Welfare Losses When There Are Cost Differences Among Firms

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Recently articles by Daskin (1991) and Aiginger and Pfaffermayr (AP) (1997), building on a model developed by Dixit and Stern (1982), have introduced calculations of industry welfare losses when there are cost differences among firms. This is a departure from standard calculations which make the simplifying assumption of equal costs among firms. Since it is a stylized fact that larger firms have lower unit costs, this is an important departure if, as is the case, very different results are produced.[1] Specifically the traditional literature usually concludes, unless there is monopoly pricing, that welfare losses due to allocative inefficiency are well below one percent of industry revenue.[2] In contrast, without assuming monopoly pricing, Daskin and AP find welfare losses considerably above one percent . For example, Daskin (p. 182) for U.S. manufacturing finds "deadweight loss is roughly 6 - 10 percent of the value of shipments if demand is inelastic or unit elastic" and AP, for their most preferred scenario, find losses close to eight percent of revenue for two European industries.

At face value then, the introduction of cost differences implies previous studies may have seriously underestimated the cost of market power. We shall argue, however, that introducing cost differences cuts two ways. On the one side cost differences can lead to higher welfare losses but on the other side, using only a slightly different perspective, cost differences can imply negligible losses. This is because once the simplifying assumption of identical costs is dropped, an important question becomes why are there cost differences among firms? How this question is answered is crucial to conclusions about the size of welfare loss.

Essentially there are two explanations of cost differences. The one implicitly adopted by Daskin and AP is that inefficient firms are sheltered by the high price created by the output restricting behaviour of larger more efficient firms. Absent this behaviour, the industry could settle where price matches the unit cost of the most efficient firm, which therefore defines the appropriate benchmark for the measurement of welfare loss. In fact this benchmark is very much like the perfectly contestable equilibrium since it can be described as a Bertrand equilibrium when there are economies of scale or superior efficiencies.

However there is another view on cost differences which suggests another benchmark for measuring welfare loss. This perspective, originating with Demsetz (1973), has been termed the differential efficiency hypothesis (DEH) by Schmalensee (1987). It sees cost differences as efficiency rents rather than as a byproduct of larger firms' market power. Under DEH the pursuit of profit produces cost differences, share differences and profit. This profit is both a reward and inducement to efficiency rather than a return to cooperative or collusive behaviour. After Demsetz, several authors (Cowling and Waterson (1976) Clarke and Davies (1982), Dixit and Stern (1982)) have shown that the non-cooperative Cournot - Nash equilibrium translates cost differences among firms into share differences and profit. From this perspective the Cournot equilibrium as a long-run *non-cooperative* equilibrium, which provides a profit incentive for efficient behaviour but no return for collusive behaviour, could be a reasonable benchmark for defining welfare loss. With this benchmark, welfare losses may occur when output falls below Cournot output because of cooperative output restrictions or, in Schmalensee's terminology, because of differential collusion effects.

This paper deals with these issues by first, for purposes of background and comparison, reproducing in slightly modified form the Daskin and A-P studies for Canadian manufacturing in 1980. By and large we find, for the Bertrand equilibrium benchmark, that the losses are roughly equivalent to those found in Daskin and AP.

We then introduce the Cournot equilibrium as an alternative benchmark and from this reference point explore the welfare implications of more cooperative conduct and more concentrated structure. Unlike the Bertrand case whose reference point is unambiguously defined by the equality of price and best practice marginal cost in an industry, the position of the Cournot coordinate is not so easily identified. Accordingly our solution will be to impose a coordinate by initially assuming that Canadian manufacturing can be described by a Cournot equilibrium and to ask what happens to welfare when conduct or structure are altered. (Although there is no guarantee that Canadian manufacturing can be so described , this exercise will give us an idea of the size of welfare losses associated with this approach.) To examine the effects of changing structure and conduct requires that we make endogenous key variables like concentration, elasticity of demand , costs and price since they will depend on conduct and structure. We do this with a model developed by Clarke and Davies (1982) in which increases in collusion affect not only price but also firms' shares and hence industry costs.

With this model, one of our conclusions is increases in collusion or concentration may not increase welfare losses. This conclusion applies whether we use the first explanation of cost differences and the Bertrand benchmark or the second explanation and the Cournot benchmark. In addition even though we use the Cournot equilibrium as a benchmark to introduce our points, another conclusion is, when cost differences are interpreted as efficiency rents, that the very existence of a clearly defined benchmark is an issue. We conclude, unless one is confident that the first explanation of cost differences dominates across most industries, that the introduction of cost differences does not make the case that market power imposes more costs than previously thought. Instead it shows how slippery statements about welfare loss can be, especially statements based on averages for a broad sample of industries. In the next two sections we present the models for calculating welfare losses for the alternative benchmarks with results. This is followed by a concluding section which includes a discussion of when each benchmark should be used.

II. Cost Differences -the Bertrand Benchmark

To begin we introduce Figure 1 which depicts an industry equilibrium with cost differences. The distinctive feature is that the industry cost curve is a staircase with the lowest cost largest firm having constant unit cost equal to c_1 and output q_1. Other firms on the staircase have higher costs and smaller shares. Average cost in the industry, indicated by c, is the share weighted average cost of each firm i's cost , $c = \sum s_i c_i$.

The traditional literature that submerges differences in costs takes the intersection of industry demand and industry average cost as the reference point and accordingly defines triangle A in Figure 1 as the deadweight loss. The Dixit-Stern modification adopted by Daskin and AP is to take the intersection of the demand curve and the best firm cost level, c_1, as the reference point. This Bertrand point expands the deadweight loss to include not only area A but also areas B and C in figure 1. This larger area can be divided into the triangle A+B which measures the loss imposed by by the divergence between price (P) and best practice marginal cost (c_1), and area C which measures the loss imposed by the existence of high cost firms.

The next task is to measure these areas.[3] The areas of triangles A and A+B can be calculated with the formula (1/2) dP dQ where for triangle A the relevant price distortion is dP = (P - c) and for (A+B) the relevant distortion is $(P - c_1)$. Introducing the industry Lerner index (L) for (P -c)/P and the best firm Lerner index (L_1) for $(P - c_1)/P$ means the relevant areas can be expressed as follows:

(1) $$A = (1/2)(dP/P)(dQ/Q)(PQ) = (1/2)RL^2e$$

In the above R is industry revenue and e is the negative of the industry price elasticity of demand, e = -(dQ/Q)/L. Concentrating on the larger triangle it follows analogously that area A+B is:

(2) $$A+B = (1/2)RL_1^2e$$

Finally given industry output, Q, firm output, q_i, and since firms i's share of industry output is $s_i = q_i/Q$, means that the excess cost area can be calculated as:

(3) $$C = \sum (c_i - c_1)q_i = Q \sum (c_i - c_1)\, s_i = Q(c - c_1)$$

$$\therefore \quad C = Q(P(1-L) - P(1-L_1)) = R(L_1 - L)$$

These results will be more useful if we introduce, from Clarke and Davies (1982), expressions for L_1 and L that characterize the oligopoly equilibrium.

(4) $L_1 = (s_1 + \alpha (1 - s_1))/e$

(5) $L = (H + \alpha (1 - H))/e$

In these expressions H is the Herfindahl index and α is the representative conjectural variation elasticity which is interpreted as a parameter indexing cooperative behaviour.[4] If $\alpha = 1$ we have fully cooperative behaviour and monopoly equilibrium, while if $\alpha = 0$ we have non-cooperative Cournot equilibrium. Substituting for L_1 and L leads to the following revised expressions for A, A+B, C and total welfare loss A+B+C:

(6) $A = (R/2e)(H + \alpha (1 - H))^2$

(7) $A+B = (R/2e)(s_1 + \alpha (1 - s_1))^2$

(8) $C = (R/e)(s_1 - H + \alpha (H - s_1))$

(9) $A+B+C = (R/2e)[(s_1 + \alpha (1 - s_1))^2 + 2(s_1 - H) + 2\alpha (H - s_1)]$

The next step is to use these expressions to measure welfare loss for a 1980 sample of 146 Canadian manufacturing industries. Data on industry revenue and H are available from Statistics Canada but data for s_1, e and α are not. For s_1 we use a proxy introduced by Schmalensee (1976) which uses published data on the four and eight firm concentration ratios.

The proxy assumes that the largest four firms have shares that decline linearly while the next four have equal shares.[5]

For the remaining variables, e and α, we follow the usual approach and make assumptions about plausible values for these and explore how sensitive the results are to the assumptions. For e we take values of .5, 1 and 2 and for α we take values ranging from the non-cooperative $\alpha = 0$ to the fully cooperative $\alpha = 1$.[6]

The results of fitting expressions (6) to (9) to the Canadian data are presented in Table 1. The numbers suggest a wide range of possibilities for welfare loss, some more plausible than others. For example, since Lerner indices must be less than one, or $H + \alpha\,(1\text{-}H)$ must be less than e, implausible or even impossible combinations occur when α is high and e is low. In fact when e=.5 and $\alpha > .5$ some industries in the sample show Lerner indices greater than one. For this reason the only case for which we report results when $\alpha = 1$ is when demand is elastic, i.e, e=2. In fact, even here the full collusion case is degenerate in the sense that it imposes $L_1 = L = (1/e)$ and therefore eliminates excess cost (area C) as a possibility.

Putting aside these extremes, the more plausible cases produce results for total losses (area A+B+C) broadly comparable to Daskin's for U.S. manufacturing and to AP for their two European industries. For example, given e=1 and Cournot equilibrium, total welfare loss in our sample is 10.1 percent which roughly matches Daskin's estimate of about 10 percent when e = 1.

Focusing next on the components of welfare loss and their patterns, and reading down the columns in Table 1 we see that the triangle losses (A and A+B) increase with α for given e, but the excess cost area (C) decreases with α. Total losses however always increase with α. The other pattern is that for given α, higher demand elasticities reduce both the loss triangles and excess cost area. What explains these patterns?

The answer for the triangles A and A+B is straightforward. First for given elasticities, a higher α produces higher markups for both the leading firm and the industry and consequently larger triangles. Similarly for given α, lower demand elasticities produce higher markups and larger deadweight losses. (Although not in Table 1, it is clear from expressions (6) and (7) that higher values for H and s_l produce higher values for A and A+B.)

Explaining the pattern for the excess cost numbers is less straightforward. To help, we recall, from equation (3) that C/R is simply $(L_l - L)$.This means that the numbers in Table 1 imply, given s_l and H, that rising e and α must be associated with a smaller spread in costs or markups (the L's) between the leading firm and industry. To expand on this since, from equations (4) and (5) $(L_l - L) = (1 - \alpha)(s_l - H)/e$, it follows for a given difference between s_l and H, that an increasing e must produce L_l closer to L or smaller cost differences. Similarly a rising α must also produce smaller cost differences given values for s_l, H and e.[7]

Finally, looking at total welfare losses, (A+B+C)/R, Table 1 shows that higher elasticities for given α produce lower losses, while higher α produces larger losses.[8] An interesting point with respect to α is the potential for a trade-off since higher α increases C/R and decreases (A+B)/R. In our sample, though, the total effect is that higher α always leads to higher losses.[9] This is a conclusion that will be modified in the next section.

In summary our results on balance support the earlier papers on key issues. In particular incorporating cost differences among firms greatly increases welfare loss. Furthermore, for plausible cases, by far the most important component is the excess cost rectangle. Given these results as background, our next step is to question these conclusions with alternative measurements based on a different reference point. Until now all cost differences have been interpreted as signs of inefficiency, wherein output restriction generates a high price that protects high cost firms. In the next section we begin with another extreme in which all cost differences are evidence of efficiency.

III Cost Differences - the Cournot Benchmark

In this section we reinterpret Figure 1 using the differential efficiency hypothesis (DEH). Accordingly, we define as the benchmark the Cournot equilibrium which is a non-cooperative equilibrium consistent with rewarding efficiency but not collusive behaviour. This implies a welfare loss when cooperative conduct, indexed by values of $\alpha > 0$, reduces the sum of consumers and producers surplus. We shall also investigate, for given conduct, the welfare implications of industry restructuring which eliminates inefficient firms. Although we shall concentrate on the Cournot benchmark, in principle the effects of more collusive conduct or concentrated structure can be interpreted from either the Bertrand (market power is the problem) or Cournot (efficiency rents) perspectives.

The nature of these tasks can be illustrated with Figure 1. Defining point E as the initial Cournot equilibrium, any increase in α will lead to movement up the demand curve and a new calculation for area A+B+C. The increase in A+B+C, if any, measures the welfare loss from cooperative conduct or, in Clarke and Davies' terms, the "abuse component" of market power. Alternatively, the same loss can be described as the decrease in the net surplus, this being the area underneath the demand curve and above the cost staircase. In a similar way, changes in structure can also be examined for their impact on welfare.

The preceding suggests we should be able to use equation (9) to measure the described welfare losses. However, as indicated in the introduction, there are important complications when the Cournot reference point is used. In the previous section the Bertrand reference was anchored at $P = c_1$, and welfare loss was measured by comparing this to an equilibrium defined by specific values of H and s_1 (from published sources or constructed from these sources) and different assumed values for e and α. Now the Cournot benchmark is itself defined by these values and the question is what happens when the equilibrium is changed by, for example, an increase in α. Among other things, movement up the demand curve will lead to a different e, H and s_1 and consequently a different cost staircase. To measure welfare losses we need to take these effects into account.

This approach is different from the previous section; there we took given existing values for H, s_1 and e, and asked what happened to welfare losses if these values are consistent with different α's. Now we shall allow changes in α to change H, s_1 and e. This endogenizing will produce some modification of our conclusions from the previous section but not of the central point that losses are high when Bertrand is the benchmark.

In the following we introduce the Clarke - Davies model which deals with the identified complications. We then use this model to explore the welfare loss implications in Canadian manufacturing of more cooperative conduct and more concentrated structure.

The Clarke-Davies Model

There are n firms with $c_1 < c_2 \ldots < c_n$, industry average cost is $c = \sum s_i c_i$ and, as in Figure

1, industry demand is P = a-bQ with $Q = \sum q_i$ .We also introduce the simple mean of firm costs, $\mu = \sum c_i/n$ and v which is the coefficient of variation of firm costs, c_i. From the profit maximizing conditions Clarke and Davies derive:[10]

(10) $P^* = ne^*\mu/[n(e^*-\alpha)-(1-\alpha)]$

(11) $c^* = \mu[1 + v^2(1 - n((e^* - \alpha)/(1 - \alpha))]$

(12) $H^* = (1/n) + [1 - n((e^* -\alpha)/(1 - \alpha))]^2 (v^2/n)$

(13) $s_1^* = ((e^*-\alpha)/(1-\alpha)) (1 - c_1/\mu) + c_1/n\mu$

The asterisk for P, c, H, s_1 and e indicates these variables are endogenous since they change with α. .These equations will help us use equation (9) to compute total welfare loss (A+B+C) when the Cournot equilibrium is the benchmark. One more equation is needed to link the elasticity and α. Since for linear demand curves $e^* = P^*/(a-P^*)$, where a is the demand curve intercept, we can substitute the right hand side of equation (10) for P* and obtain:

(14) $e^* = [n\mu + a + a\alpha(n - 1)]/(a - \mu) n$

Now to explain how these equations are used: our approach is to interpret the intersection of linear demand and the cost staircase as the Cournot equilibrium for an industry. At this equilibrium we initialize the arithmetic mean of costs at $\mu = 1$. This together with the given values for H , n and s_1 (all from published sources), e (assumed as before to be .5, 1 or 2), and α ($\alpha = 0$) define the demand curve intercept (from (14) $a = (n + ne)/(ne - 1)$), the unit cost of the most efficient firm (from (13)) $c_1 = (s_1 - e)/((1/n)-e))$ and the square of the coefficient of variation of unit costs (from (12)) $v^2 = (H - (1/n))n/(1 - ne)^2)$. The slope of the demand curve, b, is (a-P)/Q where P is the beginning Cournot price (P=ne/(ne-1)) and Q is measured by industry revenue (from Statistics Canada) divided by Cournot price. These are the parameters that describe an industry and they do not change as α changes. What does change with α, as signified by the asterisks, are P^*, c^*, H^*, s_1^* and e^*. It is these values which will determine, when plugged into welfare loss equations (6) through (9), how A/R, (A+B)/R and (A+B+C)/R change compared to their Cournot benchmark values.

To explain using Figure 1, any $\alpha > 0$ will produce a different cost staircase that will cut the demand curve at a higher price. If the area (A+B+C) grows there is a welfare loss, but what may happen is that increases in α may produce a decrease in (A+B+C) and therefore a welfare gain. A welfare gain is possible because while inspection of equation (10) reveals that $\partial P^*/\partial\alpha > 0$, inspection of (11) reveals $\partial c^*/\partial\alpha < 0$. In fact increases in α reduce industry unit costs because both H^* and s_1^* increase with α.[11]

The Effect of Increased Collusion

To explore the effects of more cooperative conduct we substitute the expressions for H^*, s_1^* and e^* into (9) which defines total welfare loss (A+B+C)/R. The result is an intractable expression in which total welfare loss depends on α and the exogenous parameters. To deal with this we explored the effect on welfare loss for our sample by incrementing α in steps of .01 from 0 to 1. This numerical analysis revealed two patterns in α for the 146 industries. For 91 industries the loss area first decreased, then increased before sharply decreasing below the original Cournot levels as α approached 1. For the remaining 55 industries the loss area decreased monotonically in α.[12] At face value these patterns imply that collusion ($\alpha = 1$) is always a preferred result. The problem with this inference is that the equations of the model are not reliable as α approaches 1 and in fact are not defined at $\alpha =1$. For example as α approaches 1, industry unit cost collapse towards zero (see equation (11)) thus producing increases in welfare.

Because of this problem we cannot find the α that maximizes welfare for the 55 industry sample. For the 91 industry sample we choose optimal α at the first turning point in (A+B+C). To help understand the relationships in each sub-sample, we report in Table 2 the mean for H and n, together with some of the characteristics of the 91 industry sample at optimal α. First we note that the 55 industry sample, by comparison to the other sample, has much higher concentration (H). This concentration is considerably higher than (1/n), the value for H when firms have equal costs. We conclude that because there is greater share inequality for this sample, cost differences among firms are more important and the beneficial cost effects of higher α are greater. The adverse price effects of higher α do work against the cost effects but not before the computational problems that occur as α approaches one dominate the results. In contrast for the 91 industry sample, where share differences and hence cost differences are smaller, the efficiency advantages from increasing α are soon offset by market power effects.

In fact, as shown in Table 2, the optimal α for this sample (.047) is very close to the

Cournot solution. (If we could observe an optimal α for the 55 industry sample we would expect it to be higher than this because of stronger cost effects). In addition the average H changes only a little (from .058 to .069), and for the e= 1 case the elasticity increases only to e = 1.09. Concerning welfare, the effects are also small, since the area (A+B+C) is only .05 percent smaller than in Cournot, i.e., there is a welfare gain of .05 percent of revenue in moving from Cournot equilibrium to the optimal α equilibrium. Unlike the modelling in the previous section, increases in α can now reduce (A+B+C) since α now changes s_1 and H.

The idea that there are welfare gains points out how difficult is the problem of defining appropriate benchmarks and consequent welfare losses. We chose, so that we could get started, a Cournot-Nash equilibrium consistent with a differential efficiency hypothesis and zero collusion. However, one could argue that the appropriate benchmark should be the equilibrium consistent with optimal α. We will return to this issue in the conclusion.

The Effects of Changing Structure

The results for the effects of changing conduct are interesting but, especially for the high concentration 55 industry sample, incomplete. Since we can not meaningfully force α close to one, we take another tack and explore the impact of monopoly-like structures rather than monopoly-like conduct. To do this we investigate the welfare implications of monopolies in Canadian manufacturing where only the least cost firms with costs at c_1 operate. To do this we compare the area (A+B+C) in the Cournot equilibrium with the area when only the best practice firm survives.

Accordingly, from equation (9) the Cournot area is (R/2e) ($s_1^2 + 2\ s_1 - 2H$) whereas the monopoly area is R*/2e* where R* and e* are revenue and elasticity in the monopoly equilibrium. (R and e are the published revenue figures and assumed elasticity in the initial Cournot equilibrium). To find R* and e* we use the price equation (10), the elasticity equation (14) and the linear demand equation. After substituting into these equations the monopoly values $n=1$, $\alpha=0$, $\mu=1$, we get $e^* = (a + c_1)/(a - c_1)$, $p^* = (a + c_1)/2$ and $q^* = (a - c_1)/2b$. Next, substituting for a, c_1 and b, which are parameters dependent on s_1, n, e and R, allows the monopoly area (A+B+C) to be expressed as:

(15) $(A+B+C)(\text{monopoly}) = (.125R/e)(1 + s_1)^2$

In (15) R, e and s_1 are initial Cournot revenues, elasticities and shares. Inspection of (15) and initial Cournot area $(R/2e)(s_1^2 + 2s_1 - 2H)$ shows that welfare losses for the best practice monopoly are smaller than Cournot losses if :

(16) $s_1 > -1 + (2/3)(3 + 6H)^{.5}$

Expression (16) indicates that for s_1 sufficiently large, and therefore unit costs c_1 sufficiently below industry average cost , the cost advantage from one best practice firm outweighs the adverse price consequences. Is this a possibility for our sample? The mean for s_1 calculated from the Schmalensee procedure is .182 whereas the mean for s_1 evaluated with the right hand side of (16) is .266. In fact none of the 146 industries in our sample produces an s_1 that satisfies (16). Furthermore in the monopoly equilibrium average welfare loss, using the

Cournot benchmark, is 7.5 percent of shipments when e = 1 and 3.7 percent when e = 2. (The implied monopoly elasticities are 2.4 and 4.1 respectively.) In general, therefore, reorganization to best practice monopoly is not a good idea.[13]

Would a softer reorganization give results more favourable to restructuring? The answer is yes. For example we considered the case where the four largest firms survive in a Cournot equilibrium and found that the restructuring reduced the welfare loss area (A+B+C) for 125 of the 146 industries.[14] Because the average H is .093 for the 125 industries and .166 for the 21 industries, these numbers imply that welfare gains from concentrating to 4 firms occur unless there is already substantial concentration. Since most industries benefit from the restructuring, there is, on average, a welfare gain from restructuring away from the Cournot benchmark. In fact the average gains are for e =.5,1,2 respectively .63, 1.26 and 2.57 percent of shipments.

That some re-structuring will, on average, produce welfare gains is not too surprising, especially since we consider a re-configuration that exploits the cost benefits but limits price effects by assuming the remaining four firms continue to be non-cooperative. Presumably we could introduce increases in cooperation that would make the reconfiguration welfare neutral. Again this points out, since there are many possibilities that can produce welfare gains or losses compared to the initial Cournot solution, how problematic the idea of a fixed benchmark is.

IV Conclusion

This paper first measured losses assuming cost differences result from the market power of larger more efficient firms. We found welfare losses that were significantly larger than those obtained assuming equal unit costs among firms. In particular, for the Bertrand benchmark, losses under fairly plausible conditions could be 10 percent of industry revenue.

We then adopted a second paradigm for measuring welfare loss. This attributed cost differences to efficiency effects rather than to inefficiency effects resulting from the market power of larger firms. From this perspective we considered a particular Cournot equilibrium as the relevant reference point and explored the consequences of more cooperative behaviour and more concentrated structure. We found that increases in cooperative behaviour do not necessarily lead to higher welfare losses because, in addition to adverse price effects, there are beneficial cost effects as larger firms increase their share of output. We also found that changes in structure could produce, on average, either increased welfare losses (the monopoly restructuring) or gains (the four firm restructuring). These results indicate that defining a benchmark when cost differences are attributed to efficiency rents is itself problematic. The appeal of the Cournot equilibrium as benchmark is that it has no collusion based profits but, as shown, increases in collusion can contain cost benefits and there is always the question of whether there may not be a better restructuring of the industry.

There is another problem that applies to both perspectives. Since all welfare losses are opportunity costs, a welfare loss calculation implies a foregone opportunity to be at a benchmark. In other words there must be available to policy makers an alternative arrangement of conduct or structure that can make the benchmark an equilibrium. For the Bertrand benchmark, a problem is that even an effective policy against price fixing or collusion could still leave a non-cooperative Cournot equilibrium and a welfare loss. An alternative is regulating price such that price equals best practice unit cost. However this is also problematic for the well known reasons that firms have incentives to evade effective price regulation and information about costs is hard to dislodge. For the Cournot benchmark equilibrium this problem of policy may be smaller since the goal would be only to eliminate cooperative price behaviour.

This policy issue is less vexing for the traditional literature and its implicit assumption of trivial cost differences among firms. Here, if needed, one could atomize the industry into many firms without adverse cost and welfare consequences. In fact even the issue of the appropriate benchmark point dissolves since when there are no cost differences there are no efficiency rents and the competitive equilibrium is the only natural reference point.

In conclusion the introduction of cost differences has led to two benchmarks as alternative coordinates for the measurement of welfare loss. The Bertrand coordinate suggests, abstracting from the problem of how to get there, that welfare losses are significant, while the Cournot coordinate suggests welfare losses are small and in fact the idea of a meaningful benchmark is a fuzzy concept. Which view is correct? A safe answer is that neither is appropriate for all industries and all times, and, at any particular time, both differential efficiency and collusion effects may be embedded in the equilibrium. Our own view is that efficiency rents leading to cost and share differences are an important factor behind the evolution of industry structure, but this by itself does not preclude the subsequent emergence of inefficient firms sheltered by high prices. To be more definitive would require in depth study of the history of each industry which is another way of saying sweeping statements about average welfare losses should be treated with more than the usual caution.

Figure 1

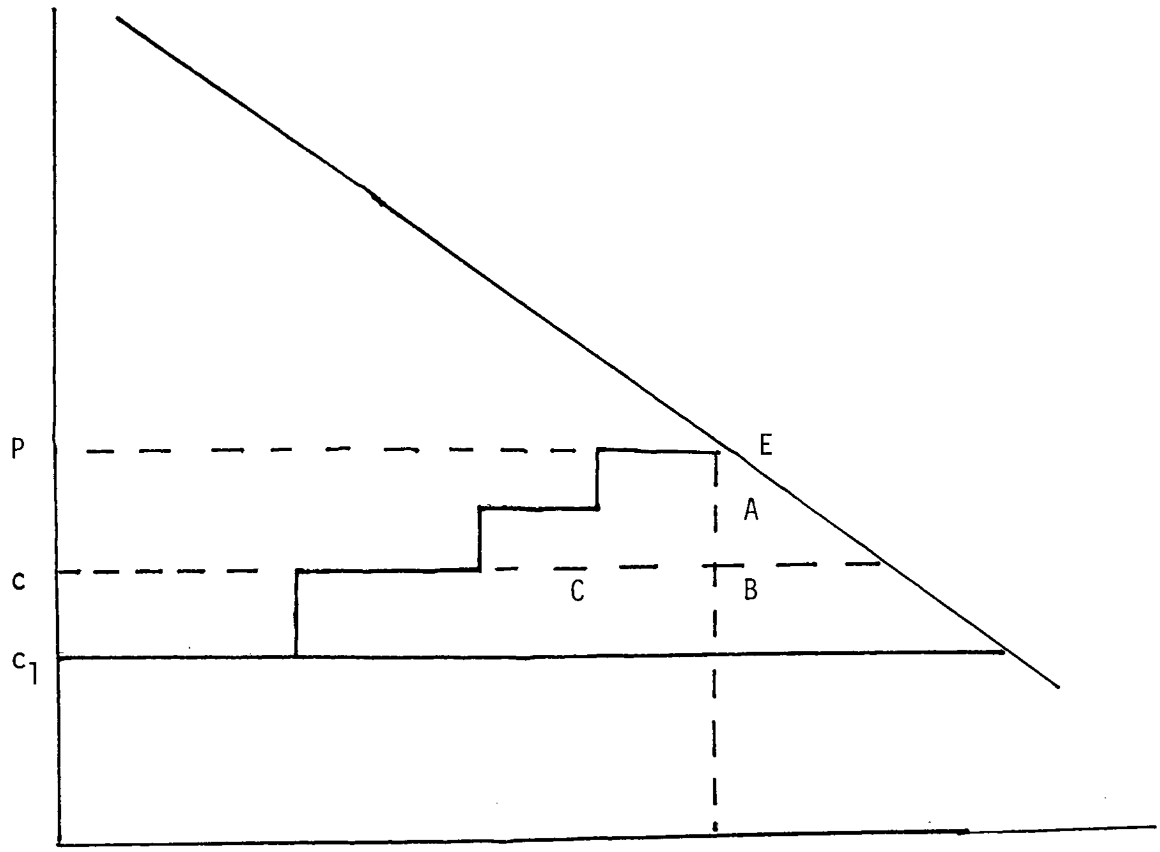

Table 1

WELFARE LOSSES AS PERCENTAGE OF REVENUES					
	α	Triangle(A/R)	Expanded Triangle (A/B)/R	Excess Cost (C/R)	Total (A+B+C)/R
e = 5	0	1.8	4.3	15.8	20.1
	.1	4.3	7.7	14.2	22.0
	.5	30.6	35.2	7.9	43.1
e = 1	0	.9	2.1	7.9	10.1
	.1	2.1	3.9	7.1	11.0
	.5	15.3	17.6	4.0	21.6
e = 2	0	.4	1.1	4.0	5.1
	.1	1.1	1.9	3.6	5.5
	.5	7.7	8.8	2.0	10.8
	1	25.0	25.0	----	25.0

Table 2

INDUSTRY CHARACTERISTICS FOR 55 AND 91 INDUSTRY SAMPLES						
Sample	H	n	H*	e*	Optimal α	Welfare Loss (Gain)
n = 55	.178	96	—	—	—	—
n = 91	.058	255	.069	1.09	.047	(.05)

Endnotes

1.For Canadian manufacturing there is considerable evidence that costs decline with size. See, for example, Baldwin and Gorecki (1986), Fuss and Gupta (1981) and Robidoux and Lester (1988).

2. For a review of this literature see Scherer and Ross (1990). An example of an article assuming monopoly pricing is Cowling and Mueller (1978) who find welfare losses in U.S. manufacturing of about four percent of GNP. The assumption of monopoly pricing invariably implies, given observed price-cost margins, high market demand elasticities.

3. Dixit and Stern assume a constant elasticity demand curve and define A+B+C as the definite integral of this demand curve between industry price and c_1, minus industry profits. Daskin follows this approach, while AP assume a linear demand and then calculate the relevant triangle and rectangle areas. Our procedure is a variant of the AP procedure.

4. Derivations of (4) and (5) are in Clarke and Davies. We use α only to index the equilibrium. Bresnahan (1989) has argued that conjectural variations can be useful for summarizing oligopoly behaviour in multi-period games. Cabral (1995) has also shown that the conjectural variation equilibrium can be interpreted as a long run solution or reduced form of a dynamic game.

5. The formula for s_1 is 1.75x - .75y where x is average share of the four largest firms and y is the average share of the next four. Schmalensee uses this proxy to help construct Herfindahl indices from concentration ratio data and concludes this proxy does a better job than others. An alternative procedure is to assume a lognormal distribution and use published data on H and the number of firms to estimate s_1 (see Davies (1979)). In fact the sample average for s_1 is .18 with Schmalensee and .19 with the lognormal procedure.

6. An alternative measurement strategy is to use expressions (1) to (3), make assumptions about e and, rather than assume values for α, try to measure L_1 and L. Measuring L_1 (especially) and L raises its own set of problems and inevitably involves making wide ranging assumptions about the opportunity cost of capital. Our decision to make assumptions about α makes explicit the oligopoly equilibrium, facilitates drawing out conclusions about the cost associated with different oligopoly equilibria, and makes it easier to introduce the points we wish to make later about pitfalls in welfare loss measurement.

7.A better insight may result by noting that $(L_1 - L) = (1 - \alpha)(s_1 - H)/e$ also means, for given cost differences, that higher e's increase the difference between s_1 and H or the share advantage of lower cost firms. Daskin (1983) makes a similar point when he shows that higher e are associated with higher concentration. Similarly, for given differences in costs, higher values for α also increase the share advantage of lower cost firms. Finally the result that increases in α reduce C/R appears to contradict AP who report that increases in α do not affect C/R. However they calculate C/R by trying to measure L and L_1 directly. Hence, when they consider higher α their values for these markups do not change. This means, since markups are unchanged, that in the background elasticities must be increasing as they consider higher α's.

8. This conclusion appears at odds with Daskin who has total losses increasing in e. Again the reconciliation is that Daskin in his tables considers higher e's for a given measured L, thereby, in the background, implicitly increasing α.

9. Evaluating $\partial((A+B+C)/R)/\partial\alpha$ shows this is positive as long as $\alpha > (s_1^2 - H)/(1 - s_1)^2$ which is negative since $H > s_1^2$.

10. For equations (10), (11) and (12) see respectively equations (12), (15) and (13) in Clarke and Davies. Our equation (13) is based on their equation (11) after substituting for P in their equation.

11. To evaluate each derivative we first substitute for e* in each equation. Inspection of equations (12) and (13) also shows that $\partial H^*/\partial\alpha$ and $\partial s_1^*/\partial\alpha$ are positive.

12. The patterns in (A+B+C), but not the level, are independent of the initial value (e = .5,1,2) for elasticities.

13. It is possible that for some industries there is more skew in the top four firms than implied by the Schmalensee procedure which would therefore underestimate s_1. To give a concrete example of the skew required, if H = .10 then s_1 must be greater than .26. We note that s_1 is bounded from above by the square root of H which is .32.

14.The procedure for evaluating this restructuring is analogous to that for the monopoly restructuring. The only additional data required are original firm shares for the second, third and fourth largest firms which are computed with the Schmalensee procedure. After working through the algebra, it turns out welfare losses are smaller than in the original Cournot equilibrium if $H < (H4-.22)CR4^2 + .24CR4 - .02$, where CR4 is the four firm concentration ratio and H4 is the initial Herfindahl index for the four largest firms subgroup. Details on this derivation are available in an appendix from the author.

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