

Trade and Industrial Policy under International Oligopoly

Sajal Lahiri and Yoshiyasu Ono



CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge CB2 1RP, United Kingdom

CAMBRIDGE UNIVERSITY PRESS

The Edinburgh Building, Cambridge, CB2 2RU, UK
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa
<http://www.cambridge.org>

© Sajal Lahiri and Yoshiyasu Ono 2004

This book is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2004

Printed in the United Kingdom at the University Press, Cambridge

Typeface Plantin 10/12 pt. System L^AT_EX 2_ε [TB]

A catalogue record for this book is available from the British Library

ISBN 0 521 77033 5 hardback

The publisher has used its best endeavours to ensure that URLs for external websites referred to in this book are correct and active at the time of going to press. However, the publisher has no responsibility for the websites and can make no guarantee that a site will remain live or that the content is or will remain appropriate.

Contents

<i>List of figures</i>	<i>page</i> viii
<i>List of tables</i>	ix
<i>Preface</i>	xi
Introduction	1
1 Cost asymmetry and industrial policy in a closed economy	8
2 R&D policy	19
3 Trade and industrial policy under foreign penetration	31
4 Trade and industrial policy under asymmetric oligopoly: a synthesis	47
5 Trade policy when producers and sellers differ	64
6 Foreign penetration in the presence of unemployment	82
7 Local content requirement and profit taxation	95
8 Export-oriented foreign direct investment	110
9 Lobbying for local content requirement	120
10 Foreign direct investment in the presence of cross-hauling	128
<i>Bibliography</i>	140
<i>Index</i>	148

Figures

1.1	Critical shares for a minor firm	<i>page</i> 11
2.1	Comparative statistics	23
2.2	Critical shares in the presence and absence of R&D	26
3.1	Critical foreign shares	40
7.1	Case: $k > 2k^f$	102
7.2	Case: $k < 2k^f$	106
8.1	Case 1 Optimal LCRs	116
8.2	Case 2 Optimal LCRs	116

Tables

1.1	Critical shares for welfare-reducing technical change	<i>page</i> 14
1.2	Critical shares for welfare-improving elimination of a minor firm	15
1.3	Critical shares for a welfare-reducing production subsidy	17
3.1	Critical shares for welfare-improving elimination of foreign penetration	39
3.2	Various critical shares with foreign penetration	44

1 Cost asymmetry and industrial policy in a closed economy

1.1 Introduction

Oligopolistic firms restrict their production and earn excess profits. Since an increase in competition is considered to raise each oligopolist's production and make it closer to the first-best level, it is commonly believed that increasing competition among firms raises national welfare. With this theoretical underpinning, antitrust policies are generally designed so that new entries are encouraged and entry barriers are strictly prohibited.

Recently, however, it has been found in the theoretical literature on industrial organization that more competition may well reduce welfare in various contexts. For example, Spence (1984), Stiglitz (1981) and Tandon (1984), while analysing R&D decisions under oligopolistic situations, have pointed out the possibility of welfare loss caused by the existence of potential entrants or by free-entry of identical rival firms. Schmalensee (1976), Suzumura and Kiyono (1987) and von Weizsäcker (1980a, b) found that in a Cournot oligopolistic sector the optimal number of (identical) firms may well be smaller than the equilibrium number of firms with free entry and exit.¹ In these models, the existence of fixed costs (or increasing returns to scale) plays a crucial role in deriving diseconomies of competition. While a new entry raises consumers' surplus, it requires an additional fixed cost. It is shown that the latter cost may well exceed the former benefits.

In this chapter we focus on an asymmetric oligopolistic industry with a fixed number of firms. An uneven technical level amongst firms provides the key ingredient. In the presence of marginal cost differential among firms, less efficient firms have lower market shares than the others. Thus, elimination of a minor firm raises the average efficiency of production in the industry, though at the same time it creates a more oligopolistic market structure that causes total output to decrease and thus consumers' surplus

¹ For a more recent analysis of entry–exit policy, see, for example, Agarwal and Barua, 1994; Asplund and Sandin, 1999; Hamilton and Stiebert, 2000.

to decline. This chapter shows that such an improvement in production efficiency may well exceed the welfare loss caused by a more oligopolistic market structure.

The mechanism is rather related to the effect of licensing in Katz and Shapiro (1985), in which they find that, under Cournot oligopoly, a firm's licensing to the other may well reduce total surplus. In order to highlight the difference in mechanism, we ignore the existence of fixed costs. In this setting the perverse beneficial effect of elimination of a firm presented by Schmalensee and others disappears, and yet elimination of a minor firm is shown to increase national welfare.

The basic model is spelt out in section 1.2. Section 1.3 then derives the welfare effect of a cost reduction in a firm, or elimination of it, under general demand and cost functions. It derives critical values of market shares of a firm below which helping the firm reduces national welfare or elimination of it maximizes national welfare. In section 1.4, we consider linear demand and cost functions and obtain numerical values of these critical shares for different values for the number of firms in the industry. Section 1.5 considers a tax-cum-subsidy policy (financed through lump-sum taxation) and derives a critical share of a firm below which subsidizing it reduces national welfare. Finally, in section 1.6 we draw some conclusions.

1.2 The model

Suppose there are n firms producing a homogeneous commodity. We assume constant returns to scale throughout and perfect factor markets so that the marginal (or average) cost of each firm – c_j for firm j – is constant.² The technical level of a firm may however differ from that of another firm, i.e., typically $c_i \neq c_j$ for $i \neq j$. Firm j maximizes profits given by

$$\pi_j = [f(D) - c_j]x_j \quad (1.1)$$

à la Cournot, where x_j is firm j 's output, D is the total output or demand satisfying $D = \sum x_j$, and $f(\cdot)$ is the inverse demand function, i.e., $p = f(D)$, where p is the price of the commodity. The optimal behaviour of

² The model can be viewed as a part of a general equilibrium framework in which there is another competitive sector and one factor of production which is perfectly mobile within a country between the two sectors. The competitive sector, which produces the numeraire good, ties down the factor price. Therefore, as far as the oligopolistic sector is concerned, the marginal costs can be taken as given. Moreover, if one assumes the utility function to take a particular (quasi-linear) form as in Krugman (1979), the demand function would be independent of income as it is here.

firm j satisfies

$$\frac{\partial \pi_j}{\partial x_j} = f'(D)x_j + f(D) - c_j = \text{MR}^j - c_j = 0 \quad (1.2)$$

for $j = 1, \dots, n$.

We make two standard assumptions:

$$f' < 0 \quad \text{and} \quad \text{MR}_x^j (= f''x_j + f') < 0. \quad (1.3)$$

The first inequality simply means a negatively sloped demand function. The second is a conventional stability condition for Cournot oligopoly (see, for example, assumption (A2) in Hahn 1962).

National welfare W is given by the sum of producers' and consumers' surplus, i.e., $W = \sum_{j=1}^n \pi_j + \text{CS}$. It is well known that consumers' surplus CS satisfies $d\text{CS} = -Ddp$ so that

$$dW = d\left(\sum_{j=1}^n \pi_j\right) - Ddp. \quad (1.4)$$

Using the above model, in the following section we analyse the effect of technical progress – or, equivalently a reduction in the marginal cost – of a firm on national welfare. Without loss of generality, we deal with the effect of changes in firm 1's marginal cost c_1 on welfare.

1.3 Cost reduction and national welfare

Using the model developed in section 1.2 we examine the effect of a firm's cost reduction on national welfare. It will be shown that a minor firm's cost reduction reduces welfare.

Differentiating (1.1) and (1.2) totally and then substituting the relevant terms in (1.4) yield

$$(-\Delta) \cdot \frac{dW}{dc_1} = -x_1 \left\{ 2 \left(f' + \sum_{j \neq 1} \text{MR}_x^j \right) + \text{MR}_x^1 \right\} + \sum_{j \neq 1} x_j \text{MR}_x^j \quad (1.5)$$

where

$$\Delta = f' + \sum_{j=1}^n \text{MR}_x^j < 0. \quad (1.6)$$

The first term on the right-hand side of (1.5) is negative whereas the second term is positive. Therefore, a cost reduction in firm 1 has two opposing effects on welfare. These two effects can be explained as follows. First, a reduction in c_1 results in an increase in total output, which clearly

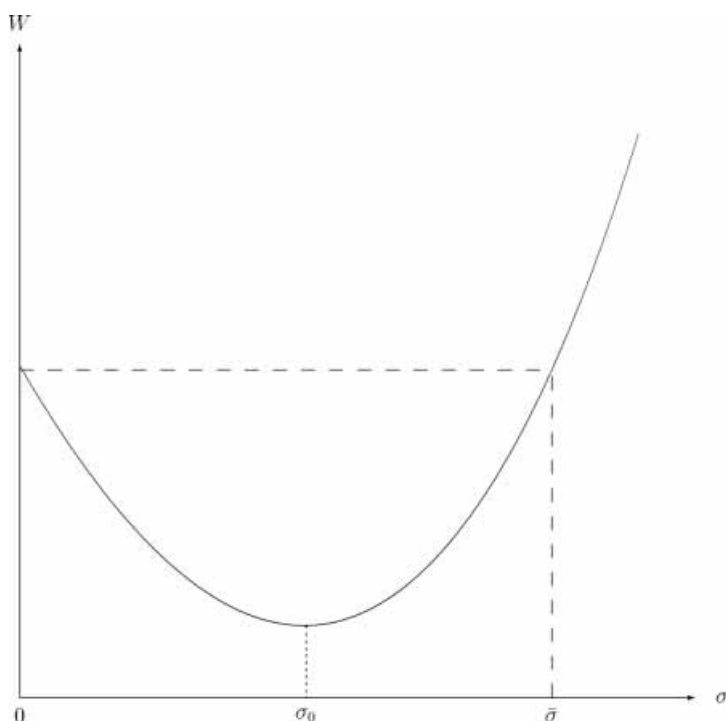


Figure 1.1 Critical shares for a minor firm

benefits the economy. The other effect is a change in profits for all the firms. If firm 1 has lower profits than the others, a decrease in c_1 results in a small rise in profits for this firm, which may be dominated by a large drop in profits for the other firms. In other words, the cost-reducing technical progress in a less efficient firm, which has a minor share of the market, shifts production from the more efficient firms to the less efficient one. Consequently, producers' surplus may fall. The two terms on the right-hand side of (1.5) precisely represent the above two opposing effects. If the beneficial effect on consumers' surplus is dominated by the harmful effect on producers' surplus, a cost reduction in a minor firm will decrease national welfare even though we ignore R&D costs.³ It may be noteworthy that fixed costs have nothing to do with this result.

From equation (1.5), one can directly derive the following properties. First, if the firms are identical, i.e., $c_i = c_j$ and therefore $x_i = x_j = D/n$

³ R&D costs will be explicitly considered in chapter 2.

for all i and j , equation (1.5) reduces to

$$\frac{dW}{dc_1} = -\frac{D\left(2f' + \sum_{j=1}^n MR_x^j\right)}{n\Delta} < 0. \quad (1.7)$$

Thus, a cost reduction in any firm always improves national welfare. This is because there cannot be any reallocation of production from more efficient to less efficient firms in this case, as all firms are equally efficient.

Second, if c_i 's are such that x_1 is relatively insignificant, the welfare improving effect – the first term in (1.5) – disappears and one is left only with the welfare reducing effect of the cost reduction. On the other hand, if x_1 is relatively large, the first term in (1.5) dominates the second and hence welfare improves. In fact, if $x_1 \geq D/3$, i.e., if firm 1's share of the market is greater than a third, then $x_j < (2/3)D$ for any $j \neq 1$. Since in (1.5) the coefficient of x_1 is negative and that of x_j is positive, substituting $D/3$ for x_1 and $(2/3)D$ for x_j give

$$\frac{dW}{dc_1} < -\frac{D\{2f' + MR_x^1\}}{3\Delta} < 0 \quad \text{if } x_1 \geq \frac{D}{3}.$$

This implies that in this case a cost reduction in firm 1 increases welfare regardless of the number of rival firms.

Thus we have established the following proposition.

Proposition 1.1 *In Cournot oligopoly a marginal cost reduction in a firm with a sufficiently low market share decreases national welfare, while that for a major firm whose share is higher than 1/3 increases welfare. If the market share is equally distributed among all firms, a cost reduction in any firm benefits the country.*

Clearly, technical progress in firm 1 increases its market share which is denoted by σ . Thus, from proposition 1.1, national welfare first declines and then rises as firm 1's technical level increases, i.e., there is a 'U' shaped relationship between σ and national welfare, as is illustrated in figure 1.1. One can find two critical values of σ from this relationship. First, σ_0 is the value of σ at which welfare attains the lowest value. Proposition 1.1 is about σ_0 . The implication of σ_0 is that if a firm's market share is less than that fraction, helping the firm reduces welfare. Second, $\bar{\sigma}$ is the level of σ at which national welfare has the same level as that at $\sigma = 0$. The implication of this critical value is that if a firm's share is below $\bar{\sigma}$, elimination of the firm improves welfare. Formally,

Proposition 1.2 *In Cournot oligopoly national welfare increases if a firm with a sufficiently low share is removed from the market.*

The two propositions can provide a rationale for some of the industrial policies followed in Japan since the 1950s. Policies favouring major firms and harming minor ones were actually carried out in Japan. MITI (Ministry of International Trade and Industry) selected only major firms and organized R&D groups. Consequently, the members of the groups had better access to innovation than the minor firms. MITI also restricted the number of firms in some industries by urging minor firms to merge or exit under the name of industrial structure adjustment policy.⁴

1.4 A linear example

In the previous section, we pointed out the possibility of a loss of national welfare caused by an increase in a minor firm's market share under general assumptions. In this section, we assume the linearity of the demand curve, and derive some figures for critical shares σ_0 and $\bar{\sigma}$ explained in the previous section. We shall notice that under the linearity assumption, the critical shares are rather high. In other words, technical progress for a firm with a considerably high share may be harmful, and that elimination of such a firm may be beneficial to the country.

If the demand function is given by

$$p = \alpha - \beta D, \quad (1.8)$$

equation (1.5) reduces to

$$\frac{dW}{dc_1} = \frac{\beta[2(n+1)x_1 - D]}{\Delta}. \quad (1.9)$$

Therefore, the critical share $\sigma_0 (= x_1/D)$ is

$$\sigma_0 = \frac{1}{2(n+1)}. \quad (1.10)$$

So long as σ is smaller than σ_0 , firm 1's technical progress decreases national welfare. Table 1.1 presents critical share σ_0 for different values of n . For example, in the case of triopoly, so long as the share for a firm is less than 12.5%, its technical progress reduces national welfare. Table 1.1 also gives the average share of the other firms (σ'_0). The difference between the 'minor' firm whose technical progress is harmful and the average of the others becomes very small as the number of firms increases.

We next obtain critical share $\bar{\sigma}$ for firm 1, i.e., eliminating firm 1 benefits the country if it has a lower share than $\bar{\sigma}$. From (1.1), (1.5) and (1.8) we obtain

$$\pi_j = (p - c_j)x_j = \beta x_j^2. \quad (1.11)$$

⁴ See Komiya, Okuno and Suzumura (1988) for various examples of such policies.

Table 1.1 *Critical shares for welfare-reducing technical change*

n	σ_0 (in %)	σ'_0 (in %)
2	16.7	83.3
3	12.5	43.8
4	10.0	30.0
5	8.3	22.9
6	7.1	18.6
7	6.3	15.6
8	5.6	13.5
9	5.0	11.9
10	4.5	10.6

Therefore, under the demand function given in (1.8) the sum of producers' and consumers' surplus is

$$\begin{aligned} W &= \sum_{j=1}^n \pi_j - pD + \left(\alpha D - \frac{\beta D^2}{2} \right) \\ &= \beta \left(\sum_{j=1}^n x_j^2 + \frac{D^2}{2} \right). \end{aligned} \quad (1.12)$$

Using the above welfare function, we shall now obtain critical share $\bar{\sigma}$.

Substituting (1.8) into (1.2) yields

$$D = \frac{n\alpha - \sum_{j=1}^n c_j}{(n+1)\beta}, \quad (1.13)$$

$$x_j = \frac{\alpha - nc_j + \sum_{k \neq j} c_k}{(n+1)\beta}. \quad (1.14)$$

From (1.12) and (1.14) we find

$$\begin{aligned} (n+1)^2 \beta W &= \left(n + \frac{n^2}{2} \right) \alpha^2 - (n+2)\alpha \cdot \sum_{j=1}^n c_j \\ &\quad - \left(n + \frac{3}{2} \right) \left(\sum_{j=1}^n c_j \right)^2 + (n+1)^2 \sum_{j=1}^n c_j^2. \end{aligned} \quad (1.15)$$

Thus W is represented as a function of c_j 's. Let us fix c_k ($k = 2, \dots, n$) and vary c_1 . If for $c_1 = c_1^0$ the value of x_1 given in (1.14) is zero, $W(c_1^0)$ is the welfare level for the case where firm 1 is eliminated. Therefore, if for the actual level of c_1 the welfare level is lower than $W(c_1^0)$, elimination of firm 1 makes the country better off.

Table 1.2 *Critical shares for welfare-improving elimination of a minor firm*

n	$\bar{\sigma}$ (in %)	$\bar{\sigma}'$ (in %)
2	30.8	69.2
3	24.0	38.0
4	19.5	26.8
5	16.4	20.9
6	14.1	17.2
7	12.4	14.6
8	11.0	12.7
9	9.9	11.3
10	9.1	10.1

From (1.14) for firm 1, c_1^0 is given by

$$c_1^0 = \frac{\alpha + \sum_{k \neq 1} c_k}{n}. \quad (1.16)$$

Substituting (1.16) into (1.15), and solving the following equation:

$$W(c_1) = W(c_1^0),$$

we find the critical level of c_1 as

$$\bar{c}_1 = \frac{(1 + \frac{1}{2n})\alpha + (n + 2 + \frac{1}{2n})\sum_{j \neq 1} c_j}{n^2 + n - \frac{1}{2}}. \quad (1.17)$$

Substituting (1.17) into (1.14) and manipulating them, we obtain $\bar{\sigma}$, the critical share for firm 1 below which eliminating this firm increases national welfare,

$$\bar{\sigma} = \frac{n}{n^2 + n + \frac{1}{2}}, \quad (1.18)$$

which only depends on the number of firms n .

Table 1.2 presents $\bar{\sigma}$ for various values of n . For example, in the case of triopoly, if a firm has a share lower than 24% (say, the distribution is 20%, 35%, 45%) the country can increase national welfare by eliminating the firm. Table 1.2 also shows the average share of the other firms ($\bar{\sigma}'$). It may be noteworthy that the difference between the share of the firm whose elimination benefits the country and the average share of the others is very small especially when the number of firms is large.

1.5 Production tax-cum-subsidy

Let us next consider the effect of a production tax-cum-subsidy on national welfare. We shall derive a similar property to the previous analysis, i.e., a tax on minor firms and a subsidy to major ones are beneficial to the country.

If tax t_j is imposed on production by firm j , the optimal condition for firm j becomes

$$MR^j = p + f'x_j = c_j + t_j. \quad (1.19)$$

Differentiating (1.19) totally, we derive

$$MR_x^j dD + f' dx_j = dt_j. \quad (1.20)$$

Adding (1.20) over all j 's and using (1.6) yield

$$\begin{aligned} \Delta dD &= \sum_{k=1}^n dt_k, \\ f' dx_j &= dt_j - \frac{MR_x^j \sum_{k=1}^n dt_k}{\Delta}. \end{aligned} \quad (1.21)$$

In the presence of production taxes and subsidies, national welfare W equals $\sum_{j=1}^n \pi_j + CS + \sum_{j=1}^n t_j x_j$ so that a change in W is given by

$$dW = d \left(\sum_{j=1}^n \pi_j \right) - Ddp + d \left(\sum_{j=1}^n t_j x_j \right),$$

and thus

$$dW = d \left(\sum_{k=1}^n (p - c_k) x_k \right) - Df' dD. \quad (1.22)$$

Substituting (1.21) into (1.22) and rearranging the terms, we have

$$\Delta f' dW = \sum_{k=1}^n \left\{ \left(f' + \sum_{j=1}^n MR_x^j \right) (p - c_k) - \sum_{j=1}^n (p - c_j) MR_x^j \right\} dt_k. \quad (1.23)$$

Therefore, from (1.6) and (1.19), we get

$$\left. \frac{dW}{dt_k} \right|_{\forall t_j=0} = \frac{f' x_k + \sum_{j \neq k} MR_x^j (x_k - x_j)}{(-\Delta)}. \quad (1.24)$$

From (1.3), (1.6) and (1.24), we find that if x_k is sufficiently small, (1.24) is positive. However, if firm k has the largest share, (1.24) is negative. Furthermore, if $x_j = D/n$ for all the firms, (1.24) becomes negative. Formally,

Table 1.3 *Critical shares for a welfare-reducing production subsidy*

n	$\tilde{\sigma}$ (in %)
2	33.3
3	25.0
4	20.0
5	16.7
6	14.3
7	12.5
8	11.1
9	10.0
10	9.1

Proposition 1.3 *A marginal tax (subsidy) on production by a firm with a sufficiently small (large) share increases national welfare. If the share is equally distributed among all the firms, a marginal subsidy benefits the country.*

In order to find a simple expression for the critical share at which $dW/dt_k = 0$, let us assume the linear demand function given by (1.8). Substituting (1.8) into (1.24), we find

$$\Delta \left. \frac{dW}{dt_k} \right|_{\forall t_j=0} = -\beta(n+1)D \left(\frac{1}{n+1} - \sigma_k \right), \quad (1.25)$$

where $\sigma_k (= x_k/D)$ is the share of firm k . Therefore, critical share $\tilde{\sigma}$ is

$$\tilde{\sigma} = \frac{1}{n+1}, \quad (1.26)$$

whose values are given in table 1.3 for different values of n .

For example, if there are five firms whose shares are 33%, 25%, 19%, 14%, 9%, marginal production subsidies for the first three firms and marginal production taxes on the last two firms increase national welfare. Thus, a tax policy which favours major firms and impairs minor firms may benefit the country even if it seems to reduce competition among firms.

Though it seems striking, it is rather plausible since the policy shifts production from less efficient firms to more efficient ones. In order to see the point, let us consider the first-best tax-cum-subsidy policy. Equation (1.23) shows that a prohibitive tax on all the firms except the most efficient firm and a (Marshallian) subsidy for the most efficient firm that makes the actual marginal cost equal to the price are the best policy. In other words, under the optimal tax-cum-subsidy policy only the most efficient firm should be in operation and produce the Pareto optimal level of output.

1.6 Conclusion

Policies favouring minor firms, such as a production subsidy and an entry promotion policy, cause a more competitive market structure. A minor firm's technical progress not only creates a more competitive market structure but also raises the average efficiency of production. Therefore, these policies and changes are widely believed to benefit the country. Conversely, it may be said that exit of minor firms and policies impairing them strengthen the oligopolistic position of major firms and consequently decrease national welfare. Such a belief forms a backbone for various antitrust policies in many countries across the globe. However, in this chapter we have established that elimination of minor firms and tax-cum-subsidy policies which favour major firms and harm minor ones increase national welfare. Moreover, a minor firm's technical progress reduces national welfare.

These results are based on the following logic. Generally speaking, minor firms have less efficient technology than major ones. Under perfect competition, the most efficient allocation of production is attained. However, under Cournot oligopoly, the allocation of production among firms is not Pareto optimal. Technical progress for a minor firm (or a less efficient firm) increases production by the less efficient firm and decreases production by the more efficient firms. Thus, the allocation of production is further distorted and national welfare may be lowered although the technical progress itself is beneficial. If all the firms are identical, the harmful effect does not appear since a change in allocation of production exercises only a negligible effect. Tax-cum-subsidy policies which favour minor firms and harm major firms exert the same harmful effect as above.

On the other hand, tax-cum-subsidy policies favouring major (more efficient) firms and impairing minor (less efficient) firms, and elimination of minor firms shift production from the less efficient firms to the more efficient ones: they redress the misallocation of production. Consequently, national welfare increases. Thus, some industrial policies carried out by MITI in Japan, such as selection of major firms as members of R&D groups and elimination of minor firms by grouping firms or urging mergers, might be given a rationale.