Western University
Scholarship@Western

Centre for the Economic Analysis of Property Rights Working Papers

Centre for the Economic Analysis of Property Rights

1982

A Note on Product Standardization as Competition Policy

Michael R. Veall

Follow this and additional works at: https://ir.lib.uwo.ca/economicsceapr_wp

Part of the Economics Commons

Citation of this paper:

Veall, Michael R.. "A Note on Product Standardization as Competition Policy." Centre for the Economic Analysis of Property Rights Working Papers, 82-02. London, ON: Department of Economics, University of Western Ontario (1982).

3456

Working Paper Series
82-02

A NOTE ON PRODUCT STANDARDIZATION AS COMPETITION POLICY

by

M. R. Veall

May, 1982

Department of Economics Library
MAY 25 1982
University of Western Ontario

Draft: Comments Welcome

Major funding for the Centre for Economic Analysis of Property Rights has been provided by The Bureau of Corporate Affairs, Consumer and Corporate Affairs, and by the Academic Development Fund, The University of Western Ontario. The views expressed by individuals associated with the Centre do not reflect official views of the Centre, The Bureau of Corporate Affairs, or The University of Western Ontario.

Subscriptions to the Workshop papers and the Working Paper Series are $40 per year for institutions and $25 per year for individuals. Individual copies, if available, may be purchased for $3 each. Address all correspondence to John Palmer, Centre for Economic Analysis of Property Rights, The University of Western Ontario, London, Ontario, CANADA N6A 5C2

Draft: Comments Welcome.

A NOTE ON PRODUCT STANDARDIZATION AS COMPETITION POLICY

M. R. Veall*
Department of Economics
University of Western Ontario
London Canada

April, 1982

*Funding was provided by the Centre for Economic Analysis of Property Rights, The University of Western Ontario. I am also grateful to A. Gregory and R. Schmalensee for their comments. Errors are mine alone.

ABSTRACT

Suppose the government intervened in an imperfectly competitive multi-brand market by compelling all firms to make one standardized product: could the benefits of the increase in competition ever overcome the loss in product variety? The answer is typically no under the assumptions of Cournot behavior, constant marginal costs, symmetric outputs and CES consumer benefit functions, whether or not free entry is assumed. The prospects for the policy become only slightly more favourable under a variety of generalizations.

I. Introduction

Consider a market equilibrium where each of a group of firms is selling a distinct brand of a particular product (e.g., laundry detergent, toothpaste, candy bars, scotch whiskey). Consumers perceive (and enjoy) that the brands are different and each firm is exercising its market power to maximize profits (in, for example, a Cournot equilibrium). Now suppose the government believes there is "excessive" product differentiation and intervenes by choosing one existing formulation of that product and compelling all firms to sell only that formulation so that consumers cannot identify the maker. One effect of this product "standardization" is that it tends to reduce the pleasure of consumers since the variety of brands has been eliminated. However the policy has also increased the competition in the market as the firms no longer have the market power associated with their own brand and hence the price paid by consumers is lowered for the one good that is produced. The purpose of this note is to examine whether the "competition effect" can outweigh the "diversity effect" so that the standardization policy improves economic welfare.

The natural context in which to examine this question is in the literature on optimal product diversity in private markets. While there have been many interesting approaches to this issue (see for example Lancaster [1975, 1979], Salop [1979] and Gabszewicz and Thisse [1980]), this note will use the method of Spence [1976], Dixit and Stiglitz [1977] and more recently Koenker and Perry [1981]. These authors use multi-brand consumer benefit functions, most commonly of constant elasticity of substitution (CES) form.[1] The general conclusion is that the number of

brands privately produced can be greater or less than the social optimum.[2] This is because a firm deciding whether to introduce a new product does not consider the consumer surplus the product would generate and this tends to result in insufficient product variety. But the firm also does not consider the (negative) effect of the new brand on other firms' profits and this latter effect can in some cases outweigh the former and lead to an excessive number of products. In general, the optimum appears to require regulatory control over both the number of firms and the output per firm as well as a system of subsidies (as firms could have losses at the social optimum). However, following a suggestion by Chamberlin [1933, 1950], Spence and Dixit and Stiglitz each showed that free entry monopolistic competition under some circumstances could be socially optimal given the constraint that no brand could be produced at a loss.

Koenker and Perry point out that this result depends on the type of firm behavior that is assumed. Using a more general approach which allows for a richer variety of imperfectly competitive or "collusive" behavior,[3] they find that the free-entry/laissez-faire equilibrium may not attain this constrained social optimum. They also consider the case where the policies of controlling the number of firms and each firm's output may not be feasible. They therefore discuss the welfare-improving potential of each of these policies applied individually.

This note extends the work of Koenker and Perry by considering the "standardization" policy discussed above. As in their work and as in much of Spence and Dixit and Stiglitz,[4] the focus is on the symmetric (i.e. equal output) CES case. This simplifies the mathematics and minimizes the

reliance on numerical analysis, with most of the analysis requiring only very simple calculus. In addition, some asymmetric examples will be discussed.

The simplicity of the approach allows treatment of a variety of situations, focussing on the case with "barriers to entry" but also allowing for "free entry". There is consideration of the case where the standardization policy removes entry barriers and also where fixed costs are largely promotional and hence vanish after standardization. In addition, while most of the analysis assumes that firm behavior is Cournot, there is an extension following Koenker and Perry to allow firms to make "linear conjectures" about the output behavior of other firms.

The following section presents the model and the analytical results, which are in general not encouraging for the standardization policy. Section III considers some extensions to the basic model while Section IV gives the summary and conclusions.

II. Analysis

Suppose society has consumer-benefit function

$$U = X_o^{1-\alpha}\left(\sum_{i=1}^{N} X_i^{\rho}\right)^{\frac{\alpha}{\rho}}, \quad \begin{array}{l} 0 < \rho < 1 \\ 0 < \alpha \leq 1 \end{array} \tag{1}$$

where X_o is the numeraire good and $X_1,\ldots,X_n$ are the N brands produced by the industry under consideration. The restriction that ρ be positive means that only substitute goods will be considered and also that U will be non-zero if not all brands are available. The elasticity of substitution between any two brands is $1/1-\rho$ and if $\rho=1$ the goods are perfect substitutes and

identical. The use of the constant elasticity of substitution functional form with $0 < \rho < 1$ to model brand preference follows Spence [1976], Dixit and Stiglitz [1977] and Koenker and Perry [1981]. However only Dixit and Stiglitz include a numeraire good and functional form (1) is essentially a combination of their first two examples. The inclusion of the numeraire good in Cobb-Douglas form eases the study of the effects of profits (as this paper does not restrict itself to the usual free entry/zero profits assumptions). Note that the assumption of a constant budget share for the industry is analogous to conventional Chamberlinian analysis assuming a fixed demand curve for the group as a whole, as Dixit and Stiglitz [1977, p. 300] point out.

The simplest interpretation of the general equilibrium model is that society receives lump-sum income M which when added to Π, the profits of the multi-brand industry, gives total income Y. There are no profits or other income accruing from the numeraire good industry.

Supposing the number of brands is initially N, it can be shown that

$$X_o = (1-\alpha)Y$$

and

$$p_j = \frac{\alpha Y}{\sum_{i=1}^{N} \left(\frac{X_j}{X_i}\right)^{1-\rho} X_i} \qquad (2)$$

where p_j is the price of the jth good in terms of the numeraire good.

Supposing the firms' oligopoly behavior is of the Cournot variety with costs of production $C(X_j)$

$$C(X_j) = F + cX_j, \quad j=1,\ldots,N \tag{3}$$

where firm j produces (only) brand j. Exploiting the symmetry of the problem, it can be shown that each firm will produce output

$$X_i = \frac{\alpha Y}{cN^2}(N-1)\rho, \quad i=1,\ldots,N \tag{4}$$

so that consumer benefits equal

$$U = ((1-\alpha)Y)^{1-\alpha} N^{\frac{\alpha}{\rho}} \left(\frac{\alpha Y}{cN^2}(N-1)\rho\right)^{\alpha} \tag{5}$$

Now suppose the government chooses product 1 as a standard and compels all firms to make that one product. Assuming the policy does not change the cost function and Cournot behavior is maintained, it can be shown that each firm will produce output

$$X_s = \frac{\alpha Y_s}{cN_s^2}(N_s - 1) \tag{6}$$

where the subscript s denotes "post-standardization". (Note that (6) and (4) are the same if $\rho = 1$ and hence the products are identical.) Consumer benefits equal

$$U_s = ((1-\alpha)Y_s)^{1-\alpha} N_s^{\alpha}\left(\frac{\alpha Y_s}{cN_s^2}(N_s-1)\right)^{\alpha} \tag{7}$$

The standardization policy will therefore improve welfare if and only if

$$\frac{U_s}{U_1} = \frac{((1-\alpha)Y_s)^{1-\alpha} N_s^{\alpha} \left(\frac{\alpha Y_s}{cN_s^2}(N_s-1)\right)^{\alpha}}{((1-\alpha)Y)^{1-\alpha} N^{\rho} \left(\frac{\alpha Y}{cN^2}(N-1)\rho\right)^{\alpha}} > 1 \tag{8}$$

Expression (8) will now be studied under the alternative assumptions of restricted entry and free entry while allowing for different treatments of profits in the social consumer benefit function. As a start, suppose that the number of firms does not change under the standardization policy. (This implies that there are profits, at least before standardization: hence there must be a barrier to entry or an integer constraint.) Also assume that for social policy reasons, the government's social benefit function depends only on "consumer welfare" and does not "count" the spending of profits by capitalists and moreover such spending is not on any of the industry's brands and does not affect the price of the numeraire good. (An alternative assumption is simply that the capitalists are foreigners.) In this "profits-not-counted" case $N_s = N$ and $Y = Y_s = M$ (where M is income excluding profits) and

$$\frac{U_s}{U} = \frac{N^{\alpha}}{N^{\rho}\rho^{\alpha}} \tag{9}$$

which is greater than one if and only if

$$N < \rho^{\frac{\rho}{\rho-1}} \tag{10}$$

The expression on the right-hand side of (10) has a maximum of $e \doteq 2.178$, the base of natural logarithms. Therefore expression (10) can only be satisfied if $N = 2$ <u>and</u> ρ is between .5 and .1.[5] Therefore even if the government ignores the profit reduction associated with standardization, the policy can still never increase the value of the consumer benefit function if there are more than two firms, regardless of the value of ρ.

Consider now what happens when profits are spent like other income and such spending counts in the consumer benefit function. Assuming that $N = N_s$, (8) becomes

$$\frac{U_s}{U_1} = \left(\frac{N^{\alpha}}{N^{\frac{\alpha}{\rho}}\,\rho^{\alpha}}\right) \cdot \left(\frac{Y_s}{Y}\right) \tag{11}$$

or the ratio in (9) multiplied by the income ratio. It is shown in the Appendix that the standardization policy must reduce total profits and hence $\frac{Y_s}{Y} < 1$. Therefore for $N \geq 3$ both the first part and the second part on the right-hand side of expression (11) are less than one so $\frac{U_s}{U_1} < 1$ and the policy must reduce welfare. As is also described in the Appendix, expression (11) is less than one for $N = 2$. Therefore if profits are included in the analysis in the same manner as other income, the value of the consumer benefit function must fall with standardization, for all N and ρ.

Now suppose that instead of $N = N_s$, the more usual assumption of free entry is adopted. As profits will initially be zero (now allowing for N and N_s to be non-integers) and, as discussed above, standardization reduces profits,

it is clear that standardization must reduce the number of firms. (See the Appendix for the proof. Note also that because of the Cournot assumption, more than one firm can produce the same product in equilibrium, in contrast to the results of Spence and Dixit and Stiglitz.) In addition, it is shown in the Appendix that $\frac{U_s}{U}$ will be less than one and hence standardization reduces welfare.

The results so far are not favourable for the standardization policy. Whether the number of firms is constant because of barriers to entry or whether there is free entry, standardization must reduce welfare as normally measured. The only situation where the policy can be welfare-improving is if the government for some reason ignores the effects of the reduction in profits, and even then, welfare will only rise if $N=2$ and ρ is greater than .5. The following section will see how these results are modified by extensions to the basic model, including consideration of different types of firm behavior and cases where standardization removes entry barriers or reduces costs.

III. Extensions

The first extension to be considered is to allow for non-Cournot behavior by firms. A simple method suggested by Koenker and Perry is to assume firms make linear conjectures regarding other firms' behavior. In the notation here, firm i assumes that

$$\frac{dX_j}{dX_i} = \frac{\delta}{N-1}, \quad -1 \leq \delta \leq N-1 \qquad (12)$$
$$i,j=1,\ldots,N, \; i \neq j$$

The Cournot assumption used above is that $\delta = 0$ while the assumption of "monopolistic competition" by Spence and Dixit and Stiglitz corresponds to $\delta = -1$, in which each firm faces inverse demands with constant elasticity. Any negative δ implies that each firm expects that if it expands, the rest of the industry will contract to "absorb" some of the extra output. A positive conjectural variation indicates that a firm's increase in output will be "punished" by output expansions by other firms. Koenker and Perry suggest positive δ's can therefore embody degrees of collusive behavior.

The basic result following from assumption (12) is that policy standardization will improve welfare[6] if and only if

$$\frac{U_s}{U_1} = \frac{((1-\alpha)Y_s)^{1-\alpha} N_s^{\alpha}\left(\frac{\alpha Y_s}{cN_s^2}(N_s-1-\delta)\right)^{\alpha}}{((1-\alpha)Y)^{1-\alpha} N^{\frac{\alpha}{\rho}}\rho^{\alpha}\left(\frac{\alpha Y}{cN^2}(N-1-\delta)\right)^{\alpha}} > 1 \qquad (13)$$

Following the same steps as for the pure Cournot case, assume first that $N = N_s$ and $Y = Y_s = M$ (i.e., profits not counted). In this case (13) is <u>exactly</u> the same as (9) and the same results hold, namely that welfare can only increase if $N = 2$ and $.5 < \delta < 1$. It can also be shown that for all $\delta < N-1$, profits must fall after standardization and therefore if profits are counted, standardization can never improve welfare if $N \geq 3$. For $N = 2$ and $\delta \leq 0$, it remains impossible for the policy to be helpful but for $\delta > 0$, it may be. As an example, even if ρ is as large as .99 and α is as small as .001, standardization cannot improve welfare unless δ

is at least .4, compared to a maximum δ of 1. In the free entry case, it can again be shown that the number of firms must always fall with standardization and that for all $N \geq 2$, the policy must reduce welfare.[7]

Now return to the original $\delta = 0$ model and consider the case where there are initially barriers to entry which depend on the existence of brands. Standardization policy would therefore lead to a state of free entry. The success of such a policy will depend on the parameters, including those which determine how "binding" the entry barriers are. In general, the greater the difference between the original number of firms (N) and the number after free entry (N_s) and the greater the degree of substitutability (ρ), the more favourable will be the effects of the policy.

Figure 1 gives the combinations of N and ρ for a given N_s consistent with the policy having no effect on welfare (with the area to the upper left illustrating those combinations for which welfare will improve). Note that if the products are perfect substitutes so that $\rho = 1$, the standardization part of the policy is meaningless and welfare must improve because of the elimination of entry barriers.

Considering first the profits-not-counted case, the only parameter besides N and ρ which matters is $N_s = (\alpha M/F)^{1/2}$. For example, if $N_s = 100$ and $N = 5$, ρ must be at least .77 for welfare improvement. If $N = 10$, ρ must be at least .93 and if $N = 20$ (not shown), ρ must be at least .98. The line for $N_s \to \infty$ is virtually the same as the $N_s = 100$ line while if N_s falls to 10, the line shifts upwards, substantially reducing the zone of welfare-improving standardization.

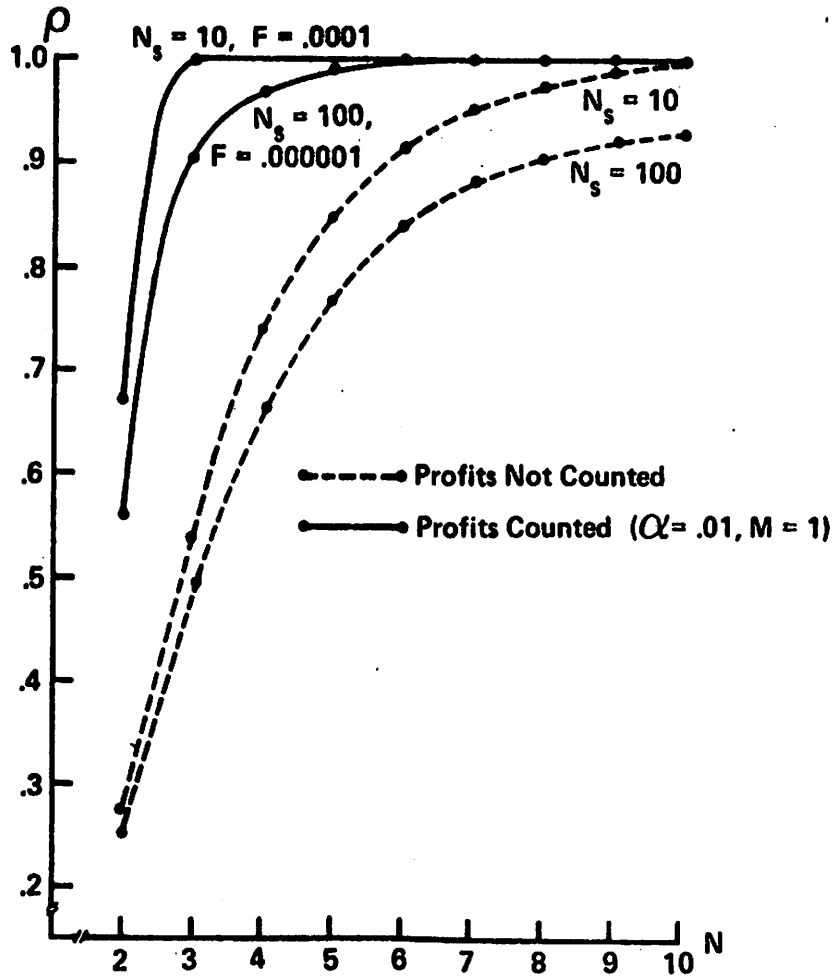

FIGURE 1. WELFARE IMPROVEMENT WHEN STANDARDIZATION REMOVES ENTRY BARRIERS

If profits are counted, the prospects for the policy are much less favourable. The analysis now depends on other parameters so, as an example, α is set at .01 and F at .000001 which along with M = 1, sets N_s as 100. It can be seen that if N = 5 in this case, ρ now must be at least .99 for welfare improvement and if F is changed to .0001 so that N_s = 10, the line shifts even further upward. To consider the sensitivity to change in industry share, suppose for N_s = 100 α is dropped to .001. The zone for policy improvement increases, but by an amount so small as to be virtually imperceptible if graphed.

Now suppose that not only does standardization remove entry barriers but it reduces fixed costs to zero and hence products are supplied at marginal cost. (This could be the case if the fixed costs were all promotional and hence were unnecessary after standardization.) The profits-not-counted case is given by the lower line on Figure 2 and indicates for example that if N = 5, ρ must be at least .77 for welfare improvement. Note that this line is the same as the $N_s \to \infty$ line would be in the profits-not-counted case of Figure 1, as for a given initial number of firms the reduction in F only affects welfare through its impact on profits.

Again if profits are included in the analysis, specific parameter values must be chosen so α is set at .01, M at 1 and F = .000001. If N = 5, ρ must now be at least .98 for welfare improvement and again as N increases, the required ρ increases still further. Changing α to .001 makes almost no difference but if instead F is increased to .0001, the curve shifts downward as shown in Figure 2.

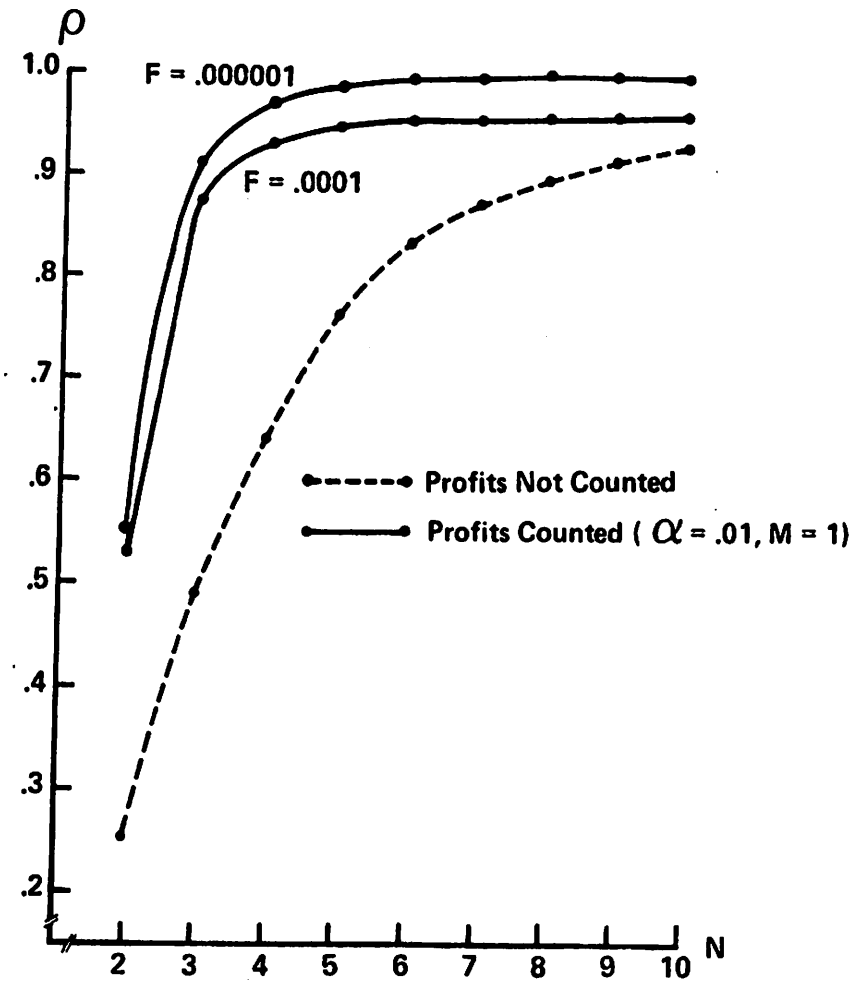

FIGURE 2. WELFARE IMPROVEMENT WHEN STANDARDIZATION REMOVES ENTRY BARRIERS AND FIXED COSTS

Finally, the assumption of symmetry has been maintained in the above analysis. To relax that assumption in general is very difficult but a few numerical examples may be instructive. One easy way to introduce asymmetry into the problem is to keep the consumer benefit function unchanged and allow for different marginal costs. Consider the case where there are barriers to entry before and after standardization ($N = N_s$), profits are counted in the welfare function but now one firm has marginal cost c while the other firms have marginal cost $a \cdot c$ where a is greater than or equal to one.

One result from the above is that in the symmetric case ($a = 1$), standardization can never improve welfare. If $a > 1$, it can be shown (as perhaps is obvious) that if the government chooses one of the high cost products as the "standard", the policy can never help. But if the lower cost product is chosen, the policy can improve welfare. If $M = 1$, $\alpha = .01$, $F = .0001$, $\rho = .9$ and $N = 2$, welfare can improve if costs differ by as little as 5%. If $N = 3$, the cost difference must be at least 15% and if $N = 4$, the differential must be close to 25%.

While these are only examples of a fairly simple form of asymmetry, they show that the previous findings are somewhat sensitive to the symmetry assumption.[8] However, particularly as N increases, fairly substantial asymmetry is required to alter the basic results. In addition, the asymmetric case highlights further drawbacks to the standardization policy not covered by the model. Standardization involves penalizing a firm which has secured through research or other means a less costly (or perhaps more desirable) product by giving its advantage to other firms. This could adversely affect

incentives for future product development. More generally it can be seen that the policy always tends to harm firms with established positions, and this consideration should be added to the generally negative prospects for the policy already discussed.

IV. Summary and Conclusions

This note considers the prospects of a government policy which standardizes all the products in an industry. Consumers are harmed by the elimination of product variety but may be aided by the increased production and lower price associated with more direct competition. The question is raised as to whether the "diversity" effect can ever be outweighed by the "competition" effect, so that the standardization policy improves welfare.

The model used has a CES consumer benefit function with cost functions which are linear in output and assumes equal outputs by all firms, with Cournot behavior. It is shown that if there are barriers to entry such that the number of firms is fixed, standardization cannot improve welfare if profits are treated as other income. If the government is so concerned with some kind of equity that the spending of profits is not counted in the consumer benefit function, welfare may improve but only if there are exactly two firms. In the free entry case it is shown that the policy is never advantageous. These results are not altered much by the Koenker and Perry assumption of linear conjectures, a generalization of Cournot behavior.

Standardization is more advantageous if it breaks down entry barriers and perhaps removes fixed costs, both of which may be associated with the

existence of brands. Even in these cases, as is shown by numerical analysis, the policy is unlikely to be helpful unless there are initially very few firms or the products are very close substitutes.

The other possibility for welfare-improving standardization is if there are some firms with a special advantage (e.g., a secret formula or process) which the government reveals as part of the standard. In this case it is clear that the policy can improve welfare in the context of the model, as is illustrated by a few simple examples. Of course this case also emphasizes the broader issue that intervention of this kind may work by hurting established firms that have successfully innovated and hence may reduce the incentives for future innovation.[9]

The results of this note seem to suggest a presumption against the usefulness of standardization as competition policy. Of course, wider theoretical support for this kind of policy can still be found by relaxing the assumptions of perfect information or consumer sovereignty.[10]

Appendix

The Effect of Standardization on Profits

With N profits, N firms

$$\Pi = \alpha Y - N(F + cX)$$

$$= \alpha(M + \Pi) - NF - \alpha(M + \Pi)\rho \frac{N-1}{N}$$

$$= \frac{1}{N - \alpha N + \alpha\rho N - \alpha\rho} [\alpha MN - \alpha M\rho N + \alpha M\rho - N^2 F]$$

With 1 product, N_s firms

$$\Pi_s = \alpha(M + \Pi_s) - N_s(F + cX)$$

$$= \frac{1}{N_s - \alpha} (\alpha M - N_s^2 F)$$

If $N = N_s$,

denominator of Π - denominator of Π_s

$= N - \alpha N + \alpha\rho N - \alpha\rho - (N - \alpha)$

$= \alpha(1-\rho)(1-N) < 0$ for $N > 1$

numerator of Π - numerator of Π_s

$= \alpha MN - \alpha M\rho N + \alpha M\rho - N^2 F$

$= \alpha M(1-\rho)(N-1) > 0$ for $N > 1$

Therefore $\Pi > \Pi_s$.

As profits always fall with standardization and utility with profits-not-counted can only rise if $N = 2$, it follows that the only possibility of welfare improvement with the spending of profits in the consumer benefit function is if $N = 2$. If

$$N = N_s = 2$$

$$\frac{U_s}{U} = \frac{2\alpha}{\rho^{\alpha}\, 2^{\frac{\alpha}{\rho}}} \frac{\left(M + \frac{\alpha M - 4F}{2-\alpha}\right)}{\left(M + \frac{2\alpha M - 2\alpha\rho M + \alpha\rho M - 4F}{2 - 2\alpha + 2\alpha\rho - \alpha\rho}\right)}$$

$$= \frac{2\alpha}{\rho^{\alpha}\, 2^{\frac{\alpha}{\rho}}} \frac{2 - 2\alpha + \alpha\rho}{2-\alpha}$$

Numerical analysis techniques were used to show that this expression is always less than or equal to one for $0 < \rho \leq 1$, $0 < \alpha \leq 1$.

<u>The Effect of Standardization on Number of Firms in the Free Entry Case</u>

As just shown, before standardization profits will be

$$\Pi = \frac{1}{N - \alpha N + \alpha\rho N - \alpha\rho} \left[\alpha MN - \alpha M\rho N + \alpha M\rho - N^2 F\right]$$

With free entry, Π will be zero so that

$$N = \frac{(1-\rho)\phi + \sqrt{(1-\rho)^2\phi^2 + 4\phi\rho}}{2} \quad \text{where } \phi = \frac{\alpha M}{F}$$

where in this case N may not be an integer.

After standardization

$$\Pi_s = \frac{1}{N_s - \alpha} (\alpha M - N_s^2 F)$$

or with $\Pi_s = 0$, $N_s = \sqrt{\phi}$

$$\frac{N}{N_s} = \frac{(1-\rho)\phi + \sqrt{(1-\rho)^2\phi^2 + 4\phi\rho}}{\frac{2}{\sqrt{\phi}}}$$

$$= \frac{(1-\rho)\sqrt{\phi} + \sqrt{(1-\rho)^2\phi + 4\rho}}{2} > 1 \text{ for } \phi > 1$$

so $N > N_s$.

Now consider the effect on welfare in this case:

$$\frac{U_s}{U} = \left(\frac{N_s}{\frac{1}{N^{\rho}\rho}} \cdot \frac{\frac{N_s - 1}{N_s^2}}{\frac{N-1}{N^2}} \right)^{\alpha}, \text{ as } Y = Y_s$$

which is increasing in N_s, where $N_s < N$.

For $N \geq e$, $\frac{U_s}{U_1}$ can never exceed 1. This is because for $N_s = N$, $\frac{U_s}{U_1} < 1$ (see expression (9) in text) and here $N_s < N$ and $\frac{U_s}{U_1}$ is increasing in N_s. Numerical analysis techniques were used to show that $\frac{U_s}{U_1} < 1$, for $2 \leq N \leq e$.

Footnotes

[1]One way of viewing this is that the economy is treated as consisting of a single consumer who gets utility directly from variety (i.e. because of the convexity of CES functions the consumer will tend to buy a number of different goods rather than consuming only one).

[2]See Spence [1976], pp. 230-31 and Dixit and Stiglitz, p. 308.

[3]Koenker and Perry also allow for marginal cost to be a function of output, a generalization of the constant marginal cost approach.

[4]Note that Spence and Dixit and Stiglitz proved for this case that optimal product diversity exceeds that provided by the market. However this result does not determine the results here for several reasons, the simplest being that in their model there would be no equilibrium after standardization (see footnote 6).

[5]The maximum welfare gain occurs if $\rho = \log 2$. If $\alpha = 1$ (so that all consumption is produced by this industry), this maximum gain corresponds to a 6 percent increase in income. If $\alpha = .1$ (i.e., industry share of total income is .1), the maximum gain would be equivalent to a .6 percent income increase and if $\alpha = .01$, the maximum gain would be .06%.

[6]Profits after standardization are

$$\frac{\alpha M(1+\delta) - N_s^2 F}{N_s - \alpha(1+\delta)}$$

implying that there is no equilibrium unless $\delta \geq \frac{N_s^2 F}{\alpha M} - 1$, with the equality holding with free entry. This rules out, for example, the case of Spence and Dixit and Stiglitz with $\delta = -1$ and $F > 0$.

[7]For the $N \geq e$ case, this can be done algebraically. For N between 2 and e the result was obtained using numerical analysis.

[8]Both Spence and Dixit and Stiglitz show that asymmetry can reverse the qualitative results of the symmetric case. Koenker and Perry do not treat asymmetry.

[9]There is also some suggestion that product standards could be used as barriers to entry or as aids to collusive strategies such as price-fixing. For example Hemenway [1975] mentions that SAE automotive part standards tended to slow entry in that industry (p. 25) and that standards helped limit competitive pricing and product behavior in the steel and cement industries (p. 76). Hemenway also notes that standards in some circumstances have tended to limit innovation, such as the use of plastic construction products and doorknobs made of wrought brass rather than cast brass (p. 77).

[10]See Pettengill [1979].

References

Caves, R. E. and Roberts, M. J. (eds.), Regulating the Product. Cambridge: Ballinger, 1975.

Chamberlin, E. H. The Theory of Monopolistic Competition. Cambridge: Harvard University Press, 1933.

Chamberlin, E. H. "Product Heterogeneity and Public Policy," American Economic Review, vol. 40, no. 2 (May 1950), pp. 85-92.

Dixit, A. K. and Stiglitz, J. E. "Monopolistic Competition and Optimum Product Diversity," American Economic Review, vol. 67, no. 3 (June 1977), pp. 297-308, and "Reply", vol. 69, no. 5 (December 1979), pp. 961-963.

Gabszewicz, J. J. and Thisse, J.-F. "Entry (and Exit) in a Differential Industry," Journal of Economic Theory, vol. 22 (1980), pp. 327-338.

Hemenway, D. Industrywide Voluntary Product Standards. Cambridge: Ballinger, 1975.

Koenker, R. W. and Perry, M. K. "Product Differentiation, Monopolistic Competition and Public Policy," Bell Journal of Economics, vol. 12, no. 1 (Spring 1981), pp. 217-231

Lancaster, K. J. "Socially Optimal Product Differentiation," American Economic Review, vol. 65, no. 4 (September 1975), pp. 567-585.

Pettengill, J. S. "Monopolistic Competition and Optimum Product Diversity: Comment," American Economic Review, vol. 69, no. 5 (December 1979), pp. 957-960.

Salop, S. "Monopolistic Competition with Outside Goods," Bell Journal of Economics, vol. 10, no. 1 (Spring 1979), pp. 141-156.

Spence, A. M. "Product Selection, Fixed Costs, and Monopolistic Competition," Review of Economic Studies, vol. 43, no. 2 (June 1976), pp. 217-236.