

Kemp, Murray C.; Shimomura, Koji

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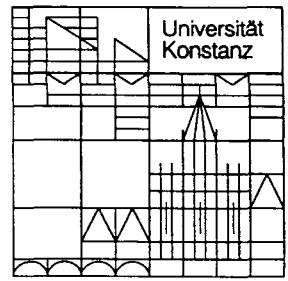
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Murray C. Kemp  
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International Trade:  
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**Murray C. Kemp**

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# INCREASING RETURNS AND INTERNATIONAL TRADE: A NEW APPROACH\*

Murray C Kemp

Koji Shimomura

*University of New South Wales*

*University of New South Wales and Kobe University*

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## **Abstract**

We develop a model of international trade with increasing returns to scale by taking into account the possibility of cooperation among agents in an egalitarian economy. It is shown that each country gains from trade in a trading world in which there are arbitrary numbers of increasing-returns-to-scale goods, constant-returns-to-scale goods, factors of production, and countries.

**Correspondence to:** Koji Shimomura

Research Institute for Economics and Business Administration

Kobe University, Rokko, Nada, Kobe 657, JAPAN

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# INCREASING RETURNS AND INTERNATIONAL TRADE: A NEW APPROACH

Murray C Kemp, University of New South Wales

Koji Shimomura, University of New South Wales and Kobe University

## 1. INTRODUCTION

In the so-called “new trade theory” it is customary to assume that, in each country, identical oligopolistic firms play a *non-cooperative* (Cournot-Nash or Bertrand-Nash) game. However, it has been argued recently that identical firms which know themselves to be identical will *cooperate* and behave like a single firm; see Kemp and Shimomura (1995). In particular, it has been argued that if all agents in an economy are identical and know themselves to be identical then they will cooperate to achieve an efficient allocation; see Kemp and Long (1992).

In the present paper we adopt an alternative approach to oligopolistic trade theory, retaining the assumption that in each country agents are identical but accepting all the implications of that assumption. Thus we construct a general-equilibrium model of a single autarkic economy and of a trading world, where in each country all agents are identical. By identical agents we mean agents who have the same preferences, technical information, factor endowments and shareholdings. In view of the argument in Kemp and Shimomura (1995), all agents in a country have an incentive to cooperate in forming a giant monopoly firm which produces all goods.

Section 2 presents a general equilibrium model of an autarkic economy which consists of an arbitrary number of increasing-returns-to-scale and constant-returns-to-scale industries. We derive, in a formal way, the Kemp-Long (1992) proposition that in an egalitarian autarkic economy the monopoly firm engages in marginal-cost pricing even in the presence of increasing returns to scale.

Then we move on to a trading world which consists of an arbitrary number of countries. Each of the countries is egalitarian. But the preferences, technology and factor endowments can be arbitrarily different among them. It is assumed throughout

this paper that increasing returns to scale are restricted within the border of each country. Thus a giant firm is formed by the residents of each country. These firms compete oligopolistically in world markets. In Section 3, we prove that each country gains from trade in this general framework, if the oligopoly game has a Cournot-Nash solution.

## 2. AN AUTARKIC ECONOMY

First, let us review our assumptions. There are  $M + 1$  increasing-returns-to-scale (IRS) and constant-returns-to-scale (CRS) goods. We denote the outputs by an  $M$ -dimensional vector  $x$  and a scalar  $x_0$  for good 0 which serves as the numeraire. It is assumed that the (direct) utility function is increasing and strictly quasi-concave.

Let  $x_0 = F(x)$  be the production possibility curve. The objective of the giant firm is described by the indirect utility function of each agent:

$$(1) \quad U = U(p, I)$$

where  $I \equiv \frac{1}{H}[p'x + F(x)]$  is per capita income and  $H$  is the number of agents. The prime (') attached to a vector indicates the transpose of the vector. For simplicity, we normalize  $H$  to be unity. The giant firm seeks to maximize (1) under the following constraints.

$$(2) \quad U_p + U_I x = 0$$

In view of *Roy's Identity*, (2) is the market-clearing conditions for all goods in an autarkic economy.

Under the standard assumptions about preferences, technology and factor endowments, for any given  $x$  there is a unique  $p(x)$  which satisfies (2). Substituting  $p(x)$  into (1), we have

$$(1') \quad \bar{U}(x) \equiv U(p(x), p(x)'x + F(x))$$

The giant firm chooses its output vector  $x$  so as to maximize (1'). Differentiating (1') with respect to  $x$ , we find that

$$\begin{aligned}
(2) \quad \frac{d\bar{U}(x)}{dx} &= \left( \frac{dp(x)}{dx} \right) \cdot [U_p + U_I x] + [p(x) + F_x(x)] \cdot U_I \\
&= [p(x) + F_x(x)] \cdot U_I
\end{aligned}$$

Assume that there is an internal optimal solution. Since  $U_I > 0$ , it follows that the first-order condition is

$$(3) \quad p(x) + F_x(x) = 0$$

Since the absolute value of each element of the vector  $F_x(x)$  is the ratio of the marginal cost of each good to that of the numeraire good, (3) means that the giant firm engages in marginal-cost pricing for both IRS and CRS goods. Thus, the equality is a formal expression of the proposition in Kemp and Long (1992).

Note that in the foregoing argument, and in the subsequent argument as well, the giant firm takes explicit account of the effects of its decisions on factor markets and national income. To our knowledge, it is a standard assumption that oligopolists, even monopolists, take factor prices as given. In this paper, and in an earlier paper by Okawa and Tawada (1995), the assumption is relaxed.

### 3. THE GAINS FROM TRADE PROPOSITION

Now let us move on to a trading world in which there are  $J$  countries each of which is able to produce the  $M + 1$  goods. As already assumed, agents can cooperate only within national borders. Thus, when all countries open their borders,  $J$  giant firms are formed and compete with each other in world markets. The market-clearing conditions for  $M$  non-numeraire goods are

$$(4) \quad \sum_{j=1}^J \frac{U_p^j}{U_I^j} + \sum_{j=1}^J x^j = 0$$

where the superscript  $j$  attached to a variable indicates that the variable belongs to the  $j$ th country.

Suppose that, as in the autarkic case, the system (4) has a unique solution  $p(X)$  for any given  $X \equiv (x^1, \dots, x^J)$ . Substituting the solution in the indirect utility function of an agent of the  $j$ th country, we obtain

$$(5) \quad V^j(p(X)x^j) \equiv U^j(p(X), p(X)'x^j + F^j(x^j))$$

The  $j$ th giant firm chooses the output vector  $x^j$  to maximize (6), taking

$$X_{-j} \equiv (x^1, \dots, x^{j-1}, x^{j+1}, \dots, x^J)$$

as given. Without loss we shall write  $X$  as  $(X_{-j}, x^j)$ .

**PROPOSITION:** *Suppose that the Cournot-Nash oligopoly game has a solution. Then, every country gains from trade.*

**Proof:** Let us denote the Cournot-Nash solution to the oligopoly game by  $X^e \equiv (X_{-j}^e, x^{je})$ . Let us also denote the autarkic equilibrium solution of the  $j$ th country by  $(p_a^j, x_a^j)$ . (In what follows, we omit the superscript  $j$ .)

First,

$$(6) \quad U(p_a, p_a'x_a + F(x_a)) \leq U(p, p'x_a + F(x_a)) \text{ for any } p$$

In particular,

$$(6') \quad U(p_a, p_a'x_a + F(x_a)) \leq U(p(x_a, X_{-1}^e), p(x_a, X_{-1}^e)'x_a + F(x_a))$$

This inequality holds because the standard theory of gains from trade assures us that any small open country with fixed amounts of outputs gains from trade. Second,

$$(7) \quad U(p(x_a, X_{-1}^e), p(x_a, X_{-1}^e)'x_a + F(x_a)) \leq U(p(x^e, X_{-1}^e), p(x^e, X_{-1}^e)'x^e + F(x^e))$$

This inequality comes from the definition of Nash equilibrium. (6') and (7) together imply that

$$(8) \quad U(p_a, p_a'x_a + F(x_a)) \leq U(p(x^e, X_{-1}^e), p(x^e, X_{-1}^e)'x^e + F(x^e))$$

Therefore, the country gains from trade in the weak sense; and, since the (direct) utility function is strictly quasi-concave, the country gains from trade in the strict sense provided only that the equilibrium world price vector differs from the autarkic price vector.



**REMARK:** We have considered the case in which in each country agents cooperate in forming a giant firm which produces all goods. It is possible that some CRS goods are produced competitively. Thus, suppose that there are  $N + 1$  CRS goods which are produced competitively while the remaining  $M - N$  goods are produced by the giant firm. Without loss, we can partition the price and output vectors  $p$  and  $x$  into  $(p^I, p^{II})$  and  $(x^I, x^{II})$ , where  $p^I$  and  $x^I$  are  $N$ -dimensional vectors and  $p^{II}$  and  $x^{II}$  are  $(M - N)$ -dimensional vectors, so that the first  $N$  goods are CRS goods and produced competitively while the remaining  $M - N$  goods are produced by the giant firm. Good 0, the numeraire, is supposed to be a CRS and competitive good.

First, suppose that the production set  $P(x^{II}) \equiv \{(x_0, x^I) : 0 \leq x_0 \leq F(x^I, x^{II})\}$  is a convex set of  $(x_0, x^I)$  for  $x^{II} = x_a^{II}$ . Then the standard theory of gains from trade in convex economies assures us of the inequality.

$$(9) \quad U(p_a, p_a x_a + F(x_a)) \leq U(p, (p^I)' G(p^I, x_a^{II}) + (p^{II})' x_a^{II} + F(x_a)) \quad \text{for any } p$$

where  $G(p^I, x_a^{II})$  is defined as the solution to the first-order conditions for the first  $N$  competitive CRS goods, namely

$$p^{II} + F_{x^I}(x^I, x_a^{II}) \leq 0, \quad [p^I + F_{x^I}(x^I, x_a^{II})]' x^I = 0, \quad x^I \geq 0$$

Based on (9) and by an argument similar to that in the proof of the Proposition, we can prove that the country gains from trade.

Second, if the production possibility set  $P(x_a^{II})$  is not convex for  $x_0$  and  $x^I$ , then there is an incentive to increase the number of goods produced by the giant firm. Therefore, eventually either (i) all goods are produced by the giant firm or (ii) the production possibility set is convex for a given output vector of the giant firm. In any case the above gains-from-trade proposition must hold.

It is pleasing that such a sweeping result has been obtained. For in the earlier work of Kemp and Okawa (1995) it was found that, even under constant returns to scale, trade is necessarily gainful only when there is at most one oligopolistic industry. Of course that paper (and all earlier contributions) was written without benefit of the Kemp-Shimomura point referred to in Section 1.

#### 4. CONCLUDING REMARKS

In deriving the gains-from-trade proposition, we have assumed that the oligopoly game has a Cournot-Nash solution; uniqueness is not required. We now offer a couple of brief remarks about existence.

First, we cannot make use of the standard proofs of existence developed by Friedman (1977, p.160) and Nishimura and Friedman (1981, Theorem 1). Thus, it is one of their sufficient conditions that the strategy space is compact and convex. Under the assumption of increasing returns, however, the production possibility set is not generally convex [Herberg and Kemp (1969), Wong (1996)], which implies that the strategy space also is not generally convex.

On the other hand, it can be shown that in the canonical two-countries two-goods case, with one IRS and one CRS good, there exists a Cournot-Nash equilibrium under quite mild conditions. We conjecture that a Cournot-Nash equilibrium exists in wider contexts under similar conditions; but that remains to be proved.

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