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Perfect Competition and Intra-Industry Trade

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Abstract

The paper presents a formal study of how risk aversion can be applied to analysis of international trade. It seeks to illustrate, amongst other things, that risk-averse firms operating in perfectly competitive markets with uncertainty of demand tend to diversify markets and that this provides the basis for international trade in identical commodities between identical countries. The paper argues that such trade may be welfare-improving, despite efficiency losses due to cross-hauling and transportation costs. Moreover, the analysis shows that reduction of tariff per unit of imported goods (e.g., due to the organization of custom unions) increases trade flows but does not necessarily improve total welfare. Therefore, in some particular cases, the use of sophisticated government intervention can lead to better outcomes than can free trade.

1. Introduction

Casual observation would lead one to conclude that a large part of international trade (called intra-industry trade) cannot be fully explained by classical trade theory. The growing share of such trade in world markets needs explaining. The introduction of product differentiation and economies of scale assumptions into trade models provides a partial answer. The presence of economies of scale creates incentives for countries to specialize in the production of a small number of differentiated products and therefore naturally leads towards intra-industry trade (see Grubel and Lloyd, 1975; Helpman 1983; Krugman, 1979, 1980, 1995), but it is also at the root of imperfectly competitive markets. "New" trade theory starts from these new assumptions (imperfect competition, economies of scale and differentiated goods), and identifies new gains from international trade (see e.g., Brander, 1981; Venebles and Smith, 1986; Hwang and Schulman, 1992). The intuition is simple: by creating larger and more competitive markets within a single industry, trade reduces the distortions associated with imperfect competition in a closed economy. Based on these assumptions, Brander (1981) shows that there are reasons to expect two-way trade even in identical products, due to strategic interactions among firms operating in non competitive markets. What is not so widely recognized is that there are reasons to expect international trade in identical commodities (i.e., within a single industry) even if markets are perfectly competitive. This paper is, then, intended to contribute to the theory of trade between similar or even identical countries (such as trade within the European Union). In particular, countries in the model are assumed to be identical and trade patterns are determined by the interaction of demand uncertainty, risk aversion and the perfectly competitive behavior of firms.

One should note that the paper's basic area of reference, risk reduction via market diversification, is well established in international capital markets and is known as the theory of portfolio choice with risk aversion. The originator of the theory – James Tobin – described its fundamental concept as: "Not putting all the eggs in one basket". This paper, however, explicitly introduces transportation costs, and interprets the model within the framework of international trade. In particular, we show that when transportation costs are small enough and an economy is open to international trade, producers can reduce the risk they face by placing some "eggs" in additional foreign "basket(s)". This reduction in risk is a new motive for international exchange.

The paper is organized as follows: Section 2 presents the trade model. Section 3 characterizes international exchange in free trade equilibrium. This is followed by a discussion of both autarky and free trade equilibrium in Section 4. The Welfare effects of intra-industry trade in perfectly competitive markets are also analyzed. In Section 6 the effects of tariff reductions (e.g. due to integration with a common market) are discussed. Finally, Section 5 summarizes the results and posits some conclusions.

2. The Model

2.1. Markets

Let us suppose that there are two identical countries: Home country and Foreign country. In each country a single commodity can be produced and supplied to perfectly competitive, separated, markets. The countries are identical, but in both of them there is uncertainty about market demand. We assume that two states of nature (*S1* and *S2*) can occur independently in each country. In particular, we assume that in each country the probability of state *S1* is *q*, and the probability of state *S2* is *1-q*. Market demand in each particular state is assumed to be identical in both countries, and in the analysis which follows inverse market demands at state *S1* and *S2* are denoted correspondingly as $D^{-1}(X)+\lambda$ and $D^{-1}(X)-\lambda$ ($\lambda>0$, $dD^{-1}(X)/dX<0$), *where* X($X\geq0$) is the total quantity supplied to the market.

2.2. Firms

The cost function of any firm in the model is given as

$$TC(x+x^{\circ})=C(x+x^{\circ}) \tag{1}$$

where *TC* is a total cost, x and x^{o} denote correspondingly the volume of output supplied to the domestic market and exported (x, $x^{o}\geq0$), and *C* denotes constant marginal cost (no fixed cost is assumed). Transport costs are borne by producers. The per unit transport cost equals t ($t>0$) and is the same in both directions.

In an uncertain world, we assume that any decision on the volume of output to be produced must be taken prior to the sales date, at which actual market demand is known. The firm´s beliefs about market demand are given by the probabilities of state *S1* and *S2*. The firm is assumed to be unable to influence this distribution (i.e., to be able to predict market demand). Moreover, we assume that firms are managed according to the wishes of their owners who are typical asset holders, and that the decisions in each firm are made by a group of decision-makers with sufficiently similar preferences to guarantee the existence of a group-preference function, representable by a von Neuman-Morgenstern utility function[1]. Given these conditions we assume risk aversion, so that the utility function of each firm (*U*) is strictly concave and twice the differentiable function of profits[2].

2.3. Individual Output Decisions

For the sake of clarity we assume that each firm makes its output decisions with sole regard for short-run profits and does not consider the relationship between this output policy and long-term investment and finance policies (a more complete model would make it necessary to draw up a much larger and more detailed list of assumptions about the economic environment of the firm than is needed for the purposes of this paper).

Each firm takes the market prices in each particular state as given and must decide (before the real market price is known) how much of the commodity to produce for domestic consumption and how much to export. Thus, the profit of the firm equals:

$$\pi_1(x,x^\circ)=(P+\lambda)x+(P+\lambda)x^\circ-C(x+x^\circ)-tx^\circ\ , \tag{2}$$

if state *S1* occurs in both countries;

$$\pi_2(x,x^\circ)=(P+\lambda)x+(P-\lambda)x^\circ-C(x+x^\circ)-tx^\circ\ , \tag{3}$$

if state *S1* occurs in the home country and state *S2* occurs in the foreign country;

$$\pi_3(x,x^\circ)=(P-\lambda)x+(P+\lambda)x^\circ-C(x+x^\circ)-tx^\circ\ , \tag{4}$$

if state *S2* occurs in the home country and state *S1* occurs in the foreign country;

$$\pi_4(x,x^\circ)=(P-\lambda)x+(P-\lambda)x^\circ-C(x+x^\circ)-tx^\circ \tag{5}$$

if state *S2* occurs in both countries (to simplify the notation we will skip the arguments

[1] See Sandmo (1971) for discussion.

[2] Sandmo (1971) and Leland (1972) provide detailed justifications for this assumption.

(x, x^o) when referring to the profit functions specified above). Taking the above into account, the firm takes prices as given and maximizes expected utility from profit:

$$E[U(\pi)] \equiv q^2 U(\pi_1) + q(1-q)U(\pi_2) + q(1-q)U(\pi_3) + (1-q)^2 U(\pi_4) \qquad (6)$$

with respect to x and x^o (x, $x^o \geq 0$). Since for risk averse utility function (i.e., $U'(\pi)>0$ and $U''(\pi)<0$) the objective function (6) is strictly concave for any x and x^o (x, $x^o \geq 0$), there exists a single pair ($\tilde{x}$, $\tilde{x}^\circ$) for which the objective function is maximized[3].

2.4. Industry

Industry in both countries is competitive. Given that uncertainty of demand in competitive equilibrium means that there is a finite number of risk averse firms (N) operating in the market[4], total volume of output supplied to the market of any country can be represented as

$$\tilde{X}(P) = N \cdot [\tilde{x}(P) + \tilde{x}^\circ(P)] \ . \qquad (7)$$

Taking into account that the total volume of output supplied depends on the number of firms in the given industry (N), expected equilibrium market prices also depend on N (i.e., $P = P(N)$), and consequently, an equilibrium volume of output supplied to the market by each individual firm can be considered as a function of N, i.e., $\tilde{x}(N)$ and $\tilde{x}^\circ(N)$. The number of firms in the industry N is determined by free entry and exit, such that in equilibrium the expected utility from being in the industry is equal to the expected utility of some benchmark activity b ($b>0$). This yields the industry equilibrium condition[5]

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[3] Note that for any pairs (x_1, x_1^o) and (x_2, x_2^o) , such that (x_1, x_1^o) $\neq$ (x_2, x_2^o), and x_1, x_2, x_1^o $x_2^o \geq 0$, and for any $\gamma \in (0,1)$,

$$\pi_i[\gamma x_1 + (1-\gamma)x_2, \gamma x_1^\circ + (1-\gamma)x_2^\circ] = \gamma\pi_i(x_1, x_1^\circ) + (1-\gamma)\pi_i(x_2, x_2^\circ)$$, and, therefore

$$U\{\pi_i[\gamma x_1 + (1-\gamma)x_2, \gamma x_1^\circ + (1-\gamma)x_2^\circ]\} = U[\gamma\pi_i(x_1, x_1^\circ) + (1-\gamma)\pi_i(x_2^\circ, x_2^\circ)] >$$
$$> \gamma U[\pi_i(x_1, x_1^\circ)] + (1-\gamma)U[\pi_i(x_2, x_2^\circ)]$$

due to strict concavity of the utility function. Since $E\{U[\pi(x, x^o)]\}$ is a linear combination of $U[\pi_i(x, x^o)]$, where $i=1,2,3,4$; $E\{U[\pi(x, x^o)]\}$ is also strictly concave function of x, x^o (x, $x^o \geq 0$).

[4] See Ghosal (1996) for empirical evidence.

[5] See Appelbaum and Katz (1986).

$$E\{U[\pi(\tilde{x}(P),\tilde{x}^{\circ}(P))]\}-b=0\ . \tag{8}$$

3. International Exchange

Below we present the basic proposition of the paper, which states that under demand uncertainty international trade in identical commodities between two separate, statistically identical and perfectly competitive, markets can be observed.

PROPOSITION 1. Market equilibrium involves trade in spite of the fact that both countries produce exactly the same commodity in perfectly competitive environments, and there is an obvious loss due to transportation costs.

Proof. Suppose the total equilibrium volume of output supplied to the market is positive i.e., $\ddot{X}>0$, then an equilibrium output of a single firm $\tilde{\chi}=\tilde{x}+\tilde{x}^{\circ}=\tilde{X}/N$ is also positive ($\ddot{X}>0$). Representing $x^{\circ}=\tilde{\chi}-x$, substituting into (2)-(5) and differentiating (6) with respect to *x*, we get

$$\frac{d}{dx}E[U(\pi)]=\left[q^2\frac{dU}{d\pi}(\pi_1)+q(1-q)\frac{dU}{d\pi}(\pi_2)+q(1-q)\frac{dU}{d\pi}(\pi_3)+(1-q)^2\frac{dU}{d\pi}(\pi_4)\right]\cdot t+2\lambda q(1-q)\left[\frac{dU}{d\pi}(\pi_2)-\frac{dU}{d\pi}(\pi_3)\right]. \tag{9}$$

Note that $\pi_2(x=0)<\pi_3(x=0)$. Consequently, $\frac{dU}{d\pi}(\pi_2)-\frac{dU}{d\pi}(\pi_3)>0$ and $\frac{d}{dx}E[U(\pi)]>0$, for $x=0$ and $x^{\circ}=\tilde{\chi}$. Therefore, the pair ($x=0$, $x^{\circ}=\tilde{\chi}$) cannot be optimal, since for any small $\Delta x>0$, the pair ($x=\Delta x$, $x^{\circ}=\tilde{\chi}-\Delta x$) gives a higher expected utility level. On the other hand, $\pi_2(x=\tilde{\chi})>\pi_3(x=\tilde{\chi})$. Consequently, for $x=\tilde{\chi}$ and $x^{\circ}=0$, $\frac{dU}{d\pi}(\pi_2)-\frac{dU}{d\pi}(\pi_3)<0$ and for sufficiently small *t*, $\frac{d}{dx}E[U(\pi)]<0$. Therefore, for sufficiently small *t* the pair ($x=\tilde{\chi}$, $x^{\circ}=0$) cannot be optimal, since there exists such a pair ($x=\tilde{\chi}-\Delta x$, $x^{\circ}=\Delta x$), where $\Delta x>0$, for which the value of the objective function is higher.

Thus, we conclude that for sufficiently small *t* each firm supplies to both markets (i.e., $\tilde{x}>0$ and $\tilde{x}^{\circ}>0$). This means that if transportation costs are small enough, equilibrium in a market with uncertain demand involves international trade despite the fact that both countries produce exactly the same commodity in perfectly competitive environments, and there is an obvious loss due to transportation costs. If countries are identical, the situation in the foreign country is symmetric to that in the home country, i.e., the firm located in the home country exports to the foreign country and produces for its domestic market, while the firm in the foreign country exports to the home country and produces for its domestic market.

4. Autarky vs. Free Trade

We can now proceed to compare equilibrium in a closed economy with free trade equilibrium. In autarky, a single risk-averse firm takes prices as given and maximizes (with respect to x, $x \geq 0$) expected utility from profit:

$$E[U(\pi)] \equiv qU(\pi_{A1}) + (1-q)U(\pi_{A2}) \ . \tag{10}$$

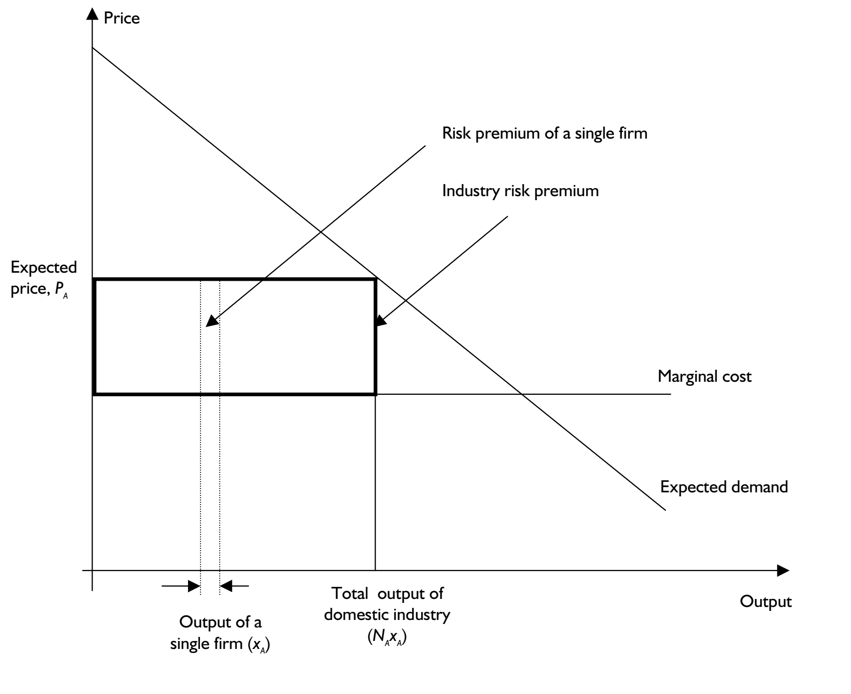
where

$$\pi_{A1} = (P+\lambda)x - Cx \ , \tag{11}$$

$$\pi_{A2} = (P-\lambda)x - Cx \ , \tag{12}$$

denote profits of the firm in state $S1$ and $S2$, respectively. Since for the risk-averse utility function (i.e., $U'(\pi)>0$ and $U''(\pi)<0$) the objective function (10) is strictly concave, for any x ($x \geq 0$), there exists a single x_A for which this function is maximized. Taking into account that under uncertainty of demand in competitive equilibrium there is a finite number of risk-averse firms (N) operating in the market, the total volume of output supplied to the market can be represented as $Nx_A(P)$. Since the total volume of output supplied depends on the number of firms in the industry (N) the expected equilibrium market price (P_A) also depends on N (i.e., $P_A = P_A(N)$), and consequently, an equilibrium volume of output supplied to the market by each individual firm can be considered as a function of N, i.e., $x_A(N)$. The number of firms in industry N is determined by free entry and exit, such that, in equilibrium the expected utility from being in the industry is equal to the expected utility of some benchmark activity b ($b>0$). This yields the industry equilibrium condition $E\{U[\pi(x_A(P_A))]\} - b = 0$.

Figure 1. Autarky equilibrium[6] (N_A denotes an equilibrium number of firms)



The proposition below compares the basic characteristics of the market under consideration in autarky and free trade equilibrium conditions.

PROPOSITION 2. Under uncertainty of demand total free trade volume of output supplied to the market is always greater than it would be in an autarky regime and the expected market price under free trade is smaller than it would be under autarky.

Proof. Let P_A and x_A (P_A, $x_A>0$) denote, respectively, the expected equilibrium market price and equilibrium output of a single firm under autarky. Suppose now that international trade is allowed. Assume that the free trade market price P equals to P_A, and consider the single firm's volume of output supplied to the home market x ($x\geq 0$) and to the foreign market x^o ($x^o\geq 0$), such that $x + x^o = x_A$. Setting $x^o = x_A - x$ and substituting into (2)-(5) yields

[6] For the sake of clarity linear demand is considered.

$$\pi_1 = (P_A + \lambda)x + (P_A + \lambda)(x_A - x) - Cx_A - t(x_A - x)\,, \tag{13}$$

$$\pi_2 = (P_A + \lambda)x + (P_A - \lambda)(x_A - x) - Cx_A - t(x_A - x)\,, \tag{14}$$

$$\pi_3 = (P_A - \lambda)x + (P_A + \lambda)(x_A - x) - Cx_A - t(x_A - x)\,, \tag{15}$$

$$\pi_4 = (P_A - \lambda)x + (P_A - \lambda)(x_A - x) - Cx_A - t(x_A - x)\,, \tag{16}$$

Plugging (13)-(16) into (6), and differentiating it with respect to x, we get:

$$\frac{d}{dx}E[U(\pi)] = \left[q^2\frac{dU}{d\pi}(\pi_1) + q(1-q)\frac{dU}{d\pi}(\pi_2) + q(1-q)\frac{dU}{d\pi}(\pi_3) + (1-q)^2\frac{dU}{d\pi}(\pi_4)\right]\cdot t + 2\lambda q(1-q)\left[\frac{dU}{d\pi}(\pi_2) - \frac{dU}{d\pi}(\pi_3)\right] \tag{17}$$

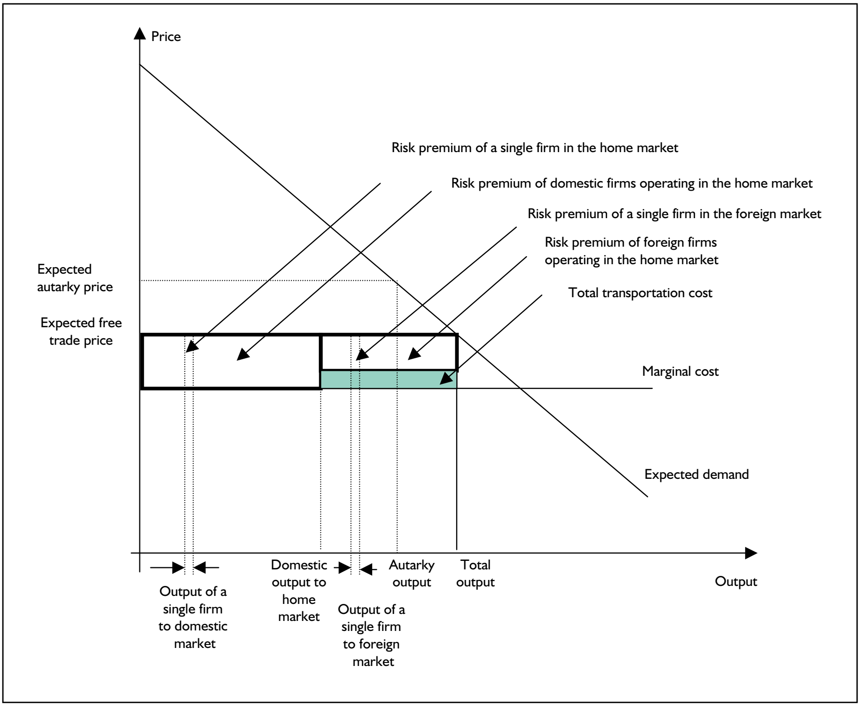
Since $\pi_2(x=x_A)>\pi_3(x=x_A)$ (see (14) and (15)), it follows from the expression above that for sufficiently small value of per unit transportation cost t: $\frac{d}{dx}E[U(\pi)]<0$. Therefore, for some $x<x_A$, $x^o=x_A$-x ($x \geq 0$ and $x^o \geq 0$), the value of the objective function (6) is greater than for $x=x_A$ and $x^o=0$. Note, that the value of the objective function (6) at $P=P_A$, $x=x_A$ and $x^o=0$ is equal to the value of the expected utility function specified by expression (10) at $P=P_A$ and $x=x_A$. Therefore, if the value of the objective function of a single firm at $P=P_A$ and $x=x_A$ and $x^o=0$ equals b, then the value of the objective function of this firm at $P=P_A$ and $x<x_A$, and $\underset{\sim}{x^o} = x_A$-$x$ is greater than b. Consequently, under free trade expected equilibrium price $\tilde{P}$ has to be lower than the expected equilibrium price under autarky P_A. This can happen, however, only if the total equilibrium output supplied to the market under the free trade regime is greater then under autarky (Figure 2).

5. Welfare Effects

This section discusses the impact of intra-industry trade in separated, perfectly competitive markets on overall welfare. Since international trade can be observed only if transportation costs do not exceed a certain level and a further decrease in transportation costs increases trade flows, we focus on the impact of the change in transportation costs on the expected total welfare defined as a sum of expected consumer and producer surplus.

Consumer surplus. Consumer surplus measures the amount a consumer gains from a purchase by the difference between the price he actually pays and the price he would have been willing to pay. Thus, expected consumer surplus equals:

Figure 2. Free trade equilibrium[7]



$$E[CS] = \int_{P}^{+\infty} D(z)dz \ . \tag{18}$$

Taking derivative of (18) with respect to *t* (at $P = \tilde{P}$, where $\tilde{P}$ denotes expected equilibrium market price), we get:

$$\frac{d}{dt}E[CS] = \frac{d}{dt}\int_{\tilde{P}}^{+\infty} D(z)dz = -D(\tilde{P})\frac{d\tilde{P}}{dt} \ . \tag{19}$$

The equilibrium values: $\tilde{x}$, $\tilde{x}^{\circ}$ and $\tilde{P}$, satisfy the following conditions:

$$\frac{\partial}{\partial x}E[U(\pi)] = 0 \ , \tag{20}$$

[7] For the sake of clarity linear demand is considered.

$$\frac{\partial}{\partial x^{\circ}} E[U(\pi)] = 0 \ , \tag{21}$$

$$E[U(\pi)] - b = 0 \ . \tag{22}$$

Consider the equilibrium values $\tilde{x}$, $\tilde{x}^{\circ}$ and $\tilde{P}$ as functions of *t* and differentiate (22) with respect to *t*. Obviously,

$$\frac{d}{dt} E[U(\pi)] \equiv \frac{\partial}{\partial x} E[U(\pi)] \frac{d\tilde{x}}{dt} + \frac{\partial}{\partial x^{\circ}} E[U(\pi)] \frac{d\tilde{x}^{\circ}}{dt} + \frac{\partial}{\partial P} E[U(\pi)] \frac{d\tilde{P}}{dt} + \frac{\partial}{\partial t} E[U(\pi)] = 0 \ . \tag{23}$$

Taking into account (20) and (21), the expression above reduces to

$$\frac{d}{dt} E[U(\pi)] = \frac{\partial}{\partial P} E[U(\pi)] \frac{d\tilde{P}}{dt} + \frac{\partial}{\partial t} E[U(\pi)] \ . \tag{24}$$

Plugging

$$\frac{\partial}{\partial P} E[U(\pi)] = \left[q^2 U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4)\right] \cdot (\tilde{x} + \tilde{x}^{\circ}) \ , \tag{25}$$

and

$$\frac{\partial}{\partial t} E[U(\pi)] = -\left[q^2 U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4)\right] \cdot \tilde{x}^{\circ} \tag{26}$$

into (24) and rearranging we get

$$\frac{d\tilde{P}}{dt} = \frac{\tilde{x}^{\circ}}{\tilde{x} + \tilde{x}^{\circ}} \ , \tag{27}$$

and finally

$$\frac{d}{dt} E[CS] = -D(\tilde{P}) \frac{\tilde{x}^{\circ}}{\tilde{x} + \tilde{x}^{\circ}} \ . \tag{28}$$

Therefore, the expected consumer surplus falls if transportation costs increase.

Producer surplus. Analogous to the concept of expected consumer surplus is that of expected producer surplus, which is understood as expected aggregate profit of the industry.

Let $\tilde{\pi}_i = \pi_i(\tilde{x}, \tilde{x}^{\circ})$, for i=1,2,...,4. In equilibrium the expected producer surplus is determined as

$$E[PS] = \tilde{N}[q^2 \tilde{\pi}_1 + q(1-q)\tilde{\pi}_2 + q(1-q)\tilde{\pi}_3 + (1-q)^2 \tilde{\pi}_4] \ . \tag{29}$$

Differentiating (29) with respect to *t* we get:

$$\frac{d}{dt}E[PS] = \frac{d\tilde{N}}{dt}E[\pi] + \tilde{N}\frac{d}{dt}E[\pi] \ . \qquad (30)$$

Since $\tilde{N} = \tilde{X}/(\tilde{x} + \tilde{x}^{\circ})$,

$$\frac{d\tilde{N}}{dt} = \frac{\frac{d\tilde{X}}{dt}(\tilde{x} + \tilde{x}^{\circ}) - \tilde{X}\frac{d(\tilde{x} + \tilde{x}^{\circ})}{dt}}{(\tilde{x} + \tilde{x}^{\circ})^2} \ . \qquad (31)$$

Taking into account that $\tilde{X} = D(\tilde{P})$, differentiating and rearranging we get:

$$\frac{d\tilde{N}}{dt} = \frac{\frac{dD}{dP}(\tilde{P})\tilde{x}^{\circ} - D(\tilde{P})\left(\frac{d\tilde{x}}{dt} + \frac{d\tilde{x}^{\circ}}{dt}\right)}{(\tilde{x} + \tilde{x}^{\circ})^2} \ . \qquad (32)$$

Taking into account (2-5) and rearranging we have:

$$E[\tilde{\pi}] = \left[q(\tilde{P} - C + \lambda) + (1-q)(\tilde{P} - C - \lambda)\right]\tilde{x} + \left[q(\tilde{P} - C - t + \lambda) + (1-q)(\tilde{P} - C - t - \lambda)\right]\tilde{x}^{\circ} \ . \qquad (33)$$

Differentiating (33) with respect to *t*, and rearranging taking into account (24) we get:

$$\frac{d}{dt}E[\tilde{\pi}] = \left[q(\tilde{P} - C + \lambda) + (1-q)(\tilde{P} - C - \lambda)\right]\frac{d\tilde{x}}{dt} + \left[q(\tilde{P} - C - t + \lambda) + (1-q)(\tilde{P} - C - t - \lambda)\right]\frac{d\tilde{x}^{\circ}}{dt} \ . \qquad (34)$$

Finally, the change of the expected producer surplus with response to change in transportation costs can be represented as

$$\frac{d}{dt}E[PS] = \frac{1}{(\tilde{x} + \tilde{x}^{\circ})^2}\left\{\frac{dD}{dP}(\tilde{P})\tilde{x}^{\circ}E[\tilde{\pi}] + D(\tilde{P})\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)t\right\} \ . \qquad (35)$$

where $E[\tilde{\pi}]$ is given by (33). Thus, the pattern of changes in the expected producer surplus in response to changes in transportation costs, depends on the shape of demand curve. In particular, expected producer surplus falls as transportation costs increase if

$$\frac{\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)t}{\tilde{x}^{\circ}E[\tilde{\pi}]} < -\frac{\frac{dD}{dP}(\tilde{P})}{D(\tilde{P})} \ , \qquad (36)$$

i.e., if

(a) market demand is very elastic (the inverse demand curve is flat),

or/and

(b) per unit transportation costs are negligible (t is close to zero).

Total effect. Under free trade expected welfare is the sum of expected consumer and producer surplus. Consequently, the change in total expected welfare in response to changes in transportation costs is determined as

$$\frac{d}{dt}E[W]=-D(\tilde{P})\frac{\tilde{x}^{\circ}}{\tilde{x}+\tilde{x}^{\circ}}+\frac{1}{(\tilde{x}+\tilde{x}^{\circ})^2}\left\{\frac{dD}{dP}(\tilde{P})\tilde{x}^{\circ}E[\tilde{\pi}]+D(\tilde{P})\left[\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ}-\tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)t\right]\right\}. \quad (37)$$

Thus, total expected welfare decreases if transportation costs increase if

$$\frac{\left[\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ}-\tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)\cdot t\right]/\tilde{x}^{\circ}-(\tilde{x}+\tilde{x}^{\circ})}{E[\tilde{\pi}]}<-\frac{\frac{dD}{dP}(\tilde{P})}{D(\tilde{P})}\quad, \quad (38)$$

i.e., if

(a) market demand is very elastic (the inverse demand curve is flat),

or/and

(b) per unit transportation costs are negligible (t is close to zero).

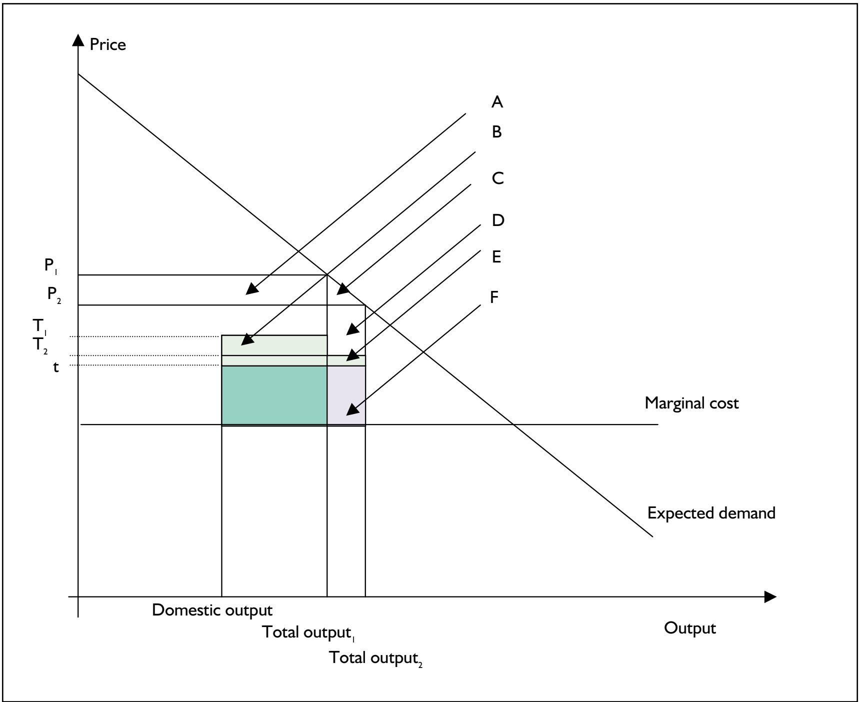
It follows from the above analysis that decreases in transportation costs, which allows countries to extend international exchange, improves expected total welfare if market demand is elastic enough, and decreases expected total welfare in the opposite case.

6. Trade Policy and Intra-industry Trade in Perfectly Competitive Markets

This section provides a background for understanding the effects of the most important instrument of trade policy in the framework of intra-industry trade in perfectly competitive markets. In the analysis which follows we focus on the welfare effects of tariffs – the oldest and the simplest trade policy instrument – since an understanding of the effects of a tariffs remains a vital basis for understanding other trade policies.

Taking into account that per unit transportation costs were assumed to be equal to t ($t>0$) the effect of the change in transportation costs is identical, as the effect of a change in specific tariffs, i.e., tariffs levied as a fixed charge for each unit of goods imported. Assuming that the countries analyzed are statistically identical (the situation is symmetric, i.e., if one country imposes tariffs the other one does the same), the expected total welfare equals the sum of expected consumer surplus, producer surplus and revenue from tariffs, less losses associated with transportation.

Figure 3. Welfare effects of tariff reduction (t – unit transportation cost, T_1 – initial tariff per unit of good imported, T_2 – reduced tariff per unit of good imported)[8]



Notes:
A+C: Increase in expected consumer surplus,
E-B: Increase in tariff revenue,
D+B-A: Increase in expected producer surplus,
F: Increase in total transportation cost.

If transportation costs are negligible ($t=0$) then a decrease in tariff per unit increases the volume of trade, and consequently, the total volume of output supplied to the market. It decreases expected deadweight loss and improves expected total welfare. If transportation costs are significant, but international exchange still takes place, then the impact of tariffs cannot be unambiguously determined. In particular, the overall effect depends on the relationship between the change in the sum of expected consumer surplus, expected producer surplus and revenue from tariffs, and the change in losses

[8] For the sake of clarity linear demand is considered.

associated with transportation (see Figure 3). Obviously, if additional transportation costs (area F in Figure 3) exceed total expected gains from tariff reduction (in Figure 3 area: C+D+E) then the overall welfare effect of tariff reduction is negative (i.e., tariffs are welfare improving), otherwise a reduction in tariff increases expected overall welfare. Consequently, in the case of intra-industry trade in perfectly competitive markets a reduction of tariff per unit of good imported (or free trade) does not necessarily improve overall welfare. Therefore, in some cases the use of sophisticated government intervention can lead to better outcomes than free trade.

7. Conclusion

The above analysis illustrates that there is some justification for international trade in identical goods even if markets are perfectly competitive. International exchange of identical commodities (cross-hauling) occurs due to the fact that risk-averse firms operating in separated and perfectly competitive markets with price uncertainty tend to diversify markets. If transportation costs are small enough this gives a basis for international trade even between identical countries. This is a view of trade which appears to be useful in understanding trade among industrialized countries.

The basic idea of the paper: risk reduction by market diversification has been adopted from a theory of portfolio choice with risk aversion. However, in the model above we have introduced transportation costs explicitly and we interpret it as a model of international trade (we should note, however, that the result would be similar if each risk-averse firm operated a plant in the home country and a higher cost plant in a foreign country, without trade taking place). The paper demonstrates that if firms act in each competitive market separately, international trade in identical commodities can arise and also, that such trade may improve welfare (even despite the existence of cross-hauling, which is obviously inefficient due to costly transportation).

The brief analysis of basic trade policy presented in the paper shows that in the case of intra-industry trade in perfectly competitive markets tariff reduction (or free trade) does not necessarily improve total welfare (it has to be recognized, however, that if transportation costs are negligible tariffs are never welfare improving). Therefore, in some cases, the use of sophisticated government intervention can led to better outcomes than free trade (similar to trade in oligopolistic industries).

Finally, we should stress that the present paper only indicates the possibility and some characteristics of international trade based on the interaction of demand uncertainty, risk aversion and perfectly competitive behavior of firms. In order to present this idea we have focused on the simplest case (two identical countries) and tariffs as a basic policy instrument. We have said nothing about asymmetric cases (e.g., countries with identical tastes but of different sizes) and other policy instruments, but detail analysis of these and other issues is left for further research.

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