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Competition Authority Substantive Standards and Social Welfare

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Competition Authority Substantive Standards and Social Welfare[1]

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1. Review: Substantive Standards in the Enforcement of Competition Law – the Debate

Recent years have witnessed a resurgence in the debate concerning the optimal substantive standard to be used in the enforcement of competition law (see, for example, Neven and Roeller, 2000; Lyons, 2002; Carlton, 2007; Farell and Katz, 2006; Fridolsson Sven-Olof (2007), Salop, 2010). Those arguing in favour of a total welfare standard have been pointing out that "overall economic efficiency" should remain the paramount criterion for the assessment of potentially anticompetitive acts and for this the income transfers between agents (consumers/producers) in the economy should be treated as welfare neutral. The proponents of a total welfare standard have stressed that by using such a standard, instead of a consumer surplus one, ALL possible efficiencies that might appear when a firm takes an action are taken into account and the implications of the action on the firm's competitors' profitability.

Proponents of the consumer surplus standard on the other hand have argued that treating all income transfers as welfare neutral may not reflect the common society's judgment of a fair distribution of wealth.

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According to this view, efficiencies that might occur, and which are likely to have an impact on consumer welfare should be taken into account while other efficiencies that just affect the distribution of profit between firms should be ignored.

It is certainly very important that the world's two largest economies, EU and USA, continue to use a pure Consumer Surplus standard in order to appraise firms' practices under competition law.

In the EU, under Art. 101 of the EC Treaty[5], agreements between undertakings and concerted practices which have as their object or effect the prevention, restriction or distortion of competition shall be automatically void. The exception in par. 3 however states that those provisions may be declared inapplicable as long as it "…contributes to improving the production or distribution of goods or to promoting technical or economic progress *while allowing consumers a fair share of the resulting benefit*".

The 2008 Commission's Guidance Paper on Art. 102 EC[6] states (in paragr. 5) that the Commission "will focus on those types of conduct that are most harmful to consumers". In par. 19 of the Paper the Commission reiterates that its aim is to protect consumer welfare and does link the concept of "anticompetitive foreclosure" directly to consumer welfare.

The latest version of Merger Guidelines in US[7] clearly states that "the Agency considers whether cognizable efficiencies likely would be sufficient to reverse the merger's potential harm to consumers in the relevant market, e.g. by preventing price increases in that market". So there must be clear evidence that part of efficiencies passes through to consumers.The Merger Guidelines explicitly suggest that when prices are raised because of a merger,then this merger should be banned irrespective of cost efficiencies for the merging firms. Only if cost savings

[5] Article 101 of the EC Treaty available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12008E101:EN:NOT

[6]Guidance on the Commission's Enforcement Priorities in Applying Article 102 EC Treaty to Abusive Exclusionary Conduct by Dominant Undertakings, Commission of the European Communities, Brussels, 3 December 2008.

[7]U.S. Department of Justice and the Federal Trade Commission, Horizontal Merger Guidelines, (Revised 1997) available at: http://www.justice.gov/atr/public/guidelines/horiz_book/hmg1.html.

are large enough so that they are passed through to consumers and prices do not raise a merger will be allowed.[8]

Salop[9] (2010) reviews the US evidence observed in a large number of specific antitrust issues – including mergers, horizontal agreements, predatory pricing, monopsony conduct, and harm to competitors (from mergers or exclusionary conduct) - and concludes that the standard that has been and is used in USA by antitrust authorities and by courts is the *true* consumer welfare standard. Salop argues that it is not just that authorities and courts apply in practice a consumer surplus standard but that "normative analysis" shows that this is indeed the right approach. He makes three points in this regard:

(i) There is no reason to think that adopting the total welfare standard would maximize long-run consumer welfare

(ii) Adopting the consumer welfare standard does not involve or require using antitrust law to redistribute income and wealth.

(iii) Adopting the total welfare standard would lead to inefficient economic conduct that harms consumers.

On the other hand Carlton (2007) arguing in favor of a total welfare standard puts forward the following points:

(i) A (short run) total welfare standard is more likely to maximize long run consumers surplus than is a (short run) consumer surplus standard, given that efficiencies, like reductions in fixed costs, not taken into account by the latter but taken into account by the former imply, especially in high-tech dynamic industries, enhanced incentives to invest in R&D, mew products and plants – that provide the greatest consumer benefits in the long run. As he notes "By focusing only on efficiencies that influence price over a short period[10], a government agency runs the risk of failing to

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[9] Steven C. Salop, "Question: What is the Real and Proper Antitrust Welfare Standard? Answer: The *True* Consumer Welfare Standard", Loyola Consumer Law Review, September 2010.

[10] Assuming that, in practice at least, competition authorities adopting a consumer welfare standard do not take into account considerations that affect **long-run** consumer welfare.

credit the future efficiencies, which will benefit consumers in the long-run". Salop (2010) counteracts this by pointing out that long run consumer gains depend on the diffusion of innovations which, especially under entry barriers, "is neither instantaneous nor complete".

(ii) The notion that antitrust should focus on consumers, not firms, is premised on a false vision of who are consumers and who are firms. Most transactions in modern economies are between firms, consumers get profits flowing-back to them as shareholders and, finally, if one shows a preference for one group of people "it is a small step in logic to treat different groups of consumers differently" – something that even proponents of the consumer surplus standard would not wish.

(iii) By ignoring upstream sellers' harm, a consumer surplus standard would treat buying cartels as perfectly legal.

In this paper we would like to concentrate on one of the issues in the debate above, related to Salop's point (iii) – or, to the issue that, as he states: "The adoption of an aggregate welfare standard likely would not require firms to engage in conduct that maximizes aggregate welfare". The point goes back to the clever insight of Lyons (2002) who examined firms choosing among mutually exclusive mergers subject to antitrust constraints. Since Lyons (2002) a number of papers have discussed or further pursued this issue: Farell and Katz, 2006; Nocke V. and M. D. Whinston (2011); Armstrong M. and J. Vickers (2010).

In this paper we generalize the analysis of Lyons (2002) by examining firms belonging to different environments and choosing between mutually exclusive potentially anticompetitive actions of **any type.** The extent to which actions of some specific type influence welfare depends on the price-cost margin raising and cost reducing effects of these actions and on how uncompetitive is the environment in which the firms operate. Considering first actions that are equivalent in terms of their cost reducing potential, total welfare for any given environment is smaller when higher-profit actions are chosen. And, higher profit actions may pass a total welfare standard but not a consumer welfare standard. So, having a consumer welfare standard may push firms to choose lower-profit actions which result in higher welfare than would higher-profit actions, which would be chosen under a total welfare standard. This is what might be termed the Lyons Effect. We characterize the circumstances under which the Lyons effect will emerge and under which it will not emerge. We then examine the case of actions also differing in their cost-reducing capacity. We show that in this latter case the Lyons Effect is less likely to emerge.

2. Basic Assumptions and a Model

2.1Basic Assumptions

Suppose that a number of firms from a range of environments are considering taking alternative mutually exclusive actions of a specific type (e.g. alternative bundling strategies or alternative rebate schemes) OR (?) mutually exclusive actions of different types (e.g. alternative exclusionary practices) which will result in their increasing their price-cost margin but can also have some efficiency benefits of driving down their costs. There may be many potential actions of this type any one firm can take, each associated with particular levels of cost reduction and increase in the price-cost margin. In particular we always allow for the default action of doing nothing and so neither increasing price nor lowering cost. Firms can choose which action within this class to take.

In making this decision firms take account of the possibility that a Competition Authority (CA) will assess their action and, if it is ruled to be anti-competitive in the light of the specific criterion used by the CA, their action will be disallowed and they will have to pay a penalty.

Here we assume that:

(i) all actions that are taken will be detected and assessed by the CA – in other words, the coverage rate is unity;

(ii) the CA can determine absolutely accurately whether or not the action is anti-competitive in the light of its criterion – there are no Type 1 or Type II errors;

(iii) there is no delay by the CA in reaching this decision.

We consider two different standards the CA might use:

- a consumer surplus standard
- a total welfare standard that is the sum of both consumer and producer surplus (profit).

We assume that firms know what standard the CA will use and have the capacity to determine what impact any action they take will have on the welfare standard (consumer surplus or total welfare) used by the CA. Given our assumptions about the capacity of the CA, firms will anticipate making negative profits if they take an action that produces a negative value of the CA's standard, but a positive profit if the action does not. Firms will choose the action that gives them the highest private benefit given the anticipated reaction of the CA. Since the default action will not produce a negative value of either standard firms will always make non-negative profits.

We are interested in how social welfare depends on the criterion / standard being used by the CA. To consider this we will use the following model.

2.2 *The Model*

Suppose that for all firms the default position is one in which there are no competition policy concerns. In particular assume that this is a position in which price has been driven down to marginal cost so there is no mark-up of price over cost. Normalise so that price and costs in this default position are 1. So $p^0 = c^0 = 1$.

Consider now a typical firm that takes a typical action that has two effects:

- It lowers costs to $c^1 = c^0 - \Delta c,\ 0 \le \Delta c < 1$
- It raises the firm's price-cost margin by $\Delta m \ge 0$ so that $p^1 = c^1 + \Delta m$.

Putting these together we get:

$$\Delta p = p^1 - p^0 = \Delta m - \Delta c$$

so the price can rise or fall depending on the balance of these two effects.

Of course, the increase in the price-cost margin cannot be just anything – for example it makes no sense to think of firms charging a higher price than under monopoly. We assume that the price-cost margin is just some fraction of that which the firm would have charged had it been a monopolist. In order to work out the price-cost margin under monopoly, we need to specify in more detail the environment from which this typical firm comes.

Assume that a typical firm faces an inverse demand function:

$$p = (1 + bQ^0) - bQ \qquad (1)$$

where $Q^0 > 0$ is the output that the firm will produce in the default position and so is a parameter that reflects the intensity of demand in the market in which the firms operates, and $b > 0$ is the slope of the inverse demand curve.

Notice that the inverse elasticity of demand in the default position where $p = p^0,\ Q = Q^0$ is

$$\varepsilon = -\frac{dp}{dQ}.Q^0 = bQ^0. \qquad (2)$$

The parameter ε therefore provides a measure of the potential opportunities for raising price that a firm might face if it can exercise some market power. Put differently it provides a measure of how potentially uncompetitive is the market in which a firm operates.

In all that follows we will use this parameter ε as a one-dimensional representation of the *environment* from which a firm comes, and the larger is ε the more uncompetitive is the environment. We do this by assuming that $b = 1$ and that the markets in which various firms operate differ solely in terms of $\varepsilon = Q^0$. It follows from (2), that $\Delta Q = -\Delta p$.

Given the demand function it is straightforward to show that the price-cost margin of the firm if it were a monopolist with unit costs c^1 is

$$M = \frac{\Delta c + \varepsilon}{2} \qquad (3)$$

As indicated above, we assume that by taking an action a firm increases the price-cost margin by some fraction (μ) of what it could charge under monopoly. Accordingly we now assume that under a typical action the increase in the price-cost margin set by the firm will be:

$$\Delta m = \mu(\Delta c + \varepsilon),\ \ 0 \le \mu \le \frac{1}{2} \qquad (4)$$

From now on an *action* will be characterised by the pair of parameters $(\mu,\ \Delta c)$, and denoted by $a = (\mu,\ \Delta c)$.

We then have

$$\Delta p = \Delta m - \Delta c = \mu\varepsilon - \Delta c(1-\mu) \qquad (5)$$

$$\Delta Q = -\Delta p = \Delta c(1-\mu) - \mu\varepsilon \qquad (6)$$

and so

$$Q^1 = Q^0 + \Delta Q = (1-\mu)(\varepsilon + \Delta c) > 0. \qquad (7)$$

Two points to notice:

- From (5), whether or not the price rises or falls depends in part on the nature of the action taken, and in part on the environment from which the firm comes. In particular, if $\mu > 0$, and $\Delta c > 0$, then, in very competitive environments (those with very low inverse elasticities, ε) prices will fall, while in very uncompetitive environments (those with large inverse elasticities ε) prices will rise.
- From (7), the post-action output is positive – whatever the action and whatever the environment.

We now calculate the change in consumer surplus, profits and hence total welfare when a typical firm takes a typical action.

It is straightforward to see that the change in *consumer surplus* is given by:

$$\Delta CS = -\Delta p\left(Q^0 + \frac{\Delta Q}{2}\right) = (\Delta c - \Delta m)\left(Q^0 + \frac{\Delta Q}{2}\right) \qquad (8)$$

and so, as expected, the sign of this will be driven entirely by the change in price. Substituting (5) and (6) into (8) we get:

$$\Delta CS = \frac{1}{2}[\Delta c - \mu(\Delta c + \varepsilon)][\varepsilon + (1-\mu)(\Delta c + \varepsilon)] \qquad (8')$$

i.e. $$\Delta CS = \frac{1}{2}\{[(1-\mu)(\Delta c + \varepsilon)]^2 - \varepsilon^2\} \qquad (9)$$

The increase in *profits* (private benefit) from taking the action is

$$\Delta\pi = \Delta m.Q^1 = \Delta m.(Q^0 + \Delta Q), \tag{10}$$

so substituting (4) and (7) we get:

$$\Delta\pi = \mu(\Delta c + \varepsilon)(1-\mu)(\varepsilon + \Delta c) = \mu.(1-\mu)(\Delta c + \varepsilon)^2 \tag{11}$$

The change in total welfare is just the change in profits (producer surplus) plus consumer surplus, and so, from (8) and (10) we have

$$\Delta W = \Delta\pi + \Delta CS = \Delta c.Q^0 + \frac{\Delta Q}{2}.(\Delta c + \Delta m). \tag{12}$$

The first term is positive and shows the benefits to society from a reduction in costs if output were to remain at its original level. The second term reflects the impact of the change in output. If price falls and consequently output increases then there is an unambiguous increase in welfare since the change in both consumer surplus and producer surplus are both positive. However if the net result of the action is to drive prices up and so cause output to fall, then while society benefits from the fall in costs it loses from the reduction in output and overall welfare might fall. This will happen when the reduction in costs is very small.

By directly adding (9) and (11) and then simplifying, or, equivalently, by substituting (4) and (6) into (12) one finds that

$$\Delta W = \Delta c.\varepsilon + \frac{1}{2}\{(\Delta c)^2 - [\mu(\Delta c + \varepsilon)]^2\} \tag{13}$$

or, equivalently,

$$\Delta W = \Delta c.\varepsilon + \frac{1}{2}[\Delta c - \mu(\Delta c + \varepsilon)][\Delta c + \mu(\Delta c + \varepsilon)]. \tag{14}$$

Expressions (9), (11) and (13) show how the change in consumer surplus, profit and hence total welfare depend on

- the nature of a typical action as captured by $(\mu,\ \Delta c)$;
- the nature of the environment from which a firm comes, as captured by the inverse price elasticity, ε.

We now want to understand in more detail the nature of this relationship. There are a number of points to note.

First, the default case where no action is taken can be thought of as taking the default action characterised by the pair (0,0), in which case the change in consumer surplus, profit and welfare are all zero irrespective of the environment from which a firm comes.

Second for any non-trivial action $\left(\frac{1}{2}, 1\right) \gg (\mu,\ \Delta c) \gg (0{,}0)$ we have the following results:

- The change in *consumer surplus* is, from (8), a strictly increasing function of Δc and a strictly decreasing function of μ. Also, from (8'), if $\varepsilon < \underline{\varepsilon} = \frac{\Delta c(1-\mu)}{\mu}$ then the change in *consumer surplus* is positive, while if $\varepsilon > \underline{\varepsilon} = \frac{\Delta c(1-\mu)}{\mu}$ it is negative. In other words, as we would expect that:
  - consumers benefit from lower costs and lose from an increase in the price-cost margin;
  - and, using a consumer surplus standard, there is a critical value of the inverse price elasticity such that the action is beneficial if the environment is more competitive than that determined by this critical value, and harmful when it is less competitive.
- For **any** environment and **any** non-trivial action, the change in *profits* is positive and is, from (11), a strictly increasing function of both Δc and μ and also of ε. So, as we would expect:

- firms benefit from both lower costs and anything that allows them to charge a higher price-cost margin;
- The more uncompetitive is the environment the bigger is the increase in profits.

- The change in *total welfare* is, from (13), a strictly increasing function of Δc and a strictly decreasing function of μ. If $\varepsilon < \underline{\varepsilon} = \frac{\Delta c(1-\mu)}{\mu}$ then the change in *total welfare* is positive. It is easy to see that there exists a $\bar{\varepsilon} > \underline{\varepsilon} = \frac{\Delta c(1-\mu)}{\mu}$ such that the change in total welfare is positive if $\varepsilon < \bar{\varepsilon}$ and negative if $\varepsilon > \bar{\varepsilon}$. So:
  - while everyone in society benefits from a reduction in costs, the loss to consumers from an increase in the price-cost margin outweighs the benefit to firms and overall total welfare falls.
  - and, using a total standard, there is a critical value of the inverse price elasticity such that the action is beneficial if the environment is more competitive than that determined by this critical value, and harmful when it is less competitive;
  - the critical value of the inverse price elasticity is higher for a total welfare standard than for a consumer standard, so, as we would expect, there are environments which would be judged to be harmful using a consumer surplus standard but benign using a total welfare standard.

3. Comparison of Welfare Standards

The above results immediately tell us that if there is just a single non-trivial action that firms can take, then welfare is higher under a total welfare standard than under a consumer surplus standard.

The reason is as follows.

1. When firms come from an environment for which $\varepsilon < \underline{\varepsilon} = \frac{\Delta c(1-\mu)}{\mu}$ then the action will be taken under both a consumer surplus and a total welfare standard.
2. When firms come from an environment for which $\varepsilon > \bar{\varepsilon}$ then the action will not be taken under both a consumer surplus and a total welfare standard.
3. However when firms come from an environment for which $\frac{\Delta c(1-\mu)}{\mu} = \underline{\varepsilon} < \varepsilon < \bar{\varepsilon}$ then the action will not be taken under a consumer surplus standard but will be taken under a total welfare standard and this will contribute positively to aggregate social welfare.

What happens when there is more than one non-trivial action?

Drawing on the framework developed above, we can pose this question in very general way. So suppose that there are $n > 1$ non-trivial actions, indexed $j = 1,\ldots,n$. Index the trivial action by $j = 0$, and let $\Delta CS(j,e)$, $\Delta\pi(j,e)$, $\Delta W(j,e)$ be the changes in consumer surplus, profits and total welfare from action $j = 0, 1,\ldots,n$ when a firm comes from some environment which we will index by a parameter $e > 0$.

Assume that:

1. For all $e > 0$ $\Delta CS(0,e) = \Delta\pi(0,e) = \Delta W(0,e) = 0$.

2. For all $j > 0$, $\exists \underline{e}_j > 0$ such that
    a. $\Delta CS(j,e) > 0 \; if \; e < \underline{e}_j$;
    b. $\Delta CS(j,e) < 0 \; if \; e > \underline{e}_j$;
3. For all $j > 0$ and for all $e > 0 \quad \Delta\pi(j,e) > 0$
4. For all $j > 0$, $\exists \bar{e}_j > \underline{e}_j$ such that
    a. $\Delta W(j,e) > 0 \; if \; e < \bar{e}_j$
    b. $\Delta W(j,e) < 0 \; if \; e > \bar{e}_j$.

Under any welfare standard each firm will choose the action that maximises their private benefit subject to the constraint that the relevant welfare standard is not negative.

So let:

$$\hat{\jmath}^{CS}(e) = \operatorname{argmax}_j \Delta\pi(j,e) \; s.t. \; \Delta CS(j,e) \geq 0 \tag{15}$$

be the action chosen by a firm from environment *e* under a consumer surplus standard and

$$\hat{\jmath}^{T}(e) = \operatorname{argmax}_j \Delta\pi(j,e) \; s.t. \; \Delta W(j,e) \geq 0 \tag{16}$$

be the action chosen by a firm from environment *e* under a total welfare standard.

Notice that this allows the possibility that firms choose the default action of doing nothing.

Let:

$$\bar{\Delta W}^{T}(e) = \Delta W[\hat{\jmath}^{T}(e), e] \tag{17}$$

be welfare generated by a firm from environment *e* under a *total welfare standard*, and

$$\bar{\Delta}\bar{W}^{CS}(e) = \Delta W[\hat{j}^{CS}(e), e] \quad (18)$$

be welfare generated by a firm from environment *e* under a *consumer surplus standard*.

So the question is which of these two is higher – both for specific environments and in aggregate when account is taken of the distribution of firms across different environments.

To answer this, assume *n* = 2, and go back to the explicit framework we have worked out above. Let us simplify even further, and, firstly, confine attention to the comparison of two actions with the same value of Δc and which consequently differ solely in μ, the extent to which they increase the price-cost margin. Let $e = \frac{\varepsilon}{\Delta c}$ now denote the variable that captures the impact of the environment. By substituting this into (9), (11) and (13) we find that the changes in consumer surplus, profits and welfare are all proportional to the square of Δc and so we can effectively ignore this constant in all our analysis. Then we can re-write (9), (11) and (13) as

$$\Delta CS(\mu, e) = \frac{1}{2}\{[(1-\mu)(1+e)]^2 - e^2\} \quad (19)$$

$$\Delta\pi(\mu, e) = \mu(1-\mu)(1+e)^2 \quad (20)$$

$$\Delta W(\mu, e) = e + \frac{1}{2}\{1 - [\mu(1+e)]^2\} \quad (21)$$

The crucial features are that:

- Both ΔCS and ΔW are strictly *decreasing* functions of μ, but strictly concave quadratic functions of *e* and so inverse U-shaped in *e*;

- $\Delta\pi$ is a strictly increasing function of μ and a strictly increasing but convex function of *e.*

It follows that for **any** increase in the price-cost margin, μ, there are critical values:

- $\underline{e}(\mu) = \frac{1}{\mu} - 1 > 0$ such that: $\Delta CS(\mu, e) > 0 \ \forall e < \underline{e}(\mu)$; $\Delta CS(\mu, e) < 0 \ \forall e > \underline{e}(\mu)$;
- $\bar{e}(\mu) > \underline{e}(\mu)$ such that $\Delta W(\mu, e) > 0 \ \forall e < \bar{e}(\mu)$; $\Delta W(\mu, e) < 0 \ \forall e > \bar{e}(\mu)$.

These curves are illustrated in Figure 1.

Figure 1 here

Consider two actions $a_j = (\mu_j, \Delta c),\ j = 1,2 \ with \ 0 < \mu_1 < \mu_2 < \frac{1}{2}$. Then action 2 is more profitable than action 1 and so will be chosen whenever both are available, though that will lead to lower total welfare. If we define $\underline{e}_j = \underline{e}(\mu_j),\ \bar{e}_j = \bar{e}(\mu_j),\ j = 1,2$. then:

- $0 < \underline{e}_j < \bar{e}_j,\ j = 1,2$
- $0 < \underline{e}_2 < \underline{e}_1;\ \ 0 < \bar{e}_2 < \bar{e}_1$

Figure 2 illustrates the two function $\Delta W_j(e)$, $j = 1,2$ as functions of the environment *e* and also locates the points $\underline{e}_j,\ \bar{e}_j\ j = 1,2$

Figure 2 here

Consider first what happens under a total welfare standard.

- For $0 < e < \bar{e}_2$ both actions 1 and 2 generate positive total welfare and so both will be allowed. Hence action 2 will be chosen, generating welfare $\Delta W_2(e)$.

- However for $\bar{e}_2 < e < \bar{e}_1$ only action 1 generates positive total welfare and so it will be chosen, thus generating welfare $\Delta W_1(e)$.
- Finally for $e > \bar{e}_1$ neither action generates positive welfare, so the default action will be chosen generating welfare = 0.

So

$$\widetilde{\Delta W}^T(e) = \begin{cases} \Delta W_2(e), & 0 < e < \bar{e}_2 \\ \Delta W_1(e), & \bar{e}_2 < e < \bar{e}_1 \\ 0, & e > \bar{e}_1 \end{cases} \qquad (22)$$

Now suppose that a consumer surplus standard is used. We then have the following.

- For $0 < e < \underline{e}_2$ both actions 1 and 2 generate positive consumer surplus and so both will be allowed. Hence action 2 will be chosen, generating welfare $\Delta W_2(e)$.
- However for $\underline{e}_2 < e < \underline{e}_1$ only action 1 generates positive consumer surplus and so it will be chosen, thus generating welfare $\Delta W_1(e) > \Delta W_2(e)$.
- Finally for $e > \underline{e}_1$ neither action generates positive consumer surplus, so the default action will be chosen generating welfare = 0.

So

$$\widetilde{\Delta W}^{CS}(e) = \begin{cases} \Delta W_2(e), & 0 < e < \underline{e}_2 \\ \Delta W_1(e), & \underline{e}_2 < e < \underline{e}_1 \\ 0, & e > \underline{e}_1 \end{cases} \qquad (23)$$

Putting this together we get 5 cases depending on the environment:

- For $0 < e < \underline{e}_2$ both actions 1 and 2 generate positive *consumer surplus and hence* positive *total welfare* and so both will be allowed under both standards. Hence, action 2 will be chosen, and so $\bar{\Delta W}^{CS}(e) = \bar{\Delta W}^{T}(e) = \Delta W_2\,(e)$

- For $\underline{e}_2 < e < \underline{e}_1$ only action 1 generates positive *consumer surplus*, though both will generate positive *total welfare*. So action 1 will be chosen under a *consumer surplus* criterion while action 2 will be chosen under a *total welfare* criterion. So we have $\widetilde{\Delta W}^{CS}(e) = \Delta W_1\,(e) > \Delta W_2(e) = \widetilde{\Delta W}^{T}(e)$ so a *consumer surplus* standard generates higher welfare than a *total welfare* criterion in this range of environments. This is the *Lyons (2002) effect.*
- For $\underline{e}_1 < e < \bar{e}_2$ neither action generates positive *consumer surplus* ,and so neither would be chosen under a *consumer surplus* standard and only the default action would be chosen. However both generate positive total welfare and so since both would be available under such a standard 2 will be chosen. Hence on this interval, welfare is higher under a total welfare standard since $\widetilde{\Delta W}^{T}(e) = \Delta W_2\,(e) > 0 = \widetilde{\Delta W}^{CS}(e)$.
- For $\bar{e}_2 < e < \bar{e}_1$ only action 1 generates positive total welfare and so only it will be chosen under a total welfare criterion, but since neither action generates positive consumer surplus on this interval neither will be chosen under a consumer surplus criterion. Hence, welfare is higher under a total welfare standard since $\widetilde{\Delta W}^{T}(e) = \Delta W_1\,(e) > 0 = \widetilde{\Delta W}^{CS}(e)$.
- Finally for $e > \bar{e}_1$ neither action generates positive welfare and so, a fortiori, neither generates positive surplus. Hence under both standards only the default action will be chosen, generating zero welfare, so , on this interval $\widetilde{\Delta W}^{CS}(e) = \widetilde{\Delta W}^{T}(e) = 0$.

Proposition 1

Overall we see that there is one interval, $\underline{e}_2 < e < \underline{e}_1$ for which welfare is higher under a consumer surplus standard, since here using such a standard forces firms to use the less profitable action 1 thus generating higher total welfare.

However there is another interval $\underline{e}_1 < e < \bar{e}_1$ for which welfare is lower under a consumer surplus standard since the use of a such a standard forces firms to do nothing, so generating zero welfare whereas under a total welfare standard there is always one non-trivial action that will be chosen and this generates positive welfare.

So if there are actions that increase profits but lower both consumer surplus and also welfare, then using a consumer surplus criterion can increase welfare in those cases where it restricts choice but still leaves firms with a non-trivial action they can take. However using such a standard will lower welfare when it restricts choice to just the trivial action, while there are non-trivial actions that contribute positively to welfare.

4. Extension: Comparison when Actions Differ in two Dimensions

So far we have considered actions which differ only in the price-cost margin. It is worth considering what happens in the more general case where actions differ also in the extent of their cost reduction.

To analyse this, consider again the case where there are just two non-trivial actions. Since actions differ in both their cost reduction and the extent to which they generate higher price-cost margins, they are no longer one-dimensional and so, as before, $a_i = (\mu_i, \Delta c_i),\ \ i = 1,2$. As above we assume that action 2 is such that it generates a bigger increase in the price-cost margin, so $0 < \mu_1 < \mu_2 < \frac{1}{2}$.

We can get some simplification by defining $e = \frac{\varepsilon}{\Delta c_1}$; $k = \frac{\Delta c_2}{\Delta c_1}$. Then, ignoring the common constant $(\Delta c_1)^2$ to which consumer surplus etc will be proportional under both actions we have:

$$\Delta CS_1(e) = \frac{1}{2}\{[(1-\mu_1)(1+e)]^2 - e^2\} \tag{24}$$

$$\Delta\pi_1(e) = \mu_1(1-\mu_1)(1+e)^2 \tag{25}$$

$$\Delta W_1(e) = e + \frac{1}{2}\{1 - [\mu_1(1+e)]^2\} \tag{26}$$

and

$$\Delta CS_2(e) = \frac{1}{2}\{[(1-\mu_2)(k+e)]^2 - e^2\} \tag{27}$$

$$\Delta\pi_2(e) = \mu_2(1-\mu_2)(k+e)^2 \tag{28}$$

$$\Delta W_2(e) = ke + \frac{1}{2}\{k^2 - [\mu_2(k+e)]^2\} \tag{29}$$

There are then two cases to consider.

Case 1. $k > 1$

Here action 2 results in a higher price-cost margin but also a greater reduction in costs. This has two implications:

- For all environments action 2 will generate a bigger increase in profits than action 1 and so will always be chosen if both are available;
- But now it is less clear how the two actions compare from the point of view of both consumer surplus and total welfare.

If k is quite close to 1 then everything will be dominated by the increase in the price-cost margin and the previous results will go through.

Consider then the other extreme where the cost differences are very large. In particular consider the situation where $k \geq \frac{\mu_2(1-\mu_1)}{(1-\mu_2)\mu_1}$. This implies that $\underline{e}_2 \geq \underline{e}_1$ and so, whenever action 1 is profitable under a consumer surplus standard, so too is action 2. In this case, under a consumer surplus standard action 2 will always be chosen whenever a non-trivial action is available. Now if action 2 is profitable under a consumer surplus standard it is profitable under a total welfare standard, and so will be chosen when a total welfare standard is used. So:

- Whenever a non-trivial action is chosen under a consumer standard this will be action 2 and this will also be chosen under a total welfare standard so generating the same level of welfare;
- However for those environments for which $\underline{e}_2 < e < \bar{e}_2$ action 2 will be chosen under a total welfare standard while only the trivial action will be chosen under a consumer surplus standard, and so, for these environments it is certainly the case that welfare is higher under a total welfare standard than under a consumer surplus standard.

So we have:

Proposition 2.

If the cost differences are sufficiently large in favour of the action with the higher price-cost margin, specifically if $k \geq \frac{\mu_2(1-\mu_1)}{(1-\mu_2)\mu_1}$ then a total welfare standard welfare dominates a consumer-surplus standard.

<u>Case 2: $k < 1$</u>

Here action 2 generates a greater increase in the price-cost margin but lower reduction in costs than action 1. This has two implications:

- under both a consumer surplus and a total welfare standard action 2 is worse than action 1 in all environments – in particular, $\underline{e}_2 < \underline{e}_1$;
- however it is less clear which of the two actions is more profitable.

To understand this latter point define $\beta = \sqrt{\frac{\mu_1(1-\mu_1)}{\mu_2(1-\mu_2)}}$ so $0 < \beta < 1$.

Then it is possible to show the following:

I. If $\beta \leq k < 1$ then action 2 is more profitable than action 1 in every environment and so the analysis goes through exactly as in the simple case where *k* = 1.

II. If $k < \beta$ then if we let $\tilde{e} = \frac{\beta - k}{1-\beta}$, then action 1 is more profitable than action 2 if $e < \tilde{e}$ while action 2 is more profitable than action 1 if $e > \tilde{e}$. So what matters now is how $\tilde{e}$ relates to $\underline{e}_2$ *and* $\underline{e}_1$. In particular we have:

   a. If $\tilde{e} < \underline{e}_2 < \underline{e}_1$ then the conclusions about the relative welfare levels under a consumer surplus standard and under a total welfare standard go through exactly as in the case where *k* = 1 . That is welfare is higher under a consumer surplus standard (i.e. there is a Lyons effect) if $\underline{e}_2 < e < \underline{e}_1$ but higher under a total welfare standard if $\underline{e}_1 < e < \bar{e}_1$. The only difference is that for $e < \tilde{e}$ then under both a consumer surplus standard and a total welfare standard action 1 is chosen and so private incentives are aligned with social incentives.

   b. If $\underline{e}_2 < \tilde{e} < \underline{e}_1$ then the Lyons effect only operates for $\tilde{e} < e < \underline{e}_1$.

c. If $\underline{e}_1 < \hat{e}$ then there is no Lyons effect and a consumer surplus standard is worse than a total welfare standard.

Proposition 3.

The greater the cost differences in favour of the action with the lower price-cost margin, that is the further is *k* from 1 then the less likely is the Lyons effect to exist, and it may disappear altogether if *k* lies sufficiently far below 1.

Appendix

Figure 1

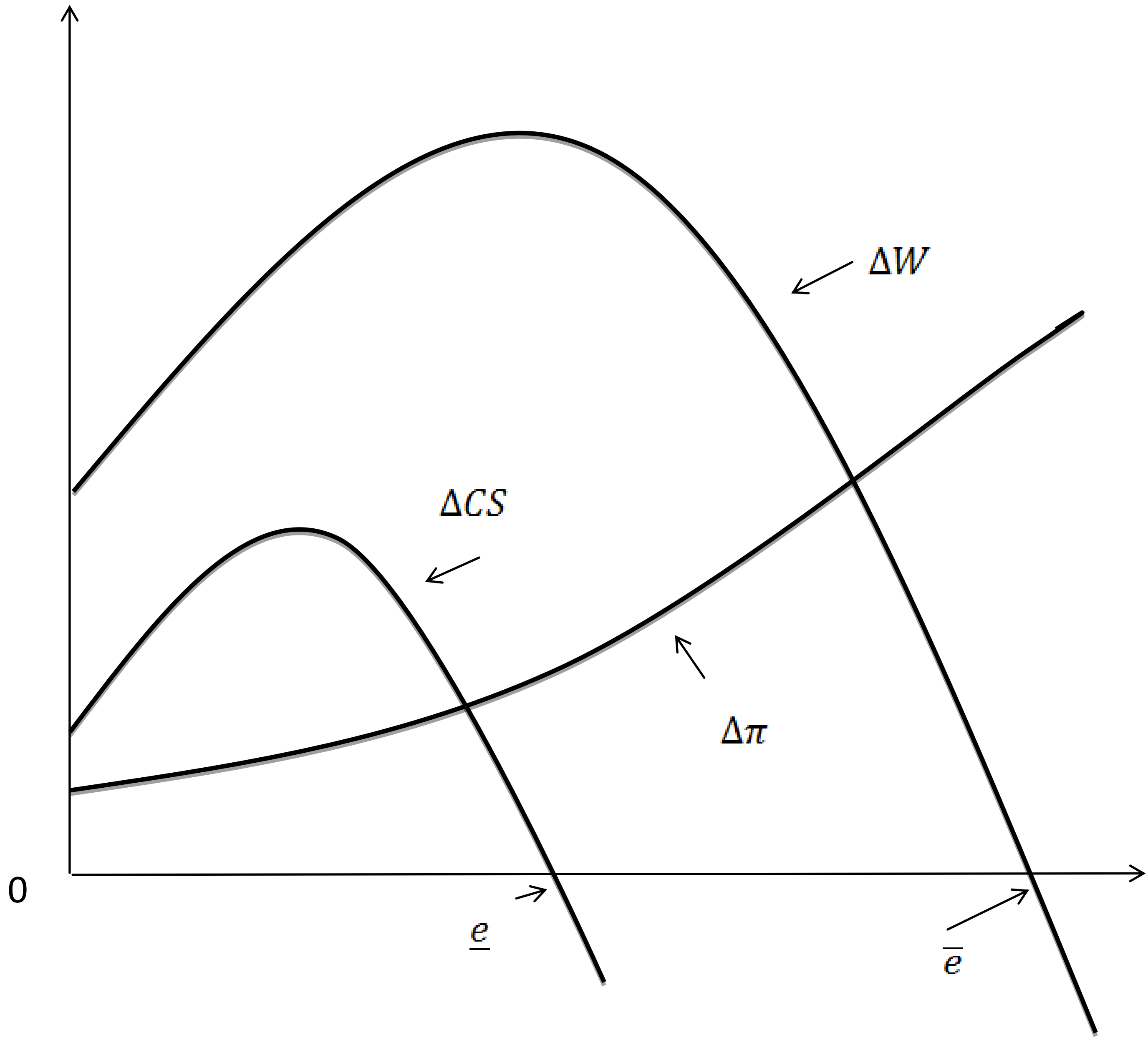
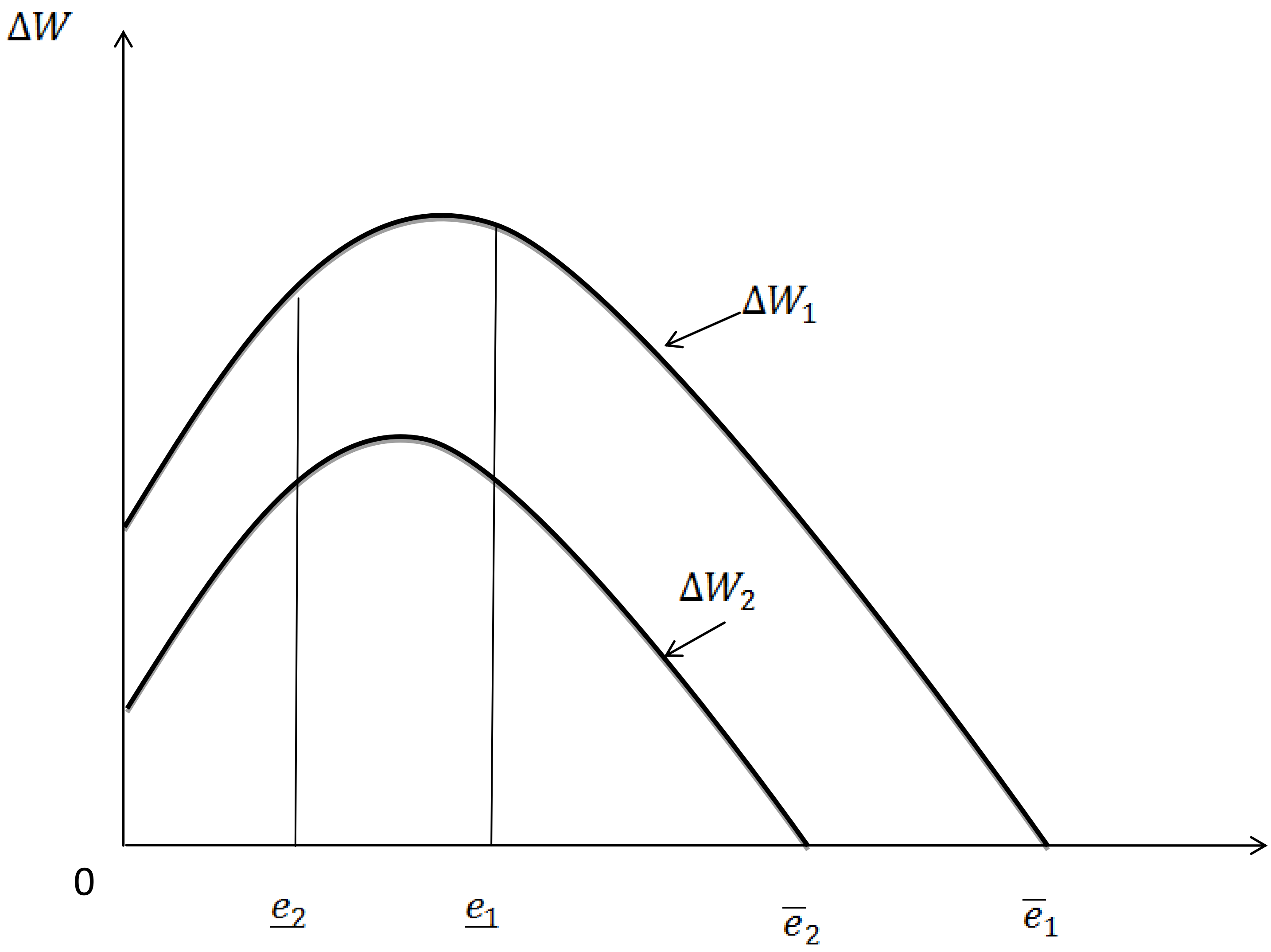


Figure 2



ΔW
ΔW_1
ΔW_2
0
$\underline{e}_2$
$\underline{e}_1$
$\overline{e}_2$
$\overline{e}_1$

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