversing their actions if these are disallowed;
- legal uncertainty.

Our framework not only provides a more formal treatment of much of the existing decision-theoretic error-cost minimisation approach but extends it by examining the effects of a Competition Authority’s decision rule on the behaviour of **all** firms and not just those that are the subject of investigation. As such it encompasses both the *direct* and the *indirect* effects of a Competition Authority’s actions. The resulting Type I and Type II errors that emerge from this framework encompass those identified in the existing literature but are very much richer.

We evaluate decision rules within a full welfare-theoretic framework that enables us to analyse the trade off between decision error costs and other costs.¹⁶ We show that an

¹⁵ Page 98. Joskow (2002), adopts a Transactions Cost framework.

¹⁶ On other costs of implementing Competition Policy see below.

error-cost framework is indeed a useful one for organising our thinking but also that existing treatments concentrating on *direct* effects – i.e. decision errors - have serious shortcomings because they neglect *indirect* effects.

Our key results are:

- If **Rule of Reason** is able to effectively discriminate between harmful and benign actions then, contrary to some of the results in the literature, it produces lower decision error costs than any other rule including **Per Se**.
- Otherwise all Rules have the same decision cost errors.
- However **Rule of Reason** has higher *indirect costs* than **Per Se** because it imposes a stronger deterrent than **Per Se** in conditions where it is preferable to have a weaker deterrent effect, and a weaker deterrent effect than **Per Se** in conditions where it pays to have a stronger deterrent effect.

The structure of the paper is as follows. In the next section we clarify the distinction between different types of Decision Rules used in implementing Competition Policy. Section 3 sets out the model and derives positive results about the decisions reached under different rules and the impact of these on firms' decisions. In Section 4 we undertake a systematic welfare comparison of decision rules, starting with an application of the framework to the traditional decision cost approach before going on to undertake a full welfare evaluation.. Section 5 provides a preliminary application of our approach to the analysis of optimal rules in dynamic industries. Section 6 concludes and discusses directions for future research.

Section 2 *Decision Rules in Competition Policy Implementation*

The aim of this section is to clarify the distinction between different types of decision rules employed by a Competition Authority (CA).

In the model that we will present below, there is a population of firms that could take an action that, if there no intervention, would confer a positive private benefit which we take to be the present value of the expected change in profits from the action over its “natural” lifetime¹⁷. The precise value of this benefit varies across firms in way that will be described below.

We could think of an *action* as a generic practice such as merging, tying, bundling, exclusive dealing, price fixing, offering rebates, competitive price cutting, vertical restrictions, refusal to sell or license, etc. that could be subject to challenge by a CA. However even under the simplest legal standards¹⁸ actions in this broad sense will usually not be allowed or be disallowed *as such* but only contingent on certain additional criteria being satisfied. For example the practice of “competitive price cutting” would typically be presumed neither legal nor illegal as such but a rule can specify that “price cutting is per se illegal if prices are below some relevant notion of cost”. So it will usually be appropriate to think of actions being described somewhat more narrowly than at this very generic level.

We think of the CA examining a subset of cases where an action has been taken. Depending on the decision rule it employs, it will gather some information about each case. By using this information in conjunction with ideas coming from law and economics it forms a presumption as to whether on balance the action taken in any particular case is likely to be harmful or benign and disallows or allows accordingly.

The idea we seek to capture is that a CA operates a *Per Se Rule* when it allows or disallows an action in a blanket fashion irrespective of any finer considerations of the characteristics of the action, of the firm and its environment – nature of product, market, demand, technology etc. Moreover, since the only evidence that is relevant in reaching a decision under such a rule is that necessary to establish whether the action was taken, we assume that under a *Per Se Rule*, this is in fact the only information that is collected by the authority¹⁹. The decision to allow or disallow is not arbitrary but reflects the CA’s perception of the expected harm of the action.

¹⁷ This captures the idea that firms operate in a changing environment and that an action taken at a particular time might be modified or even reversed at some later date.

¹⁸ The distinction between simple and complex legal standards is made more precise below where a number of other related concepts are also mentioned.

¹⁹ Of course in the process of collecting information that enables it to verify whether or not an action has been taken, the authority may collect information that would enable it to operate a differentiating rule as defined below. We assume however that this would never be sufficient to enable it to operate an effective differentiating rule. Since recognising the existence of this additional information adds nothing to the analysis, for simplicity we will treat *Per Se* as a situation in which the CA has no information beyond that needed to know that the action has taken place.

By contrast we will say that a CA uses a *Differentiating Rule* (hereafter *D-Rule*) if (i) it collects additional information about the characteristics of the action, of the firm and its environment; (ii) by combining this information with ideas coming from economics/law it gets an imperfect signal/indicator of the likely harm done by the action. This gives the authority the *potential* for making different decisions based on the different signals it receives.

Note that the general concept of *D-Rules* used here follows Kaplow (1995) who defines the complexity or precision of rules as referring to the number and complexity of distinctions incorporated in the set of rules²⁰. Related concepts that have been discussed in the literature are those of “general” vs, “specific” rules and “standards” – see for example Mahoney et al, 2005, Ehrlich and Posner 1974 and Kaplow 2000). To the extent that the distinction refers to the degree of complexity and precision of a rule then a general rule is a simple one (as a *Per Se* rule) in our sense and a specific rule or a standard (in Ehrlich and Posner’s, 1974 sense) is a *D-Rule* in our sense²¹.

Since we assume that CAs make decisions on the basis of the presumed harm, we will say that a *D-Rule* is an *Effective Differentiating Rule* (hereafter *ED-Rule*) if the expected harm conditional on one signal generated by the rule has a different sign from the expected harm conditional on some other signal generated by the rule.

We say that a CA uses a **Rule of Reason** approach when it uses a *D-Rule* based on collecting the maximum information about the characteristics of the action, of the firm and its environment required to form the most sophisticated understanding available from Economics and Law about the factors that contribute to potential harm.

Thus, within the framework adopted here we see that **Per Se** and **Rule of Reason** can be thought of as just two types of *D-Rule* but at the opposite ends of the information spectrum. Notice however that a **Rule of Reason** approach may not necessarily result in a *ED-Rule*. This could be the case where the expected harm (positive or negative) resulting from just knowing that an action has been taken is so great that no amount of refinement available from existing Economics or Legal knowledge would change the CA’s view about presumed harm. Since, in this case, **Rule of Reason** produces exactly the same decisions as **Per Se** there would be little point in collecting the additional information and the CA might as well use a **Per Se** approach. An example of such a case is that of Price Fixing Agreements, in which a *Per Se* Illegality rule is used. With such practices, economic theory can make general and robust predictions about their welfare implications and there is a presumption that differentiating is of no value (irrespective of its cost).

²⁰ This is of course fundamentally different from the notion of “toughness” of legal rules (see eg Evans and Padilla, 2004). *Per se* legality and *per se* illegality are polar opposites in terms of “toughness” but are identical in terms of “complexity” in Kaplow’s sense. See also Christiansen, A. and W. Kerber (2006), p. 221-2.

²¹ See also Christiansen, A. and W. Kerber (2006), p.222.

The literature²² also refers to rules such as *Modified Per Se Legality/Illegality* or *Structured Rule of Reason*. These are just *D-Rules* as defined, above that lie somewhere on the spectrum between **Per Se Rules** and **Rule of Reason** depending on the number and complexity of the assessment criteria, the informational requirements involved and the depth of case analysis. As such these are fully allowed for within our existing framework and, as we will show, the comparison of these rules to **Per Se** or **Rule of Reason** is just a straightforward application of our framework.

The *Two-Tier Approach* used in Merger Procedures and also proposed for the case of Predatory Price Cutting by Joskow and Klevorick (1979)²³, could also be readily analysed using the framework set out in this paper – though this is beyond its current scope. In this approach a “simpler model” is first developed, composed of a series of relatively simple “screen tests” that aim to separate the very large fraction of cases in which firms do not have market power, and whose actions can be thought of as pro-competitive, from the cases in which firms have substantial market power. For the latter, the approach proposes the development in a second phase of a more “sophisticated model” for the identification of cases that can potentially produce substantial welfare harm.

Undertaking a systematic welfare analysis of such a procedure that requires the sequential application of a low quality and high quality rule – with the decision on whether to implement the high quality rule being dependent on the signal produced by the low quality rule - is an interesting but straightforward extension of our framework that we leave for future work.

²² For example Evans and Padilla (2004, 2005) and Ahlborn, Evans and Padilla (2004, 2005) propose Modified Per Se Legality (MPSL) approaches or Structured Rule of Reason for tying and MPSL for refusal to licence an IP right. Under MPSL a practice is allowed except in “exceptional circumstances” in which the CA will be able to show substantial anticompetitive effects. These are all special cases of Differentiating Rules in our context.

²³ See also Motta (2004).

Section 3 The Model

We begin by setting out the timing of decisions. There is a population of firms who could potentially take an action. Having taken the action there is a possibility that this could become the subject of an investigation by a CA, which could disallow it and could then require the firm to reverse it and/or impose a penalty. Anticipating this firms have to decide whether or not to take the action.

This is an *ex-post* investigation process. An alternative decision process involving *ex ante* intervention by the Competition Authority is a *prior clearance* process whereby firms contemplating taking an action have to get prior approval before proceeding. We leave the investigation of this set-up, that characterizes merger procedures, to future work.

3.1 The Economy

There is a population of firms whose size is normalised to 1. As already noted, these firms could take an action which, if there were no intervention, would confer a positive private benefit which we take to be the present value of the expected change in profits from the action over its “natural” lifetime. Let $b > 0$ denote the benefit accruing to a typical firm.

Actions can also cause wider social harm, which we take to be measured by the negative of the present value of the change in consumer surplus. We assume that firms belong to just two environments which reflect the exact nature of the firms’ characteristics and the characteristics of the markets in which they operate. For firms from environment 1 the action will generate harm $h_1 < 0$ - i.e. will be socially beneficial. For firms from environment 2 the action will generate social harm of present value $h_2 > 0$ ²⁴. Notice that here, and for the rest of this paper, we are implicitly assuming that firms will not be differentiated in terms of the *nature of the action* undertaken – that is, we take actions to refer to rather specific (in contrast to generic) practices²⁵.

Suppose that the fraction of firms in environment 2 is γ , $0 < \gamma < 1$. We assume that the values of γ , h_1 and h_2 are common knowledge. The importance of the relative frequency of the socially harmful and socially beneficial actions is stressed by the Decision Theoretic (Error-Minimising) approach²⁶. Hylton and Salinger (2004) refer to γ as the “base-rate probability of anticompetitive harm”.

In principle the distribution of private benefits could be different for firms from environment 1 than for firms from environment 2. However in this paper we will impose the **symmetry assumption** that the two distributions are identical. In a companion paper

²⁴ It is important to use present values especially for discussions related to dynamic industries. In the terminology used by Hylton and Salinger (2004), h_2 is the “welfare gain from disallowing a type 2 action” while h_1 is the “welfare loss from disallowing a type 1 action”.

²⁵ As we noted in Section 2 above this is quite appropriate otherwise the notion of Per Se rules loses much of its practical significance.

²⁶ See for example Hylton and Salinger (2004) and Salinger (2006).

– Katsoulacos and Ulph (2007) – we will examine the implications of having asymmetric distributions.

So we suppose that the private benefit has a positive continuous probability density $f(b) > 0$ on $[0, \infty)$, with cumulative distribution function $F(b)$.

3.2 The Investigation Process

The process of investigating firms comprises a number of stages.

Stage 1 Notification

There are a number of ways in which it could come to the attention of a CA that a firm has taken an action which may be subject to potential challenge by the CA. In some cases firms might be required to notify the authority that they have taken the action. In other cases there may be third-party reports sent to the CA. We assume that third-parties are not able to observe whether an action is harmful or benign (i.e. to which environment a firm taking the action belongs). So firms being reported are drawn randomly from the set of firms that have taken the action.

Stage 2 Verification

Following notification the authority verifies whether or not the firm has indeed taken the action. We assume that the authority does not wrongly classify a firm as having taken the action when it has not. If this is common knowledge then there should be no malicious reporting of firms who have not taken the action. Of course, we recognise that this is a simplification: since we take actions to refer to rather specific (in contrast to generic) practices, the verification of such actions in some cases will not be an error-free process²⁷.

We assume that the authority is obliged to investigate every case that is reported to it and make a determination of whether the action should be allowed or disallowed. So let p , $0 < p < 1$ be the fraction of firms who come to the attention of the authority, are verified as having taken the action, and are subject to a ruling by CA as to whether their action is allowed or disallowed. We take p to be exogenous.

Stage 3 Investigation

The way this phase of the process goes will depend on what type of rule the CA uses. We spell this out in three sub-sections.

3.2.3a Nature of Rules

²⁷ A case that comes to mind is that of actions been “pricing below Average (Economic) Variable Cost”. In other cases the assumption that verification is error-free (and relatively costless) is much more realistic. In any case, our analysis can be thought of as one involving a **single-error stage** (that related to the investigation phase). The multi-error stage analysis is left for future research.

If the CA uses a **Per Se Rule** it carries out no further investigation. However to allow for the more general possibility that the CA uses some kind of *D-Rule* (for which we will show that the **Per Se Rule** as specified above is just a special case) we want to think of the authority as using some “model” to try to predict whether a firm has come from environment 1 or environment 2. To use this model it has to collect some additional information over and above that required in Step 2 to verify that the action has been taken.

We characterise a model in quite an abstract way, by supposing that a model generates just one of two signals – Red and Green. If the model were a perfect predictor of the environment from which a firm had come (and hence of the harm from its action) then all firms from environment 1 would produce a Green signal and all firms from environment 2 would produce a Red signal.

However models are typically imperfect so we suppose that if a firm comes from environment 1 there is a probability p_G , $0 < p_G \leq 1$ that it generates a Green signal, while if a firm comes from environment 2 there is a probability p_R , $0 < p_R \leq 1$ that it generates a Red signal.

In what follows a model is characterised by the two parameters (p_G, p_R) .

Now if $p_G + p_R = 1$ then the probability of getting a Green (Red) signal is exactly the same whichever environment the firm comes from, so the information generated by the investigation is uninformative. This would be the case under **Per Se Rules**.

However if $p_G + p_R > 1$ then following an investigation firms from environment 1 are more likely to generate a green signal than are firms from environment 2, while firms from environment 2 are more likely to generate Red signals than are firms from environment 1. So the information generated by the investigation is potentially more informative.

We suppose that at any given time the state of Economic/Legal knowledge is such that there is a maximum quality model (\bar{p}_G, \bar{p}_R) , $(0,0) \leq (\bar{p}_G, \bar{p}_R) \leq (1,1)$; $\bar{p}_G + \bar{p}_R > 1$ - this will be our **Rule of Reason** model.

In what follows we therefore confine attention to the class of models (p_G, p_R) , $(0,0) \leq (p_G, p_R) \leq (\bar{p}_G, \bar{p}_R)$; $p_G + p_R \geq 1$. **Per Se** is at one end of this spectrum with $p_G + p_R = 1$ and **Rule of Reason** at the other.

3.2.3b Costs of Using Rules

As has been pointed out in the literature²⁸ it is important to recognise that some rules are more costly to operate than others. So let $K(p_G, p_R)$ be the total economic cost of employing a model (p_G, p_R) in making decisions. This could include:

- the costs of initially developing the model;
- the costs to both the CA of gathering the information required by the model;
- the cost of conducting the analysis in each of the cases.

Notice that these costs could therefore depend on p , but since that is treated as exogenous in this paper we do not make this explicit. We assume that if $p_G + p_R = 1$ then $K(p_G, p_R) = 0$ but that if $p_G + p_R > 1$ costs are increasing in each of the arguments.

There will also be costs that fall on firms from the investigation process, and the anticipation of these could be relevant to a firm's decision as to whether or not to take the action. However in the interests of simplicity we will ignore these costs in this paper.

3.2.3c Delay in Decisions – The Litigation Cycle

As noted by Ehrlich and Posner (1974, the choice between a “simple” and a “complex” rule or a rule and a standard, “affects the speed, and hence indirectly the costs and benefits, of legal dispute resolution.....Decision by standard increases the interval between an incident giving rise to a legal dispute and final judicial resolution of the dispute”²⁹. To capture this idea we assume for simplicity that if the CA disallows an action under *Per Se* then a firm gets only a fraction ϕ , $0 \leq \phi \leq 1$ of the private benefit b that it would have got had the action been allowed, while if the authority disallows the action under a *Differentiating Rule* procedure then the firm gets only a fraction ϕ_D , $0 \leq \phi_D \leq 1$ of the private benefit b . We assume that $\phi < \phi_D$, that is under *Per Se* decisions are reached quicker than under a *Differentiating Rule* procedure (under the latter, the *litigation cycle* is longer). The fact that ϕ_D does not depend on (p_G, p_R) reflects the assumption that factors that lead to an improved model need not lead to a lengthier decision process³⁰.

Stage 4 Decision

We assume that in deciding whether to allow or disallow an action a CA does so on the basis of the expected harm caused by the action. This is the standard for reaching decisions which is typically employed in Europe and US³¹.

²⁸ Christiansen et.al. (2006) p. 223/224, 231

²⁹ Page 265-6.

³⁰ For example using a more powerful theory may improve discriminatory power but may not increase length of time to collect, process and analyse the data and then deliberate on the findings.

³¹ An alternative would be to base decisions on a more comprehensive welfare measure by considering the net harm $h - b$ – as is happening in some countries such as Canada. It would be interesting to extend our framework to consider this alternative standard for reaching decisions.

To calculate expected harm the CA has to consider how likely it is that any given firm that comes to its attention comes from environment 2. By assumption the sample of firms coming to the CA's attention is just a random sub-sample of the population of firms that *have* taken the action. However this is not necessarily the same as the base population of firms that *could* have taken the action, and so the fraction of firms who have taken the action who come from environment 2 is not necessarily γ . However, as we will show below, given the **symmetry assumption** introduced above, the fraction of firms who end up taking the action that come from environment 2 will always be γ .

So in calculating expected harm the CA can reasonably assume that the likelihood that any given firm with which it is dealing comes from environment 2 is γ .

Suppose then that the CA gets a Red signal. It is easy to see that the probability that this comes from a firm from environment 1 is $\frac{(1-\gamma)(1-p_G)}{\gamma p_R + (1-\gamma)(1-p_G)}$, and so the probability that it comes from a firm from environment 2 is $\frac{\gamma p_R}{\gamma p_R + (1-\gamma)(1-p_G)}$. Hence the expected harm conditional on getting a Red Signal is

$$\bar{h}(R) = \frac{(1-\gamma)(1-p_G)}{\gamma p_R + (1-\gamma)(1-p_G)} h_1 + \frac{\gamma p_R}{\gamma p_R + (1-\gamma)(1-p_G)} h_2 \quad (1)$$

By analogy the expected harm conditional on getting a Green signal is

$$\bar{h}(G) = \frac{(1-\gamma) \cdot p_G}{\gamma \cdot (1-p_R) + (1-\gamma) \cdot p_G} h_1 + \frac{\gamma \cdot (1-p_R)}{\gamma \cdot (1-p_R) + (1-\gamma) \cdot p_G} h_2 \quad (2)$$

The CA will disallow or allow an action conditional on getting a Red (resp. Green) signal as $\bar{h}(R) > 0$ or $\bar{h}(R) < 0$ (resp. $\bar{h}(G) > 0$ or $\bar{h}(G) < 0$).

For future purposes we note the following properties of $\bar{h}(G)$ and $\bar{h}(R)$:

Lemma 1

- (i) Under **Per Se** where $p_G + p_R = 1$ then $\bar{h}(G) = \bar{h}(R) = \bar{h}$;
- (ii) if $p_G + p_R > 1$ then $h_2 \geq \bar{h}(R) > \bar{h} > \bar{h}(G) \geq h_1$;
- (iii) if $p_G + p_R > 1$ and $p_G = 1$ then $\bar{h}(R) = h_2 > 0$
- (iv) if $p_G + p_R > 1$ and $p_R = 1$ then $\bar{h}(G) = h_1 < 0$
- (v) if $p_G + p_R > 1$ and both $p_R < 1$ and $p_G < 1$ then an increase in either p_G or p_R will increase $\bar{h}(R)$ and lower $\bar{h}(G)$

Notice that it follows from part (ii) of the Lemma that for a *Differentiating Rule* to be an *Effective Differentiating Rule* it is necessary that $\bar{h}(R) > 0 > \bar{h}(G)$. In this case the CA will disallow actions when it gets a Red signal and allow them when it gets a Green signal. To see when a differentiating rule is effective we consider the following two lemmas.

Lemma 2

If $\gamma h_2 < (1-\gamma) \cdot (-h_1)$ then $\bar{h} < 0$ and:

- (i) under **Per Se** all actions will be ruled Per Se Legal (PSL) and allowed;
- (ii) if, for a *Differentiating Rule* (p_G, p_R) , $1 \leq \frac{p_R}{1-p_G} < \frac{(1-\gamma) \cdot (-h_1)}{\gamma h_2}$ then $\bar{h}(R) < 0$ and the authority will allow all actions, so the rule is effectively equivalent to **Per Se**;
- (iii) a *Differentiating Rule* only becomes an *Effective Differentiating Rule* when $\bar{h}(R) > 0$ - i.e when its quality is sufficiently high that $q_R \equiv \frac{p_R}{1-p_G} > \frac{(1-\gamma) \cdot (-h_1)}{\gamma h_2}$;

$$(iv) \frac{\partial q_R}{\partial p_G} = \frac{p_R}{1-p_G} \cdot \frac{1}{1-p_G} > \frac{1}{1-p_G} = \frac{\partial q_R}{\partial p_R}.$$

Lemma 3

If $\gamma h_2 > (1-\gamma) \cdot (-h_1)$ then $\bar{h} > 0$ and:

- (i) under **Per Se** all actions will be ruled Per Se Illegal (PSI) and disallowed;
- (ii) if for a *D-Rule* (p_G, p_R) , $1 \leq \frac{p_G}{1-p_R} < \frac{\gamma h_2}{(1-\gamma) \cdot (-h_1)}$ then $\bar{h}(G) > 0$ and the authority will allow all actions, so the rule is effectively equivalent to **Per Se**;
- (iii) a *D-Rule* only becomes an *ED-Rule* when $\bar{h}(G) < 0$ - i.e when its quality is sufficiently high that $q_G \equiv \frac{p_G}{1-p_R} > \frac{\gamma h_2}{(1-\gamma) \cdot (-h_1)}$;

$$(iv) \frac{\partial q_G}{\partial p_R} = \frac{p_G}{1-p_R} \cdot \frac{1}{1-p_R} > \frac{1}{1-p_R} = \frac{\partial q_G}{\partial p_G}.$$

We can summarise the key findings in the following (the proof of which is apparent from Lemmas 2 and 3):

Proposition 1

- (i) If under a **Per Se Rule** an action is deemed benign, then, to have an *Effective Differentiating Rule* it is important to increase the informational content of the Red Signal, and this is most effectively done by increasing p_G , the model's ability to identify firms from environment 1.

- (ii) If under a **Per Se Rule** an action is deemed harmful, then, to have an *Effective Differentiating Rule* it is important to increase the informational content of the Green Signal, and this is most effectively done by increasing p_R , the model's ability to identify firms from environment 2.

Corollary 1:

Clearly, the larger is $|\bar{h}|$ the larger the improvement in the quality of the D-rule model has to be in order to be able to make a differentiating decision, that is, in order for the D-rule to be effective and make any difference relative to what would be decided under Per Se.

Stage 5 Enforcement

If an action is investigated and disallowed, then there are two possible consequences for the firm. It may have to pay a penalty, and it may have to reverse the action. We consider these in turn.

3.2.5a Fines

Fines are important instruments in the prevention of socially harmful actions. To quote Wils (2006), fines “may have a deterrent effect, by creating a credible threat of being prosecuted and fined which weighs sufficiently in the balance of expected costs and benefits to deter calculating companies from committing antitrust violations”³². Under the “deterrence approach” expected fines (the nominal fine discounted by the probability that the fine is effectively imposed) should be set to exceed the expected gain from the violation. An alternative approach – the “internalisation approach” – has been advocated by Becker (1968) and Landes (1983). Under this, the optimal fine equals the net harm caused to others, that is, not taking into account the benefits to the offender, again discounted by the probability that the fine is effectively imposed. “The optimal fine thus set makes the offender internalise all the costs and benefits of the violation, thus leading the offender to commit the «efficient violations» whose total benefits exceed the total costs while deterring «inefficient violations» whose total costs exceed the total benefits”³³. It is worth noting that in his seminal analysis, Kaplow (1995) advocates an internalisation approach to fines.

In practice, CAs impose fines on the basis of imperfect criteria related to the revenue or profit of the offender -see also Wils (1995) - which are likely to bear little relation to the amounts suggested by the above approaches³⁴ - though this seems to be changing³⁵.

³² Page 11. Wils (2006) contains a review of the voluminous literature on fines. As he notes apart from their deterrence effect fines can have two more beneficial effects. First, they may have a moral effect by sending a message to law abiding firms reinforcing their moral commitment to the antitrust prohibitions. Second, through leniency programmes the cost of setting up and running cartels can be raised.

³³ Wils (2006), p. 13. As he notes, the (full) deterrence approach (that he advocates) can be thought of as more appropriate when the CA uses as its standard consumers' surplus, while the internalisation approach can be thought of as more appropriate when the CA uses as its standard the total welfare.

³⁴ This is an area to which substantial attention has been given both by academics and policy makers. Wils (2006) discusses the feasibility of estimating optimal fines (Section IV).

Accordingly in what follows we will assume that if the CA disallows an action it imposes a fixed penalty $s \geq 0$.

3.2.5b Reversing the Action

We also want to allow the possibility that when the authority disallows an action it may require the firm to reverse it. This could potentially cause the firm to incur significant costs³⁶ - though these will be lower when there are good *substitutes* for the action that firms can use.

We capture this through the parameter $C \geq 0$ which reflects the costs to firms of reversing their actions. Obviously if firms are not required to reverse their action then $C = 0$.

3.3 Firms' Decisions

In deciding whether or not to take an action, firms anticipate the possibility that they will be investigated through the process as described above and that the action is disallowed – possibly after a delay.

We assume that while firms may know their own environment they do not know what model the CA is using – i.e. they do not know (p_G, p_R) . All they know is how many cases have come before the CA and what fraction are allowed and what fraction are disallowed.

To see the implications of this consider a number of cases.

Case 3.3.1 $\bar{h} < 0$ and the CA uses an *Ineffective Differentiating (ID) Rule* – which includes **Per Se** - for which $1 \leq \frac{p_R}{1 - p_G} < \frac{(1 - \gamma) \cdot (-h_1)}{\gamma h_2}$.

Here, as we saw in Lemma 2(ii) this type of Rule is effectively equivalent to a Per Se Legal rule and all actions will be allowed. Firms will receive the full private benefit and so all firms will take the action. So the population of firms who take the action is the same as the population who could take it, and the fraction of cases coming before the CA from environment 2 is indeed γ .

³⁵ See for example a number of recent statements by Commissioner Nelie Kross such as that of 12/7/2006 on the penalty imposed to Microsoft, her speech on “Developments in Competition Policy in 2006” of 20/3/2007 mentioning the “record fines” of 1.8 billion Euro imposed on cartels in 2006 and her speech in the joint Commission / IBA Conference on Competition Policy of 8/3/2007.

³⁶ These include many sunk costs involved in implementing an action potentially including R&D costs, costs in unbundling products, rearranging contractual commitments, modifying price lists, as well as the managerial effort involved in redirecting the firm’s strategy. Such costs can be quite substantial as they may involve difficult to reverse technological, marketing and/or other contractual commitments. Even if firms have to notify the CA in order to get permission for legally implementing an action (something that is true for the case of mergers involving firms with large market shares), refusal to grant permission could result in an often substantial cost for reversing and redirecting the firms’ strategic orientation.

Case 3.3.2 $\bar{h} < 0$ and the authority uses an *Effective Differentiating (ED) Rule* for which $\frac{p_R}{1-p_G} > \frac{(1-\gamma)\cdot(-h_1)}{\gamma h_2}$.

Here because the CA has an ED-Rule it will disallow an action when it receives a Red signal, and this happens with frequency $\lambda^{ED} = (1-\gamma)\cdot(1-p_G) + \gamma\cdot p_R$. Since the risk of coming before the authority is p the risk a firm perceives of having its action disallowed is $p\cdot\lambda^{ED}$. If the firm's action is disallowed it will get only a fraction ϕ_D of its private benefit and in addition will have to incur a fine s and a cost of reversing its action C . The expected net benefit is therefore

$$(1-p\cdot\lambda^{ED})b + p\cdot\lambda^{ED}[\phi_D b - (s+C)]$$

A firm will therefore only take the action if

$$b > \underline{b}^{ED} = \frac{p\lambda^{ED}(s+C)}{1-p\lambda^{ED}(1-\phi_D)}. \quad (3)$$

Consequently the same fraction $F[\underline{b}^{ED}]$ of firms from each environment $t = 1,2$ will be deterred from taking the action. This guarantees that of the firms taking the action, the fraction who come from environment 2 is indeed γ .

Case 3.3.3 $\bar{h} > 0$ and the CA uses a **Per Se Rule**.

Here the CA rules everything Per Se Illegal and disallows all actions - but with delay ϕ . The probability of having the action disallowed is just p . In this case the firm will take the action only if

$$b > \underline{b}^{PSI} = \frac{p(s+C)}{1-p(1-\phi)}. \quad (4)$$

As above a fraction $F[\underline{b}^{PSI}]$ of firms from each environment will be deterred from taking the action, so, of the firms taking the action, the fraction who come from environment 2 is indeed γ .

Case 3.3.4 $\bar{h} > 0$ and the CA uses an *ID-Rule* for which $1 < \frac{p_G}{1-p_R} < \frac{\gamma h_2}{(1-\gamma)\cdot(-h_1)}$.

Here, as above the CA, disallows all actions but now with delay ϕ_D . In this case firms will take the action only if

$$b > \underline{b}^{ID} = \frac{p(s+C)}{1-p(1-\phi_D)} \quad (5)$$

Case 3.3.5 $\bar{h} > 0$ and the CA uses an *ED-Rule* for which $\frac{p_G}{1-p_R} > \frac{\gamma h_2}{(1-\gamma) \cdot (-h_1)}$.

Here as before firms will take the action only if

$$b > \underline{b}^{ED} = \frac{p\lambda^{ED}(s+C)}{1-p\lambda^{ED}(1-\phi_D)}.$$

As above a fraction $F[\underline{b}^{ED}]$ of firms from each environment will be deterred from taking the action, so, of the firms taking the action, the fraction who come from environment 2 is indeed γ .

Proposition 2

- (i) Per Se Illegality creates more of a deterrence than does an *ID-Rule*, which in turn creates a greater deterrence than an *ED-Rule*. That is $\underline{b}^{PSI} > \underline{b}^{ID} > \underline{b}^{ED}$
- (ii) Improving the quality of an *ED-Rule* may increase or decrease it's deterrent effect. Formally $\frac{\partial \underline{b}^{ED}}{\partial p_R} > 0$; $\frac{\partial \underline{b}^{ED}}{\partial p_G} < 0$.

The proof is straightforward, and the intuition is clear. PSI creates greater deterrence than an *ID-Rule* because while they both disallow all cases PSI does so faster and so firms retain less of the private benefit. An *ID-Rule* creates greater deterrence than an *ED-Rule* because it disallows all actions while *ED* allows some. However sharpening an *ED-Rule* could increase deterrence if it increases p_R but will lower it if it increases p_G .

Notice that our model captures the idea of *legal uncertainty* and explores some of its impact. There are a number of aspects to *legal uncertainty*.

The most obvious is that while under PSI and (arguably, to a lesser extent) *ID-Rules* firms know that their case will be disallowed by the CA, with an *ED-Rule* they do not know in advance what the outcome will be and have to await the outcome of the investigation. However certainty comes at a price – the CA is certainly wrong in a number of cases – and as Proposition 1(i) makes clear there is a sense in which firms may be better off with the uncertainty of a *ED-Rule*.

Another aspect of *legal uncertainty* that our model captures is the lack of transparency. Firms do not know the model and hence the probability that a firm from their environment will be have its case disallowed. All they can observe by studying past judgements is the average probability λ^{ED} . We leave for future research the exploration of reducing this aspect of legal uncertainty.

This completes the description of the model and of the outcomes when the authority uses different types of Rule. In the next section we undertake a welfare comparison of the different Rules.

Section 4 Welfare Comparison of the Rules

We begin by establishing as point of reference the outcome that would arise in the first best world.

4.1 First Best

In the First Best the CA would be perfectly informed and could costlessly and instantly determine from which environment each firm taking the action came. It would allow all actions taken by firms from environment 1 and disallow all actions by firms from environment 2. Accordingly welfare in the first best would be

$$W^{FB} = (1 - \gamma) \cdot (-h_1). \quad (6)$$

4.2 A Decision-Theoretic Comparison of Rules

Before undertaking a full welfare comparison, it will be useful to re-examine some of the discussion in the literature using the framework developed here. The literature has focused very heavily on the impact of the decisions made by the CA on the set of firms coming before it. So in the remainder of this subsection we focus solely on this sub-population of firms and assume that this is fixed and independent of the CA's actions. For simplicity normalise the size of this sub-population to 1. Also, we abstract from the costs of implementing different decision rules.

It is useful to consider two cases.

Case 4.2.1 $\bar{h} < 0$.

We want to compare an *ID-Rule* – which encompasses **Per Se** – with an *ED-Rule*.

Suppose first that the Rule (p_G, p_R) that was being operated by the CA was such that

$$1 \leq \frac{p_R}{1 - p_G} < \frac{(1 - \gamma) \cdot (-h_1)}{\gamma h_2} \text{ and so, from **Lemma 2**, was an *ID-Rule* .}$$

Under such an *ID-Rule* all actions will be allowed. So welfare will be

$$W^{ID} = -\bar{h} = (1 - \gamma) \cdot (-h_1) - \gamma \cdot h_2$$

Consequently the welfare loss – the difference between actual welfare and that in first-best - from using an ID-Rule is

$$L^{ID} = W^{FB} - W^{ID} = \gamma h_2. \quad (7)$$

Notice that under this *ID-Rule* the CA is correctly allowing all the benign actions but wrongly allowing all harmful actions. To bring out more fully the error-costs involved we note that under this *ID-Rule*:

- the Rate of False Convictions is $RFC^{ID} = 0$;
- the Rate of False Acquittals is $RFA^{ID} = \gamma$;
- the Cost of False Convictions is $CFC^{ID} = RFC^{ID} \cdot (-h_1) = 0$;
- the Cost of False Acquittals is $CFA^{ID} = RFA^{ID} \cdot h_2 = \gamma h_2$

and so the overall Cost of Decision Error is

$$CDE^{ID} = CFA^{ID} + CFC^{ID} = \gamma h_2 \quad (8)$$

Notice that from (7) and (8) the cost of decision errors is exactly the same as the welfare loss, i.e.

$$CDE^{ID} = L^{ID}.$$

Now suppose that the Rule (p_G, p_R) that was being operated by the CA was such that

$$\frac{p_R}{1-p_G} > \frac{(1-\gamma) \cdot (-h_1)}{\gamma h_2} \text{ and so we had an } ED\text{-Rule.}$$

From **Lemma 2** the CA will allow all cases giving a Green Signal and disallow all cases giving a Red Signal. Welfare under this *ED-Rule* is

$$W^{ED} = (1-\gamma) p_G (-h_1) - \gamma \cdot (1-p_R) \cdot h_2,$$

and the Welfare Loss is

$$L^{ED} = W^{FB} - W^{ED} = (1-\gamma) \cdot (1-p_G) \cdot (-h_1) + \gamma \cdot (1-p_R) \cdot h_2. \quad (9)$$

Under this Rule the CA will be wrongly disallowing some cases from environment 1 that give a Red signal and wrongly allowing some cases from environment 2 that give a Green signal. So under the *ED-Rule*:

- the Rate of False Convictions is $RFC^{ED} = (1-\gamma) \cdot (1-p_G)$;
- the Rate of False Acquittals is $RFA^{ED} = \gamma \cdot (1-p_R)$;
- the Cost of False Convictions is $CFC^{ED} = RFC^{ED} \cdot (-h_1) = (1-\gamma) \cdot (1-p_G) \cdot (-h_1)$;
- the Cost of False Acquittals is $CFA^{ED} = RFA^{ED} \cdot h_2 = \gamma \cdot (1-p_R) \cdot h_2$;

and consequently the overall Cost of Decision Error is:

$$CDE^{ED} = CFA^{ED} + CFC^{ED} = (1-\gamma) \cdot (1-p_G) \cdot (-h_1) + \gamma \cdot (1-p_R) \cdot h_2 \quad (10)$$

As before, from (9) and (10) we see that the cost of decision error is the same as the welfare loss – i.e.

$$CDE^{ED} = L^{ED}.$$

To compare the two rules note that from (8) and (10) it follows that

$$CDE^{ED} < CDE^{ID} \Leftrightarrow (1-\gamma)(1-p_G)(-h_1) < \gamma \cdot p_R \cdot h_2 \Leftrightarrow \frac{p_R}{1-p_G} > \frac{(1-\gamma) \cdot (-h_1)}{\gamma h_2} \quad (11)$$

which immediately implies that although an *ED-Rule* has both False Acquittals and False Convictions whereas an *ID-Rule* has only False Acquittals, the overall error cost of the *ED-Rule* is lower.

Case 4.2.2 $\bar{h} > 0$

Again we want to compare *ID-Rule* – which encompasses **Per Se** – with an *ED-Rule*

Under any *ID-Rule* all actions are disallowed, so welfare is

$$W^{ID} = 0$$

and hence the welfare loss is

$$L^{ID} = W^{FB} - W^{ID} = (1-\gamma) \cdot (-h_1) \quad (12)$$

Under an *ID-Rule* all harmful cases are rightly stopped but benign cases are wrongly disallowed, so:

- the Rate of False Convictions is $RFC^{ID} = (1-\gamma)$;
- the Rate of False Acquittals is $RFA^{ID} = 0$;
- the Cost of False Convictions is: $CFC^{ID} = RFC^{ID} \cdot (-h_1) = (1-\gamma) \cdot (-h_1)$;
- the Cost of False Acquittals is $CFA^{ID} = RFA^{ID} \cdot h_2 = 0$;

and so the overall Cost of Decision Error is

$$CDE^{ID} = CFA^{ID} + CFC^{ID} = (1-\gamma) \cdot (-h_1) \quad (13)$$

As before it follows from (12) and (13) that $CDE^{ID} = L^{ID}$.

Now suppose $\frac{p_G}{1-p_R} > \frac{\gamma h_2}{(1-\gamma) \cdot (-h_1)}$ so, from **Lemma 3**, the CA had an *ED-Rule*. As in the previous Case this means that the CA will allow all cases giving a Green Signal

disallow all cases giving a Red Signal. The welfare loss and the Cost of Decision Error are exactly the same as in Case 1 and are given by (9) and (10).

As in Case 1 it is straightforward to use (10) and (13) to compare the decision errors and show that

$$CDE^{ED} < CDE^{ID} \Leftrightarrow \frac{p_G}{1-p_R} > \frac{\gamma h_2}{(1-\gamma) \cdot (-h_1)}. \quad (14)$$

and so, once again an *ED-Rule* produces lower decision error costs than any *ID-Rule*.

We can now state:

Proposition 3

- (i) In terms of both welfare and (equivalently) Decision Error Costs any *Effective Differentiating Rule* is better than any *Ineffective Differentiating Rule* – which includes **Per Se**.
- (ii) Improving an *Effective Differentiating Rule* by increasing p_R or p_G will reduce Decision Error Costs (improve welfare);
- (iii) However when $\bar{h} < 0$ (resp. $\bar{h} > 0$) the most effective way of reducing errors is to increase p_G (resp. p_R).

We have already proved (i) and parts (ii) and (iii) follow immediately from (10).

This Proposition can be used to show how our new framework can be used to both confirm and challenge some arguments that have been put forward in the literature.

For example Hylton and Salinger (2004) and Evans and Padilla (2004, 2005) argue that a Per Se Legality (PSL) rule³⁷ is preferable to a PSI Rule for tying while Ahlborn, Evans and Padilla (2005) make the same case in the context of Refusal to License an IP right. In both cases the essence of their argument is that $\bar{h} = \gamma h_2 + (1-\gamma)h_1 < 0$ and so indeed the right **Per Se Rule** is PSL rather than PSI. However they go on to argue that a Modified Per Se Legality (MPSL) rule is preferable to PSL and, further, that it is preferable to RoR.

The first part of this argument could be consistent with Proposition 1 to the extent that a MPSL rule – which is just a *D-Rule* - is interpreted as one in which $p_G \approx 1$ so the CA can recognise with high accuracy cases from environment 1. This may well be a reasonable presumption in the cases of tying and Refusal to License an IP right. If $p_G \approx 1$ then the condition in Lemma 2 (iii) is satisfied and the MPSL is an *ED-Rule* and so from Proposition 2(i) the MPSL Rule will produce lower error costs than PSL. However the reasoning of Ahlborn, Evans and Padilla (2005) for preferring MPSL to **Rule of Reason** is certainly false. **Rule of Reason** is the best possible *ED-Rule* the CA can use given

³⁷ Or Structured Rule of Reason in the case of Evans and Padilla (2004).

available information and the state of knowledge, so from Proposition 2(ii) must have no higher decision cost errors than another *ED-Rule* such as MPSL³⁸.

4.3 A Full Welfare Comparison

In this sub-section we undertake a full welfare comparison of different rules. That is we look at the effects of the CA's actions on the full population of firms that could potentially take an action. We also take account of the costs of implementing different rules. To avoid a proliferation of different comparisons, we will confine attention to a comparison between **Per Se Rules** and an *Effective Differentiating Rule*.

We will first compare **Per Se Rules** and an *ED-Rule* to the First Best, and will then compare them to each other.

4.3.1 Welfare Comparisons I: Comparisons to the First Best

In the previous sub-section we showed how the welfare losses from different rules could be equated to the cost of decision errors. In this section we will show that the welfare loss is equal to the sum of the costs of Type I and Type II errors plus the resource costs used up in implementing the Rule.

We define:

- Type I Errors: anything that allows harmful actions to take place;
- Type II Errors: anything that prevents benign actions from taking place.

So Type I errors will include False Acquittals while Type II errors will include False Convictions.

However while the Type I and Type II errors we discuss below will include these decision errors that have been much discussed in the literature, they go way beyond them. This is because this literature typically focuses on just the *direct* effects of the CAs actions – the decisions it takes on the cases coming before it – and, moreover, assumes that decisions are made instantaneously.

In the analysis considered here we take account of the effects of delays in decision-making, but more importantly include all *the indirect effects* of the various rules. For type I errors these could potentially be much larger than the direct effects given that CAs may often consider only a small fraction of firms taking actions – i.e. given that p is small.

Welfare in The First Best is once again given by (6), so

³⁸ The part of their argument which is false is that relative to RoR, a MPSL rule would result in more false acquittals but would cause fewer false convictions which, according.... (to our presumption, are) more harmful". If under MPSL $p_G \approx 1$ this will also be the case under a RoR.

$$W^{FB} = (1 - \gamma) \cdot (-h_1). \quad (6)$$

Now consider **Per Se Rules**.

If $\bar{h} < 0$ and the CA uses a **Per Se Rule** it will rule everything to be Per Se Legal (PSL) and so allow all actions. Then no one reports, no investigations are undertaken (and so no resources used up) and everyone takes the action.

Welfare is therefore

$$W^{PSL} = -\bar{h} = (1 - \gamma) \cdot (-h_1) - \gamma \cdot h_2 \quad (15)$$

Compared to the first-best, from (6) and (15), the welfare loss is:

$$L^{PSL} = W^{FB} - W^{PSL} = \gamma h_2 = CFA^{PSL} \quad (16)$$

This loss takes the form of a Type I Decision Error - False Acquittals. The loss is greater the larger the fraction of anticompetitive (harmful) acts and the greater the welfare harm caused by these acts.

If $\bar{h} > 0$ and the CA uses a **Per Se Rule** it will rule all actions to be Per Se Illegal (PSI) and disallow them. However the CA can only disallow the action for the fraction p of the firms that come to its attention –and this after a delay ϕ . The remaining fraction $(1 - p)$ will successfully undertake the action. However anticipating the possibility that they might have their actions stopped and have to incur a penalty plus reversal costs a fraction $F^{PSI} = F(\underline{b}^{PSI})$ will decide not to undertake the action. Consequently welfare under PSI is

$$W^{PSI} = [1 - F(\underline{b}^{PSI})](-\bar{h})[(1 - p) + p\phi]. \quad (17)$$

If we compare (17) with (6) the welfare loss from PSI is

$$L^{PSI} = W^{FB} - W^{PSI} = (1 - F^{PSI})\gamma h_2[(1 - p) + p\phi] + F^{PSI}(1 - \gamma)(-h_1) + (1 - F^{PSI})p(1 - \phi) \cdot (1 - \gamma)(-h_1),$$

or:

$$L^{PSI} = W^{FB} - W^{PSI} = (1 - F^{PSI})\gamma h_2[(1 - p) + p\phi] + F^{PSI}(1 - \gamma)(-h_1) + (1 - F^{PSI}) \cdot p \cdot (1 - \phi) \cdot CFC^{PSI} \quad (18)$$

The first expression on the RHS of (18) is the cost of the Type I errors created by this rule. There are two of these errors:

- (i) The first, $(1 - F^{PSI}) \cdot (1 - p) \cdot \gamma \cdot h_2$, is the cost of the *failure to deter and detect* firms whose actions are harmful.
- (ii) The second, $(1 - F^{PSI}) \cdot p \cdot \phi \cdot \gamma \cdot h_2$ is the cost of the *failure to deter and rapidly enough close down* the harmful actions of those firms who do come before the CA, and whose actions are rightly declared illegal.

The second expression is the costs of the Type II errors created by this rule. There are two of these.

- (i) The first, $F^{PSI} \cdot (1 - \gamma) \cdot (-h_1)$ is the cost of *wrongly deterring* some firms whose actions are beneficial.
- (ii) The second, $(1 - F^{PSI}) \cdot p \cdot (1 - \phi) \cdot CFC^{PSI}$, is the cost of *falsely convicting* that fraction of firms who do take benign actions and who come to the attention of the CA. However the normal *cost of false convictions* under PSI, CFC^{PSI} , is scaled down by $(1 - \phi)$ in recognition of the delay in taking the action.

Notice that an increase in delay increases the Type I error but reduces the Type II error.

Suppose now that the CA uses an *Effective Differentiating Rule*. Of the firms taking the action a fraction $(1 - p)$ will not come to the CA's attention, and so generate welfare $-\bar{h}$. Of the fraction p that do come to its attention a fraction λ^{ED} will display a Red Signal and have their action stopped, albeit after a delay ϕ_D - generating welfare $\phi_D \cdot (-\bar{h}(R))$ - while the remaining fraction $(1 - \lambda^{ED})$ will generate a green signal and have their action allowed, thus generating welfare $(-\bar{h}(G))$. Anticipating the possibility that they might have their actions stopped and have to incur a penalty plus reversal costs a fraction $F^{ED} = F(\underline{b}^{ED})$ will decide not to undertake the action. We also need to take account of the costs of using this rule.

Bringing this altogether, it is straightforward to show that, after a little re-arranging, welfare under an *ED-Rule* will be

$$W^{ED} = [1 - F^{ED}] \cdot \left\{ -\bar{h} + \lambda^{ED} p (1 - \phi_D) \bar{h}(R) \right\} - K(p_G, p_R). \quad (19)$$

By comparing (19) with (6) we see that the welfare loss under an *ED-Rule* is

$$L^{ED} = W^{FB} - W^{ED} = \left\{ \left[(1 - F^{ED})(1 - p)\gamma h_2 \right] + \left[(1 - F^{ED})p\gamma h_2(1 - p_R) \right] + \phi_D \left[(1 - F^{ED})p\gamma h_2 p_R \right] \right\} + \left\{ \left[F^{ED}(1 - \gamma) \cdot (-h_1) \right] + \left[(1 - F^{ED})p(1 - \phi_D)(1 - \gamma) \cdot (-h_1)(1 - p_G) \right] \right\} + K(p_G, p_R)$$

or,

$$L^{ED} = \left\{ \left[(1 - F^{ED})(1 - p)\gamma h_2 \right] + \left[(1 - F^{ED})pCFA^{ED} \right] + \phi_D \left[(1 - F^{ED})p\gamma h_2 p_R \right] \right\} + \left\{ \left[F^{ED}(1 - \gamma) \cdot (-h_1) \right] + \left[(1 - F^{ED})p(1 - \phi_D)CFC^{ED} \right] \right\} + K(p_G, p_R) \quad (20)$$

The first term on the RHS of (20) is cost of the Type I Errors made by the *ED-Rule*. It can be expressed as the sum of three different effects.

- (i) The first, $\left[(1 - F^{ED})(1 - p)\gamma h_2 \right]$, is the cost of *failure to deter and detect* a fraction of firms that are taking harmful action.
- (ii) The second term, $\left[(1 - F^{ED})pCFA^{ED} \right]$ is the cost of *false acquittals*. These are firms who should not have taken the action but do, and are now detected, but are wrongly acquitted.
- (iii) Finally there is the term $\phi_D \left[(1 - F^{ED})pp_R\gamma h_2 \right]$ which reflects the cost of the *failure to deter and rapidly enough close down* the harmful actions of those firms who do come before the CA, whose actions are correctly identified as being harmful, rightly declared illegal

The second expression on the RHS of (20) captures all the Type II errors made by the *ED-Rule*. As with the PSI Rule it can be expressed as the sum of two different effects.

- (i) The first $\left[F^{ED}(1 - \gamma) \cdot (-h_1) \right]$ is the cost of *falsely deterring* firms from taking actions that should have been taken.
- (ii) The second $\left[(1 - F^{ED})p(1 - \phi_D)CFC^{ED} \right]$ is the cost of *falsely convicting* that fraction of firms who do take benign actions and who come to the attention of the CA. However the normal *cost of false convictions* under an *ED-Rule*, CFC^{ED} , is scaled down by $(1 - \phi_D)$ in recognition of the delay in taking the action.

4.3.2 Welfare Comparisons II: *ED-Rules vs Per Se Rules*

Let us now compare welfare under an *ED-Rule* with that under **Per Se**. As in Section 4.2 it is useful to consider separately two cases.

Case 4.3.2.1. $\bar{h} < 0$

Here the relevant **Per Se Rule** is PSL.

If we compare (19) with (15) then, after some re-arranging we get

$$W^{ED} - W^{PSL} = -F^{ED} \cdot (-\bar{h}) + [1 - F^{ED}] \cdot p \cdot (1 - \phi_D) \cdot [CDE^{PSL} - CDE^{ED}] - K(.) \quad (21)$$

The first term on the RHS is negative because the *ED-Rule* introduces a *deterrent effect* that stops some firms from taking actions which are on balance beneficial. The second term is positive because, as we saw in Proposition 3(i), *the ED-rule makes better decisions* – involves lower costs of false acquittals and false convictions. Finally the D-rule has a higher implementation cost. This has a number of important implications which we summarise in the following

Proposition 4

- (i) While, as we saw from Proposition 3 (i) an *ED-Rule* is better than **Per Se** in terms of its *direct effects* (decision costs), a **Per Se Rule** is better than an *ED-Rule* in terms of its *indirect* (deterrent) effects, because the *ED-Rule* creates a stronger deterrent effect than **Per Se** when actions are on balance benign and so the CA should not be trying to deter them.
- (ii) When the quality of the CA's model and information is just good enough for an *ED-Rule* to be used – i.e. $\bar{h}(R) > 0$, but $\bar{h}(R) \approx 0$ - then the *indirect* effect dominates the direct effect.
- (iii) If we improve the quality of the *ED-Rule* in the most effective way – i.e. by increasing p_G ³⁹ - then this will lower **both** decision error costs⁴⁰ - and \underline{b}^{ED} ⁴¹ and F^{ED} - That is it will increase the advantage of the *ED-Rule* in terms of the *direct effects* and reduce its disadvantage in terms of the *indirect* effects. It follows that an *ED-Rule* is more likely to be preferable to a PSL rule when the CA's model recognises with a high degree of accuracy actions of type 1 ($p_G \approx 1$).
- (iv) A long litigation cycle under the *ED-Rule*, implying ϕ_D close to unity⁴², will virtually eliminate the *ED-Rule's* advantage in terms of the *direct effect*.
- (v) On the other hand if
 - (a) the cost, C , of reversing the action is small – as would be the case if firms

³⁹ See Lemma 2 (iv)

⁴⁰ Proposition 3(ii)

⁴¹ Proposition 2(ii)

⁴² See below for the implications of this in the case of dynamic industries.

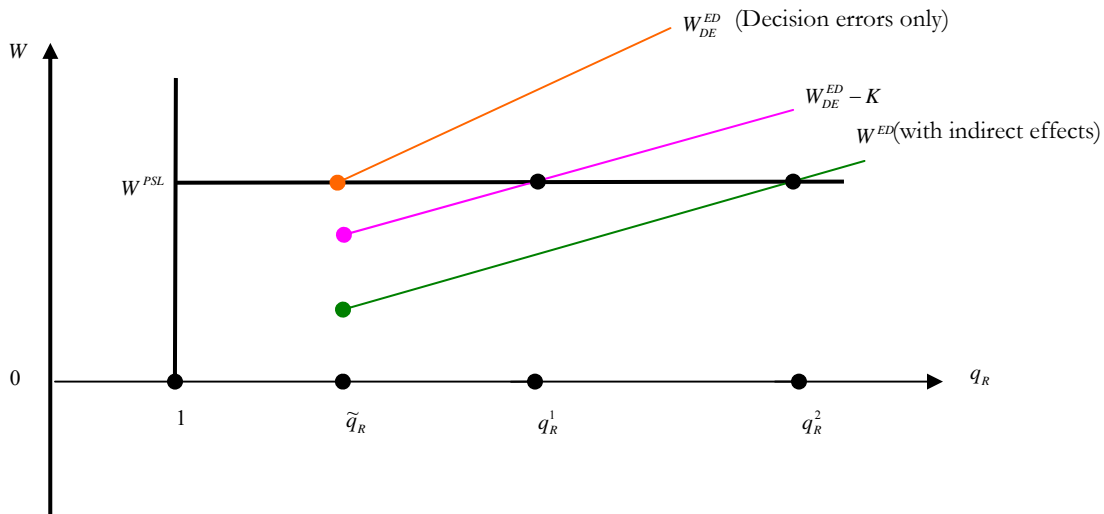
were not required to reverse their actions or there are good substitutes that firms can use; and

(b) penalties, s , are small

then the disadvantage of an *ED-Rule* in terms of the *indirect effects* is likely to be small.

These conclusions can be illustrated in Figure 1 below where, for $1 \leq q_R \leq \tilde{q}_R$, $\bar{h}(R) \leq 0$, and it is certainly optimal to use a PSL rule. For $\tilde{q}_R < q_R \leq q_R^2$, while an *ED-Rule* is preferable on the grounds of decision error cost minimisation (this holds, net of K-costs, for $q_R^1 \leq q_R \leq q_R^2$) nevertheless the PSL rule is overall preferable when taking into account the deterrent effects. However for $q_R > q_R^2$ the advantage of the *ED-Rule* in terms of direct effects is strong enough, and its disadvantage in terms of *indirect effects* is weak enough that overall it is preferable.

Figure 1



Case 4.3.2.2 $\bar{h} > 0$

Here the relevant **Per Se Rule** is Per Se Illegality (PSI).

If we compare (19) with (17) then after a bit of rearranging we get:

$$\begin{aligned}
W^{ED} - W^{PSI} = & \left[F^{ED} - F^{PSI} \right] \bar{h} \left[1 - p(1 - \phi_D) \right] + \\
& \left[1 - F^{ED} \right] \cdot p \cdot (1 - \phi_D) (CDE^{PSI} - CDE^{ED}) - \\
& \left[1 - F^{PSI} \right] \bar{h} \cdot p \cdot (\phi_D - \phi) \\
& - K(\cdot)
\end{aligned} \tag{22}$$

We consider in turn the implications of the four terms on the RHS of (22):

- the first term on the RHS is negative because, as we saw in Proposition 2(i), PSI generates a stronger *deterrent effect* than the *ED-rule*;
- the second term is positive because, as we saw in Proposition 3(i), the *ED-Rule* makes better decisions and so generates lower decision cost errors than PSI;
- the third term is negative because the *ED-Rule* involves more *delay* in stopping actions that are on balance harmful;
- finally there is the cost, K , of implementing the *ED-Rule* to take into account.

As above this has a number of striking implications which we summarise in the following

Proposition 5

(i) While, as we saw from Proposition 3 (i) an *ED-Rule* is better than **Per Se** in terms of its *direct effects* (decision costs), a **Per Se Rule** is better than an *ED-Rule* in terms of its *indirect* (deterrent) effects, because the *ED-Rule* creates a weaker deterrent effect than **Per Se** when actions are on balance harmful and so the CA should be trying to deter them.

(ii) When the quality of the CA's model and information is just good enough for an *ED-Rule* to be used – i.e. $\bar{h}(G) < 0$, but $\bar{h}(G) \approx 0$ – then the *indirect* effect dominates the direct effect.

(iii) If we improve the quality of the *ED-Rule* in the most effective way – i.e. by increasing p_R ⁴³ – then while this will lower the *ED-Rule's* decision error costs⁴⁴ – it will increase \underline{b}^{ED} ⁴⁵ and so F^{ED} . This latter effect will certainly reduce the disadvantage of the *ED-Rule* in terms of *indirect effects*. The increase in p_R increases the decision cost advantage of the *ED-Rule per capita*, but reduces the population of firms taking the action on whom this advantage is applied, so the overall effect on the *direct effect* is ambiguous. It follows that an *ED-Rule* is more likely to be preferable to a PSL rule when the CA's model recognises with a high degree of accuracy actions of type 1 ($p_G \approx 1$).

(iv) A long litigation cycle under the *ED-Rule*, implying ϕ_D close to unity⁴⁶, will virtually eliminate the *ED-Rule's* advantage in terms of the *direct effect*.

⁴³ See Lemma 3 (iv)

⁴⁴ Proposition 3(ii)

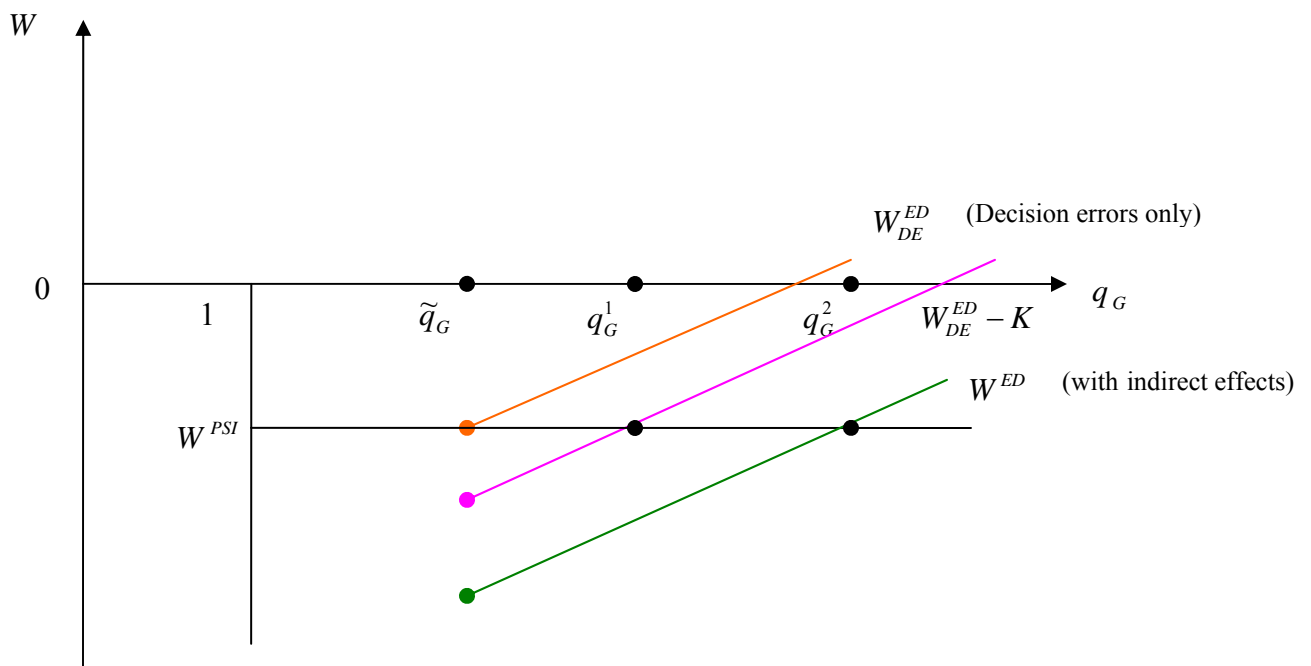
⁴⁵ Proposition 2(ii)

⁴⁶ See below for the implications of this in the case of dynamic industries.

(v) The likelihood that the *ED-Rule* will be the optimal rule is higher with a short litigation cycle relative to the PSI rule, implying that ϕ_D is close to ϕ .

These conclusions can be illustrated in Figure 2 below where for $1 \leq q_G \leq \tilde{q}_G$, $\bar{h}(G) \geq 0$ and it is optimal to use a PSI rule. For $\tilde{q}_G \leq q_G \leq q_G^2$, while an *ED-Rule* is preferable on the grounds of decision error cost minimisation nevertheless the PSI rule is preferable overall when taking into account the deterrent and delaying effects. However for $q_G \geq q_G^2$ the advantage of the *ED-Rule* in terms of direct effects is strong enough, and its disadvantage in terms of *indirect effects* is weak enough that overall it is preferable.

Figure 2



Corollary 2:

So far we have compared decision rules on the assumption that everything else is the same – in particular that the penalty, s , and the cost of reversing the action, C , are the same. But there is no reason why this has to be the case and, in the light of the above discussion, it might seem sensible to consider policy packages, whereby s and C were conditioned on the decision rule used. In particular we have

Proposition 6

In conditions where the alternative to an *ED-Rule* is PSL, then having no fines and not requiring a reversal of actions when using an *ED-Rule* would mean that, ignoring implementation costs, the *ED-Rule* is preferable to **Per Se**.

Note that the optimal fine under Per Se Illegality is $s = \bar{h}/p$. The literature on optimal fines has considered only the extreme case of Per Se rules and Perfect Differentiating ($p_G = p_R = 1$). Under Perfect Differentiating the optimal fine would be $s^{PD} = [h_2 / \lambda^{ED}] + \tilde{\kappa}$ where $\tilde{\kappa} > 0$ is the social cost of differentiating a specific case⁴⁷. Since $h_2 > \bar{h}$ and $\lambda^{ED} < p$ this is higher than the fine under Per Se Illegality. The literature has not yet considered optimal fines for the case in which differentiating is imperfect – as in the present paper. Nevertheless, our framework suggests that there are important links between a CA's fine policy and its choice of decision rule. Thus, a more systematic analysis of the optimal policy package configuration should be the subject for future research.

Section 5 Notes on Applying the Framework and a Preliminary Application to Optimal Procedures in Dynamic Industries

In this section we illustrate how the framework we have developed might be applied in specific contexts. To start with, as noted by Salinger (2006), there are three sets of factors that according to decision theory should enter the consideration of legal rules. To quote, these are:

- 1) What do we know about anticompetitive aspects of the practice? What is the underlying theory of how it can be anticompetitive? When it is, what is the cost to consumers and to economic welfare? (That tells us about the error cost of permitting anticompetitive instances.) How often is the practice anticompetitive? [In our context this involves forming presumptions about h_2 and about γ].
- 2) What do we know about the pro-competitive uses of the practice. What is the nature of the pro-competitive benefit? When the practice is pro-competitive, how large are the gains from it? (That tells us about the error cost of inadvertently chilling pro-competitive instances of it.) How often is the practice pro-competitive or competitively neutral? [This involves forming a presumption about h_1 and thus, given the above, about \bar{h}].
- 3) What sort of tests might one use to identify anticompetitive instances? For any such test, what is the risk that it will label a pro-competitive instance as anticompetitive and what is the risk that it will fail to catch an anticompetitive instance? [This involves forming presumptions about the value of p_G , if $\bar{h} < 0$ and of p_R , if $\bar{h} > 0$].

⁴⁷ See also Kaplow (1995).

As Salinger then notes, “No one seriously supposes that we can objectively measure all of these factors. In particular, there is no practical way to take a random sample of instances of a particular practice like tying or bundled discounts and assess the relative frequency of pro-competitive and anticompetitive instances. Still, any policy implicitly rests on judgments about these factors, so it is useful to form subjective estimates of the answers when objective measures are not available”⁴⁸.

Hylton and Salinger (2004) and Alborn, Evans and Padilla (2005) applied the error-cost minimising framework to the practices of tying and refusal to license, respectively. Our framework formalises and extends this framework by taking into account a number of additional considerations and indirect effects. Applying our framework to a specific practice would involve the following:

1. As in the decision error cost minimising approach just described, form presumptions about the values of γ , h_1 and h_2 and thus about \bar{h} .
2. After a careful reading of all the latest economic research on the practice form presumptions about the value of p_G , if $\bar{h} < 0$ and of p_R , if $\bar{h} > 0$.
3. Thus deduce the risk of labelling a pro-competitive case as anticompetitive and the risk of labelling an anticompetitive case as pro-competitive.
4. Form a presumption of the deterrence effect taking into account the potential costs of reversing actions – their potential size and whether there exist good substitutes for the action under consideration that firms can use – the fines policy, and the probability of detection.
5. Assess the potential length of the litigation cycle relative to the product cycle for the industry under consideration.

Doing the above on any one practice would require a separate article. However, one of the most interesting and important issues in recent debates on implementing Competition Policy concerns the issue of how the characteristics of dynamic industries affect the factors that determine the optimal design of competition policy procedures.⁴⁹ Using the approach developed above it is possible to delineate here a number of characteristics that are relevant and examine their implications:

Firstly, as Ahlborn, Denicolo, Geradin and Padilla (2006) note, in dynamic industries with rapid innovation the value of h_1 (the welfare loss from wrongly condemning a benign action) is likely to be much higher than h_2 (the welfare gain from disallowing a harmful action). For many practices, such as tying, for which γ can be presumed to be small, this would suggest that $\bar{h} \leq 0$ and that a PSL rule is the optimal Per Se rule.

⁴⁸ “Looking for the keys under the Lamppost: Insights from Economics into Standards for Unilateral Conduct”, prepared for Comments for ABA Section of Antitrust Law. See also his paper with Hylton (2004).

⁴⁹ For an overview of the main issues relating competition policy to innovation see Shapiro (2002).

Secondly, as Easterbrook (1992) has argued it is likely that “the litigation life cycle is much longer than the product life cycle in rapid technological change industries”. In our context this implies that $\phi_D = 1$. Given $\bar{h} \leq 0$, then as shown above, this is sufficient to prove that PSL would be superior to any *ED-Rule*.

Thirdly, even if $\phi_D < 1$, the cost of implementing *ED-Rules*, $K(\cdot)$, is likely to increase as the difficulty of differentiating between benign and harmful actions is much greater in dynamic industries. This is so as the standard criteria for differentiating harmful from benign cases suggested by static models (such as market shares and concentration) are not going to be equally useful in dynamic industries. (see for example Evans and Schmalensee, 2002 and Ahlborn et.al. 2001). This would again tend to make Per Se Legality the optimal procedure (in Figure 1 the $W_{DE}^{ED} - K(\cdot)$ curve will shift downwards).

Fourthly and finally, another characteristic of dynamic / new economy sectors is that firms will have to support their innovative activity through large sunk investments. This increases the cost (C) to the firms in the event of having to reverse any of their actions that are condemned by antitrust authorities. This raises the value of \underline{b}^{ED} and hence of $F(\underline{b}^{ED})$ - increasing the negative deterrent effect of *ED-rules*. (in Figure 2, the W^{ED} curve with indirect effects will shift downwards). This again raises the likelihood that PSL is the best decision rule.

Thus a number of important considerations suggest that Per Se Legality rules are more likely to be optimal in dynamic industries than in other industries.

Section 6 Conclusions and Directions for Future Research

This paper attempts a systematic formal analysis of **Per Se** and **Rule of Reason** procedures in Competition Policy implementation, which takes into account both the direct and indirect implications of such procedures. It is motivated by the increasing emphasis that has been placed in recent years by academics, policy makers and practitioners on the use of a more economics-based approach to improve the quality of Competition Authority decisions and the parallel emphasis on adopting a decision error-cost minimisation approach in selecting decision rules or standards.

Our analysis of the choice of decision rules captures the effects of decision errors and also the important indirect effect of different rules in deterring firms to take specific actions. We also address the effects of the length of the litigation cycle, of implementation costs, and of antitrust penalties.

A number of interesting results and insights emerge and a number of areas for further future research are suggested by our framework. Many of these were mentioned in the Introduction. An important policy implication suggested by our analysis is that in practice, there could be many cases where Competition Authorities may be using the

wrong Decision rule. Thus they could be using D-rules (or Rule of Reason procedures) when in fact they should be using Per Se rules. This will hold when economic models and available information cannot effectively discriminate between benign and harmful cases - making $\bar{h}(G), \bar{h}(R)$ of different signs – *or* when economic models and available information do allow effective discrimination but there are substantial deterrence effects and / or a long litigation cycle. Alternatively they could be using Per Se rules when D-rules would be optimal, as when the costs of reversing actions are small and economic models can identify with accuracy actions of type 1, in which case deterrence effects will be small and the savings in the costs of decision errors large.

Some **directions for future research** would include:

- Allowing for a total welfare standard for reaching decisions
- Allowing for asymmetric distributions of benefits in the two environments – essentially recognising the correlation between private benefit and social harm.
- Re-examining the comparison of different decision rules in a pre-clearance context where firms have to get permission from a CA before taking action.
- Re-examining two-tier rules, multi-error stages and, more generally, the issue of case selection.
- Examining the design of optimal policy packages (such as fine-tuning antitrust penalties to the decision rules).
- Examining the implications of requiring greater transparency of CAs by requiring them to reveal their model – essentially (p_G, p_R) . If firms know or can learn the model used by the CA then deterrence effects will be asymmetric (there will be a different deterrence effect depending on the type of firm).

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