ECONOMICS BULLETIN

Market Integration and Market Concentration in Horizontally Differentiated Industries

Carsten Eckel

University of Göttingen

Abstract

This paper derives the impact of market integration on equilibrium firm size and market concentration in horizontally differentiated industries. We show that market concentration (measured by the number of firms) can rise as a consequence of market integration if firms engage in RDcompetition. We also demonstrate that whether concentration occurs or not depends on the RDproduction function and on consumer preferences. This result implies that the welfare effects of market integration are not unambiguously positive.

This note is part of a research project that was started while visiting the Norwegian School of Economics and Business Administration in Bergen, Norway. Funding from the European Commission through the Research Training Network "FDI and the Multinational Corporation" is gratefully acknowledged.

Citation: Eckel, Carsten, (2005) "Market Integration and Market Concentration in Horizontally Differentiated Industries." *Economics Bulletin,* Vol. 6, No. 16 pp. 1−6

Submitted: June 21, 2005. **Accepted:** September 7, 2005.

URL: http://www.economicsbulletin.com/2005/volume6/EB−05F10009A.pdf

1. Introduction

A widespread belief among economists is that globalization increases competition and reduces concentration. Krugman (1979, 1980), Dixit and Norman (1980), Helpman (1981), and Helpman and Krugman (1985) have shown that an increase in the size of a market can lead to an increase in the number of firms producing a distinct variety of a horizontally differentiated good. Recent developments, however, seem to suggest that concentration in some highly globalized industries is rising (UNCTAD, 2000, pp. 127-129; Ernst, 1997).

Changes in market concentration can be measured at two different levels: either at a global level or at a market level. In the context of international market integration, the difference between these two is important. If two equally-sized (but previously autarkic) national markets integrate, then an increase in concentration at a global level requires only that some firms are driven out of the market, whereas an increase in concentration at a market level requires that the number of firms in the integrated market is smaller than the number of firms in either national market in autarky. Hence, if two equally-sized national markets integrate, an increase in concentration at a market level requires that the number of firms is cut by more than half. In this paper, we focus on concentration at a market level.

Based on earlier work by Dasgupta and Stiglitz (1980) and Sutton (1991, 1998) we show that international market integration can lead to an increase in concentration at a market level in models of pure horizontal differentiation. We also demonstrate that whether concentration occurs or not depends on the R&D production function and on consumer preferences. The paper concludes with a remark on welfare.

2. The Model

Following Dasgupta and Stiglitz (1980), we assume that a firm's total costs C consist of fixed costs F, stemming from R&D expenditures, and variable costs associated with the actual production of a particular variety X of a differentiated good. R&D is directed towards process innovation and firms choose output and R&D investment simultaneously. Hence, R&D has no commitment value in this framework. We assume further that there is no risk involved in R&D and that any increase in R&D will lead to a reduction in marginal costs c, so that $c = c(F)$, where $c'(F) < 0$ and $c''(F) > 0$. The cost function has the following form: $C = F + c(F)X$. The cost minimizing level of R&D (F^*) is given by:

$$-c'(F^*)X = 1. \tag{1}$$

Equation (1) shows that firms set their level of R&D (F) so that the marginal benefits of R&D (left hand side) equal the marginal costs (of one). The second order condition is easily verified $[c''(F) > 0]$. The optimal R&D expenditures are depicted in figure 1 as a function of a firm's output. It clearly shows that as X rises, the optimal F* also rises.

This leads to lemma 1:

Lemma 1: *With an endogenous R&D technology, a firm's cost function with respect to its output is upward sloping and concave, i.e.* $C'(X) > 0$ *and* $C''(X) < 0$.

Proof: $C'(X) = c[F^*(X)] > 0$ and $C''(X) = c'[F^*(X)]\frac{dF^*}{dX}$ are straightforward from the cost function. As (1) implies that $\frac{dF^*}{dX} = c''(F^*)^{-1} X^{-2} > 0$, it follows that $C''(X) < 0$.

In a monopolistically competitive market, firms face a declining demand schedule $X = X(p)$ and set their prices (p) so as to maximize profits. Profit maximization requires that

$p\left(1-\sigma^{-1}\right)=C'(X)$, where σ denotes the price elasticity of demand. In addition, free entry leads to average cost pricing, so that $p=C(X)/X$. The first order condition can then be derived by dividing this free-entry condition by $p\left(1-\sigma^{-1}\right)=C'(X)$:

$$\frac{1}{1-\sigma^{-1}}=\frac{C(X)/X}{C'(X)} \tag{2}$$

Two demand-based sources of horizontal differentiation are dominating the literature: the love of variety approach (Dixit and Stiglitz, 1977) and the ideal variety approach (Lancaster, 1979). In the love of variety approach, σ is usually assumed to be exogenously given, so that $\sigma'(n)=0$. In the ideal variety approach, σ is a function of the choices available to consumers. We follow Helpman (1981) and Helpman and Krugman (1985) and assume that σ rises with *n*, i.e. $\sigma'(n)>0$.

Define $R\equiv p/C'(X)=\left(1-\sigma^{-1}\right)^{-1}$ and $\theta\equiv AC/MC=(C/X)/C'(X)$. Since $\sigma=\sigma(n)$ with $\sigma'(n)\geq 0$, we have $R=R(n)$ with $R'\leq 0$. The first order condition can then be written as

$$R(n)=\theta(X). \tag{3}$$

We assume that consumers spend a given fraction of their income on the differentiated good (Cobb-Douglas case), so that expenditures (*E*) are exogenously given. Since there are no profits in equilibrium, market clearing implies that total expenditures on the differentiated good must equal total production costs:

$$nC(X)=E. \tag{4}$$

Equations (3) and (4) simultaneously determine the equilibrium output per firm (variety) *X* and the number of firms (varieties) *n*.

3. The Impact of Market Integration

International market integration leads to an increase in the size of the market and, provided that international demand structures are similar, raises the overall sales of an industry (*E* increases). By differentiating equations (3) and (4) with respect to *E*, we obtain two equations: $R'(dn/dE)=\theta'(dX/dE)$ and $C(dn/dE)+nC'(dX/dE)=1$. Then, the impact of market integration on the number of firms (varieties) and on output per firm (variety) is given by

$$\frac{dX}{dE}=\frac{1}{\Delta}R'\geq 0, \tag{5}$$

$$\frac{dn}{dE}=\frac{1}{\Delta}\theta', \tag{6}$$

where $\Delta=nC'R'+C\theta'$. Lemma 2 shows that the second order condition requires that $\Delta<0$.

Lemma 2: *The second order condition requires that* $\theta'<-nC'R'/C$.

Proof: Profits are given by $\pi = pX(p) - C[X(p)]$. The first order condition requires that $d\pi/dp = \left(R^{-1} - \theta^{-1}\right)p\,dX/dp = 0$, i.e. $R = \theta$. Hence, the second order condition, evaluated at the optimum, requires that $d^2\pi/dp^2\big|_{R=\theta} = \left(\theta' - R'\,dn/dX\right)p\theta^{-2}\left(dX/dp\right)^2 < 0$. From equation (4) we obtain $dn/dX = -nC'C^{-1}$, so that the second order condition can be expressed as in lemma 2: $\theta' < -nC'R'/C$.

We have already established that R is non-increasing in n $\left(R' \le 0\right)$. Therefore, equation (5) demonstrates that output per firm is clearly non-decreasing. In order to determine the impact on the number of firms (varieties), we need to determine the sign of θ':

$$\theta' = \frac{\theta}{X}\left(\underbrace{\frac{1}{\theta} - 1}_{-}\underbrace{- \frac{dC'}{dX}\frac{X}{C'}}_{+}\right), \tag{7}$$

The sign of θ' is ambiguous. It depends on two countervailing effects. On one hand, an increase in output enables firms to realize economies of scale so that average costs (AC) fall. On the other hand, an increase in output induces firms to increase their spending on R&D and lower marginal costs (MC). As $\theta = AC/MC$, the impact on θ is ambiguous.

The parameter θ can also be expressed as $\theta = \left(1 - \frac{F}{C}\right)^{-1}$. Then, $\theta' > 0$ implies that the equilibrium R&D intensity $\left(F/C\right)$ rises, too. However, whether the R&D intensity rises or falls depends on the underlying R&D function. Using (1), θ can also be expressed as $\theta = 1 + \varepsilon_{c,F}$, where $\varepsilon_{c,F} = -c'\frac{F}{c}$. Thus, $\theta' > 0$ ultimately implies that the returns to R&D are in themselves increasing.

This result implies that the second order condition is non-trivial. In fact, if $\theta' > 0$, lemma 2 establishes an upper boundary to the increase in the economies of scale. If θ' exceeds this boundary, the equilibrium becomes unstable. However, contrary to some statements in the literature [e.g., Lancaster (1980, note 4): "It is not surprising that economies of scale which themselves increase with scale will cause destabilizing problems."], lemma 2 also shows that $\theta' > 0$ is indeed consistent with a stable equilibrium if $R' < 0$ (ideal variety approach). If $R' = 0$, lemma 2 requires that $\theta' < 0$.

The first and second order conditions illustrate that the R&D production function and consumer preferences play a role in determining the change in market concentration. The first order condition states that market concentration rises if the returns to R&D are in themselves increasing. The second order condition states that increasing returns to R&D are only compatible with a stable equilibrium if consumer preferences are of the ideal variety type $\left(R'(n) < 0\right)$.

4. Final Remark

We illustrated that under certain circumstances market integration can lead to an increase in market concentration and a reduction in diversity. This finding holds important consequences for the welfare effects of market integration. If market integration can reduce the choices available to consumers, it is not unambiguously welfare increasing. The increase in consumers' purchasing power by the reduction in market prices is, at least partly, offset by a reduction in diversity.

5. References

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Figure 1: Optimal R&D Expenditures