Demand Uncertainty, Perfect Competition and Foreign Direct Investment[*]

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Abstract

Foreign direct investment (FDI) brings host countries capital, productive facilities, and technology transfers, as well as new jobs and management expertise. Thus, it is important to understand the basic reasons for FDI inflow and make clear what gains from FDI are. In the present paper, based on theoretical findings we formulate clear message stating that inflow of FDI does not need to be explained by any specific factor such as e.g., location advantage or ownership advantage, but it is a natural process driven by rational behavior of firms operating in perfectly competitive markets in uncertain environment. It is shown in a novel setting that flow of FDI between similar – even identical – countries with perfectly competitive markets is possible and can be welfare improving, despite obvious losses due to higher transaction/management costs in foreign plants.

JEL Classification: F15, F23, P20, C23.

Keywords: FDI, foreign direct investment, demand uncertainty, determinants of FDI, gains from FDI

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1. Introduction

It has been proven in economic literature that among the developing countries the fastest growing ones are the biggest recipients of FDI.[1] The empirical evidence suggests that for emerging economies, a one percentage point increase in FDI (measured as a proportion of GDP) leads, *ceteris paribus*, to an extra 0.8 percentage point increase in per-capita income (Bergsman, Broadman, Drebentsov, 2000). Moreover, it is generally accepted that FDI brings at least four things of value: financial capital, management skills, technology, and access to export markets, and, therefore, sustains growth. Consequently, in many countries FDI is viewed as a panacea for diverse problems related to economic development and it is continued to be at the forefront of economic policy decisions.

There has already been a great deal of discussion about factors determining flows of FDI. The standard practice is to view FDI as arising from three distinct types of advantages (see e.g., Dunning, 1981, 1993, and Rugman, 1998). The firm must have own or control a unique mobile asset (i.e., patent or trademark) it wishes to exploit (*the ownership advantages*); it must exploit differences in country natural endowments, transport costs, cultural factors and government regulations to be cost efficient in the asset abroad in addition to or instead of in the firm's home country (*the location advantage*); and it must be in the firm's interest to control the asset's exploitation itself rather than contracting out use of the asset to an independent foreign firm (*the internationalization advantage*). It is argued that if only the first condition is met, firms will rely on exports, licensing or the sale of patents to service a foreign market, while in the presence of *internalization incentives* FDI becomes the preferred mode of servicing foreign markets, but only if location-specific advantages are present.

In contrary to the results described in the literature the analysis presented in the present paper, intends to show that inflow of FDI can be entirely driven by rational behavior of firms operating in uncertain environment, and consequently, except of *the internationalization advantage* no other conditions need to be fulfilled in order to observe flow of FDI. In particular, in order to demonstrate that the first two conditions described above are not really necessary for FDI inflow, the analysis focuses on two identical countries (i.e., *the location specific advantage* is not present) and perfectly competitive firms (production technology is a common knowledge, i.e., there is no *the ownership specific advantage*) operating in uncertain environment (i.e., facing uncertain demand). In such a setting we show that *the internationalization advantage* results exclusively from the reduction of market risk through geographical diversification of production activities, and thus, the presence of *the internationalization advantage* is fully enough to justify location of production activities in other countries. The motivation of such kind of FDI (*risk reducing FDI*) is to rationalize the structure of production facilities in such a way that the investing company can gain from the risk reduction following from geographically dispersed production activities. The analysis of the welfare effects of FDI inflow reveals that risk reducing FDI has always positive impact on expected consumer surplus in the host country but not always increases expected producer surplus measured as expected profit of the production sector (at the same time each individual

[1] See eg., World Investment Report 2002: Transnational Corporations and Export Competitiveness (2002)

producer/investor is always better off), and, consequently, welfare of the host country as a whole.

One should note that the paper's basic area of reference, risk reduction via foreign direct investment, 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, focuses on non-tradable goods produced in perfectly competitive environment, introduces additional transaction/management costs required to operate production plant in foreign country, and interprets the model within the framework of theory of FDI. In particular, we show that when additional transaction/management costs associated with production activities abroad are small enough, producers can reduce the risk they face by placing some "eggs" in additional foreign "basket(s)". This reduction in market risk is a new motive for FDI.

The paper is organized as follows. In Section 2 a model of perfectly competitive industry facing uncertain demand is presented. Optimal behavior of firms operating in the single market is characterized in Section 3. Section 4 describes market equilibrium when geographical diversification of production activities (i.e., flow of FDI) is allowed and presents the basic results of the entire analysis. In Section 5 welfare effects of risk-reduction driven FDI are analyzed and the last Section concludes.

2. The model

2.1. Markets

Imagine a world economy in which there are two geographically distributed countries, called *A* and *B*. In each country merely a single non-tradable commodity is produced,[2] and supplied to perfectly competitive market.

The countries are identical, and in both of them there is uncertainty about market demand. In particular, we assume that two states of nature, say *S1* and S2, may occur independently 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 defined as $D^{-1}(X)+\lambda$ and $D^{-1}(X)-\lambda$, with $dD^{-1}(X)/dX<0$ and $D^{-1}(X)-\lambda>0$ for any $X\geq 0$, respectively. X ($X\geq 0$) is the total quantity supplied to the market, and λ is a constant parameter $\lambda>0$ identical in both states of the nature (it shifts demand curve up and down according to the state of nature).

[2] Alternatively it can be assumed that large distance between countries and high transportation costs make international exchange non-profitable.

2.2. Firms

In this framework of one (non-tradable) commodity, two-states of the world, and two identical countries the model assumes that firms produce a single output, behave purely competitively, know their cost functions with certainty and facing uncertain demand maximize expected utility of profit. The cost function of a single firm is

(1) $$TC(x) = F + Cx\,,$$

where *TC* is total cost, *x* denotes the volume of output supplied to the market ($x \geq 0$), *C* represents constant marginal cost, and *F* stands for fixed cost.

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 states *S1* and *S2*, and 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.[3] 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 π so that[4]

(2) $U(\pi=0)=0$, $U'(\pi0)>0$ and $U''(\pi)<0$,

and finally

(3) $lim_{\pi\rightarrow-\infty} U'(\pi)=\infty$, and $lim_{\pi\rightarrow\infty} U'(\pi)=0$.

Following the literature on the subject we assume that the objective of any firm operating in a single market is to maximize the expected utility of profit. The firm's profit function in state *S1* and state *S2* can now be defined as

(4) $$\pi_{A1} = (P_A + \lambda)x - C\ x - F$$

and

(5) $$\pi_{A2} = (P_A - \lambda)x - C\ x - F$$

[3] See Sandmo (1971) for discussion.
[4] Sandmo (1971) and Leland (1972) provide detailed justifications for this assumption.

respectively. π_{A1} represents profit of the firm in state *S1* and π_{A2} profit of the firm in state *S2*, P_A stands for market price, λ, C and x are defined as above.

3. Market equilibrium in closed economy

Risk averse firms operating in isolated market seek to maximize expected utility of profit under perfect competition, that is

$$(6) \qquad \underset{x_A}{Maximize}\ E\left[U\left(\pi\right)\right] = \underset{x_A}{Maximize}\left[q\,U\left(\pi_{A1}\right)+\left(1-q\right)U\left(\pi_{A2}\right)\right]$$

where E is the expectation operator. x_A denotes volume of output in closed economy. $U(.)$, π_{A1}, π_{A2} and q are defined as above. Since $E\left[U\left(\pi\right)\right]$ is strictly concave the second order condition of the optimization problem (6) is always satisfied. Simple rearrangement of the first order condition shows that optimal behaviour requires that:

$$(7) \qquad P_A = C + \lambda \frac{(1-q)\,U'(\pi_{A2}) - q\,U'(\pi_{A1})}{q\,U'(\pi_{A1}) + (1-q)\,U'(\pi_{A2})}\,.$$

Since under uncertainty multiplier of λ in the expression above is always smaller than 1, $C-\lambda < P_A < C+\lambda$. It is evident that if $C-\lambda < P_A < C+\lambda$, the first derivative of $E\left[U\left(\pi\right)\right]$ is positive for $x_A = 0$ and negative for $x_A = \infty$. Therefore, the necessary and sufficient condition for the existence of a unique solution of (6) is

$$(8) \qquad C + \lambda(1-2q) < P_A < C + \lambda\,.$$

Thus, in market equilibrium conditions (7) and (8) have to hold. Taking into account that total volume of output supplied to the market is $N_A x_A$, with N_A denoting the number of firms operating in the market, an equilibrium market clearing condition can be obtained as

$$(9) \qquad D^{-1}(\tilde{N}_A \tilde{x}_A) = C + \lambda \frac{(1-q)U'[\pi_{A2}(\tilde{N}_A, \tilde{x}_A)] - qU'[\pi_{A1}(\tilde{N}_A, \tilde{x}_A)]}{qU'[\pi_{A1}(\tilde{N}_A, \tilde{x}_A)] + (1-q)U'[\pi_{A2}(\tilde{N}_A, \tilde{x}_A)]}\,,$$

where the tilde denotes equilibrium values. Perfect competition under demand uncertainty implies that the expected utility of profit of any individual firm equals to zero, i.e.

$$(10) \qquad E\{U[\pi(\tilde{N}_A, \tilde{x}_A)]\} = 0\,.$$

Thus, solving together equations (9)-(10) yields the equilibrium values $\tilde{N}_A$ and $\tilde{x}_A$, while the equilibrium market price $\tilde{P}_A$ is obtained from equation (7).

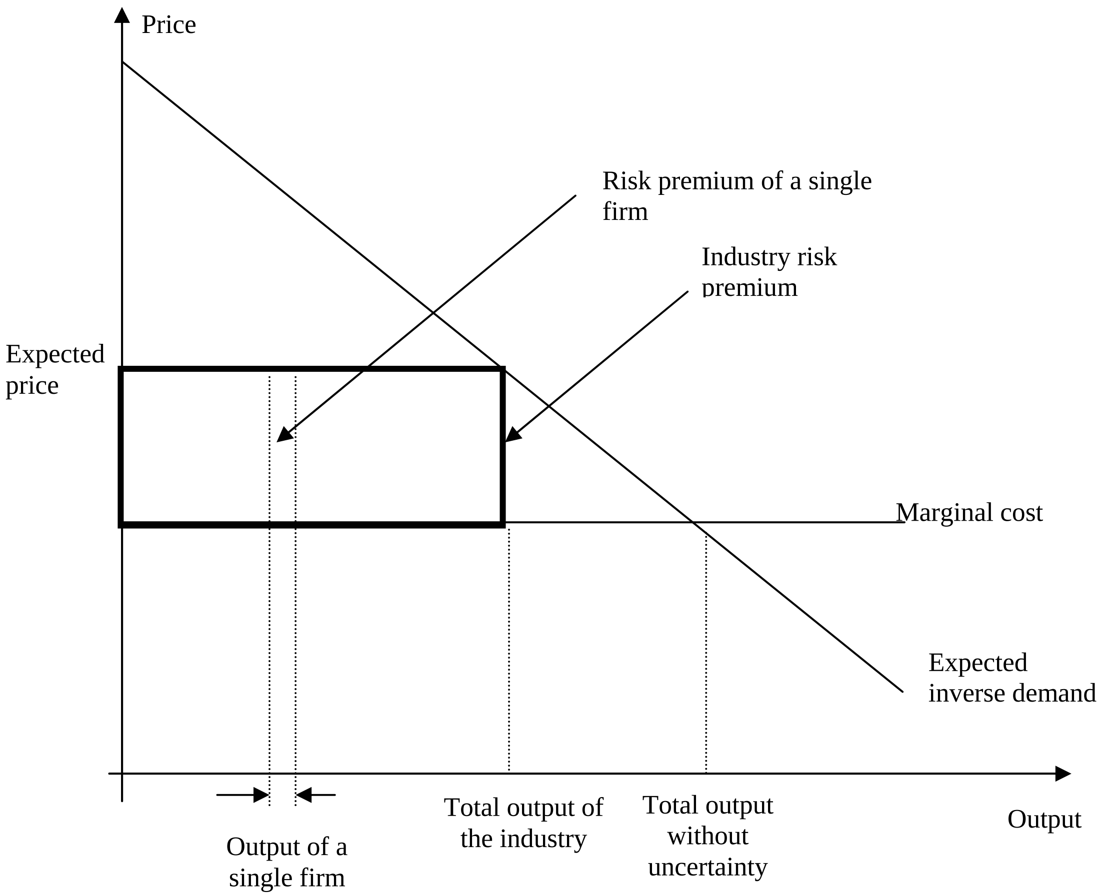

Figure 1. Market equilibrium in closed economy

Figure 1 serves to illustrate the market equilibrium in a closed economy. For expository convenience demand is assumed to be linear. Expected profit (risk premium) of any firm operating in the market is non-negative. The rectangle refers to the risk premium of N_A firms, that is industry risk premium. Note, that even if N_A would be small, the market would be still perfectly competitive, that is, none of the firms would has a monopolistic power. In the extreme case (very strong risk-aversion) there could be $N_A = 1$, and even so, this single firm would exhibit perfectly competitive behaviour (i.e., would be price taker with expected utility from profit equal to zero).

4. Market equilibrium when FDI is allowed

Now suppose that there is a possibility to operate on foreign markets, i.e., that the firm can operate a production plant abroad and use it to supply goods to foreign market. In this case all economic considerations concerning production in the world open for FDI need to start from the basic decision concerning national/multinational character of production activities, i.e., the firm needs to make a decision what is better: to operate only on domestic market or to go internationally and operate on both domestic and foreign markets? In the analysis which follows it is assumed that a firm consists of headquarter and one or more production plants (Hanson, 2001). Knowing investment costs and life time of the investment the firm can estimate total production costs in any possible production option. Assuming that both countries under consideration are identical the total production cost in foreign plant will be higher only by additional transaction/management costs associated with production abroad (e.g., additional cost of management personnel delegated from headquarter/home plant to work abroad). Thus, similarly to closed economy, in the world open for FDI, each firm knows its cost structure at home and abroad, takes the market price in any particular state of nature as given, and must decide – before the real market price is known – how much of the commodity to produce in domestic plant for domestic consumption and how much in foreign plant for foreign consumption. Formally, we can assume that the firm considering possibility of multinational production takes into account the following objective function:[5]

(11) $$\max_{\substack{x_1, x_2, \ldots x_T \geq 0 \\ x_1^{\circ}, x_2^{\circ}, \ldots x_T^{\circ} \geq 0}} \sum_{t=1}^{T \leq \infty} \left\{ \beta^t E\left[U(\pi_t(x_t, x_t^{\circ})\right]\right\},$$

where

E – expectation operator,
β – discounting coefficient ($\beta \in (0,1)$),
T – time horizon,

Taking into account that discounting coefficient is exogenous, and specific for a particular firm/industry, and time horizon and investment costs depend on the type of investment, the value of discounted steam of expected utility form profit depends on expected utility from profit in each particular period. Thus, the objective function (11) is maximized, if expected utility from profit in each particular period is maximized.

For any particular time period t ($t \in \{1,2,\ldots,T\}$) the firm faces the following optimization problem (to simplify notation in the analysis which follows we will skip subscript t):

(12) $$\underset{x, x^{\circ}}{Maximize}\ E[U(\pi)] \equiv \underset{x, x^{\circ}}{Maximize} \left[q^2\, U(\pi_1) + q\,(1-q)\, U(\pi_2) + q\,(1-q)\, U(\pi_3) + (1-q)^2\, U(\pi_4) \right]$$

[5] For the simplicity it is assumed that investment time equals zero (overnight investment) and the output is produced already in the first period.

where

(13) $$\pi_1(x,x^\circ) = (P+\lambda)x + (P+\lambda)x^\circ - C(x+x^\circ) - (F+F^\circ) - tx^\circ,$$

(14) $$\pi_2(x,x^\circ) = (P+\lambda)x + (P-\lambda)x^\circ - C(x+x^\circ) - (F+F^\circ) - tx^\circ,$$

(15) $$\pi_3(x,x^\circ) = (P-\lambda)x + (P+\lambda)x^\circ - C(x+x^\circ) - (F+F^\circ) - tx^\circ,$$

(16) $$\pi_4(x,x^\circ) = (P-\lambda)x + (P-\lambda)x^\circ - C(x+x^\circ) - (F+F^\circ) - tx^\circ.$$

$\pi_1(\cdot)$ denotes profit of the firm if state $S1$ occurs in both countries; $\pi_2(\cdot)$ profit of the firm if state $S1$ appears in the home country and state $S2$ in the foreign country; $\pi_3(\cdot)$ profit if state $S2$ occurs in both countries, and finally $\pi_4(\cdot)$ profit if state $S2$ occurs in the home country and state $S1$ in the foreign country. P stands for the market price, F° denotes fixed cost of foreign plant, $U(\cdot)$, q, x, x°, λ and C are defined as above. t denotes additional transaction/management costs associated with operating production plant abroad. For simplicity it is assumed that additional transaction/management costs depend on the volume of output produced in foreign plant, i.e., t it is a part of variable cost of foreign plant.

The utility function $U(\pi)$in equation (12) exhibits risk-aversion, i.e., it is $U'(\pi) > 0$ and $U''(\pi) < 0$, and thus, $E[U(\pi)]$ is strictly concave for any x and x° $(x, x^\circ \geq 0)$ $x^\circ \geq 0$. Thus, using similar arguments as in the case of the closed-economy, one can show that there exists a single pair $(\tilde{x}, \tilde{x}^\circ)$ for which the objective function (12) is maximized.

For the sake of exposition, let us assume for the time being that $x^\circ = 0$ (i.e., that FDI is not allowed), and let us denote the first derivative of the utility function with respect to π as $U'(\pi)$ then equilibrium[4] market price is given as

(17) $$D^{-1}[\tilde{N}(\tilde{x}+\tilde{x}^\circ)] = C + \lambda \frac{q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4) - q^2 U'(\pi_1) - q(1-q)U'(\pi_2)}{q^2 U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4)},$$

(18) $$D^{-1}[\tilde{N}(\tilde{x}+\tilde{x}^\circ)] = C + t + \lambda \frac{q(1-q)U'(\pi_2) + (1-q)^2 U'(\pi_4) - q^2 U'(\pi_1) - q(1-q)U'(\pi_3)}{q^2 U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4)}$$

and expected utility of profit as

(19) $$E\{U[\pi(\tilde{N}, \tilde{x}, \tilde{x}^\circ)]\} = 0.$$

Now we can relax the restriction on flow of FDI and proceed to analyze the equilibrium in the world open for FDI. Below we present the basic proposition of the paper, which states that under demand uncertainty, when additional transaction/management costs associated with operating production plant abroad are small, firms will be involved in production activities in foreign markets, even if any special reasons for FDI inflow (e.g., cheap natural resources or labor) are not present in a host country, i.e., flow of FDI between two separated countries, with statistically identical demands and perfectly competitive markets can be observed.

PROPOSITION 1. *Rational behavior of perfectly competitive firms operating in uncertain environment implies internalization of production even if additional transaction/management costs associated with production abroad make foreign plant less competitive.*

Proof.

Suppose the total equilibrium volume of output supplied to the market is positive i.e., $\tilde{X} > 0$, then an equilibrium output of a single firm $\tilde{\chi} = \tilde{x} + \tilde{x}^{\circ} = \tilde{X} / N$ is also positive $(\tilde{\chi} > 0)$. Substituting $x^{\circ} = \tilde{\chi} - x$ into (13)-(16) and differentiating (12) with respect to *x*, we get

(19) $$\frac{d}{dx}E[U(\pi)] = \left[q^2 U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2 U'(\pi_4)\right] \cdot t + 2\lambda\, q(1-q)\left[U'(\pi_2) - U'(\pi_3)\right].$$

Note that $\pi_2(x=0) < \pi_3(x=0)$. Consequently, $U'(\pi_2) - U'(\pi_3) > 0$ 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, $\pi_2(x = \tilde{\chi}) > \pi_3(x = \tilde{\chi})$. Clearly this implies that for $x = \tilde{\chi}$ and $x^{\circ} = 0$ $U'(\pi_2) - U'(\pi_3) < 0$, and that for sufficiently small *t*: $\frac{d}{dx}E[U(\pi)] < 0$. Thus, 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 produces on both markets (i.e., $\tilde{x} > 0$ and $\tilde{x}^{\circ} > 0$).

This means that if additional transaction/management costs are small enough, equilibrium in a market with uncertain demand involves international production (flow of FDI) despite the fact that each firm may produce in both countries exactly the same commodity in perfectly competitive environments, and there is an obvious loss due to additional transaction/management costs associated with foreign production. If countries are identical, the situation abroad is symmetric to that in the home country. That is, the firm located in country *A* produces non-tradable commodity under consideration also in country *B*, and the firm located in country *B* produces the same commodity also in country *A*.

The proposition below compares the equilibrium characteristics of the market under consideration in closed economy and when FDI is allowed.

PROPOSITION 2. *Under uncertainty of demand total volume of output supplied to the market if FDI is allowed is always greater than it would be in the* *economy closed for FDI, and the expected market price when FDI is allowed is always smaller than it would be in the closed economy.*

<u>Proof.</u>

Let P_A and x_A ($P_A, x_A > 0$) denote the expected equilibrium market price and equilibrium output of a single firm in the closed economy, respectively, and suppose, that FDI is allowed. Let under FDI regime market price P equal to P_A, and consider the single firm's volume of output produced in home country x ($x \geq 0$) and in the foreign country x° ($x^\circ \geq 0$), such that $x + x^\circ = x_A$. Setting $x^\circ = x_A - x$ and substituting into (13)-(16), plugging to expression (12), and differentiating it with respect to x, we get:

(20) $$\frac{d}{dx}E[U(\pi)] = \left[q^2\,U'(\pi_1) + q(1-q)U'(\pi_2) + q(1-q)U'(\pi_3) + (1-q)^2\,U'(\pi_4)\right]\cdot t + 2\,\lambda\,q(1-q)\left[U'(\pi_2) - U'(\pi_3)\right].$$

Since $\pi_2(x{=}x_A) > \pi_3(x{=}x_A)$, it follows from the expression above that for sufficiently small t [smaller than t_m (see inequality (23)] $\frac{d}{dx}E\left[U(\pi)\right] < 0$. Therefore, for some $x < x_A$, and $x^\circ = x_A - x$ ($x \geq 0$ and $x^\circ \geq 0$), the value of the objective function $E\left[U(\pi)\right]$ in equation (12) is greater than for $x{=}x_A$ and $x^\circ = 0$. Note that this value at $P{=}P_A$, $x{=}x_A$ and $x^\circ = 0$ is equal to the value of the expected utility function specified by expression (6) 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 $x^\circ = 0$ equals 0, then the value of $E\left[U(\pi)\right]$ of this firm at $P{=}P_A$ and $x < x_A$, and $x^\circ = x_A - x$ is greater than 0. Consequently, if FDI is allowed expected equilibrium price $\tilde{P}$ has to be lower than the expected equilibrium price in closed economy P_A. This can happen, however, only if the total equilibrium output supplied to the market if FDI is allowed is greater than in the closed economy.

FIGURE 2 serves to illustrate these arguments graphically. For expository convenience, demand is assumed to be linear again. It is evident from the figure that although in the situation when FDI is allowed the output of domestic firm is smaller than in closed economy, the total output supplied to the market increases. This affects distribution of welfare in the host country.

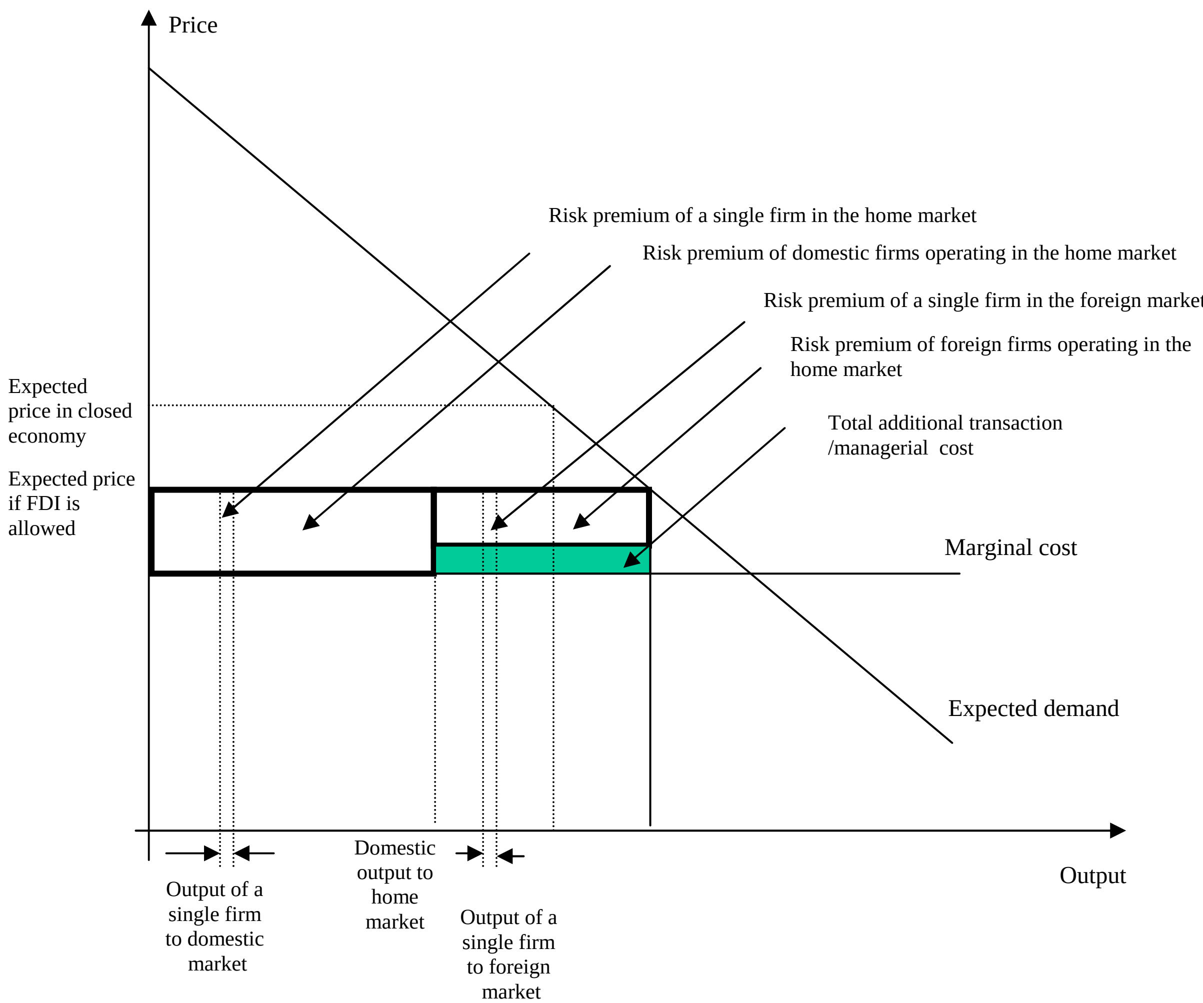

Figure 2. Market equilibrium when FDI is allowed

5. Welfare effects

This section discusses the impact of FDI on welfare distribution in the host country. Since flow of FDI can be observed only if additional transaction/management costs associated with production abroad do not exceed a certain prohibitive level and a further decrease of these costs increases FDI flows, we focus on the impact of the change in additional transaction/management costs on the expected total welfare defined as a sum of expected consumer and producer surplus.

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

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

where E denotes the expectation operator, D market demand. Taking the derivative of (21) with respect to t (at $P = \tilde{P}$, where $\tilde{P}$ denotes expected equilibrium market price), we get:

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

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

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

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

(25) $$E[U(\pi)] = 0.$$

Consider the equilibrium values $\tilde{x}$, $\tilde{x}^{\circ}$ and $\tilde{P}$ as functions of *t* and differentiate (25) with respect to *t*. Then

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

Taking into account (23) and (24), expression (26) reduces to

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

Plugging

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

and

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

into (27) and rearranging we get

(30) $$\frac{d\tilde{P}}{dt} = \frac{\tilde{x}^{\circ}}{\tilde{x} + \tilde{x}^{\circ}}$$

and finally

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

Therefore, the expected consumer surplus falls if per unit additional transaction/management costs associated with production abroad increase.

Producer Surplus. The concept of expected producer surplus (*PS*) is understood as expected aggregate profit of the industry. Let $\tilde{\pi}_i = \pi_i(\tilde{x},\tilde{x}^{\circ})$ for i=1,..., 4. In equilibrium the expected producer surplus is determined as

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

Differentiating (32) with respect to *t* we get:

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

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

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

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

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

Bearing in mind (13)–(16) we can represent expected value of equilibrium profit as:

(36) $$\begin{aligned} E[\tilde{\pi}] &= \left[q\,(\tilde{P}-C+\lambda) + (1-q)\,(\tilde{P}-C-\lambda)\right]\tilde{x} + \\ &+ \left[q\,(\tilde{P}-C-t+\lambda) + (1-q)\,(\tilde{P}-C-t-\lambda)\right]\tilde{x}^{\circ} - (F+F^{\circ}) \end{aligned}\,.$$

Differentiating (36) with respect to *t*, rearranging and taking into account (27) we obtain:

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

Finally, the change of the expected producer surplus with response to change in per unit additional transaction/management costs associated with production abroad can be represented as

$$(38) \qquad \frac{d}{dt}E[PS] = \frac{1}{(\tilde{x}+\tilde{x}^{\circ})^2}\left\{\frac{dD}{dP}(\tilde{P})\tilde{x}^{\circ}E[\tilde{\pi}] + D(\tilde{P})\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)\ t\right\},$$

where $E[\tilde{\pi}]$ is given by (36). Thus, the pattern of changes in the expected producer surplus in response to changes in per unit additional transaction/management costs associated with production abroad depends on the shape of demand curve. In particular, expected producer surplus falls as additional transaction/management costs increase if

$$(39) \qquad \frac{\left(\frac{d\tilde{x}}{dt}\tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)\ t}{\tilde{x}^{\circ}E[\tilde{\pi}]} < -\frac{\frac{dD}{dP}(\tilde{P})}{D(\tilde{P})},$$

that is, if (i) market demand is very elastic (the inverse demand curve is flat), and/or (ii) per unit additional transaction/management costs associated with production abroad are negligible (t is close to zero).

Total effect. Expected welfare is the sum of expected consumer and producer surplus. Consequently, the change in total expected welfare in response to changes in per unit additional transaction/management costs associated with production abroad is determined as

$$(40) \qquad \frac{d}{dt}E[W] = -D(\tilde{P})\frac{\tilde{x}^{\circ}}{\tilde{x}+\tilde{x}^{\circ}} + \frac{1}{(\tilde{x}+\tilde{x}^{\circ})^2}\left\{\frac{dD}{dP}(\tilde{P})\tilde{x}^{\circ}E[\tilde{\pi}] + D(\tilde{P})\left[\left(\frac{d\tilde{x}}{dt}\ \tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)\ t\right]\right\}.$$

Thus, total expected welfare decreases if

$$(41) \qquad \frac{\frac{1}{\tilde{x}^{\circ}}\left[\left(\frac{d\tilde{x}}{dt}\ \tilde{x}^{\circ} - \tilde{x}\frac{d\tilde{x}^{\circ}}{dt}\right)t\right] - (\tilde{x}+\tilde{x}^{\circ})}{E[\tilde{\pi}]} < -\frac{\frac{dD}{dP}(\tilde{P})}{D(\tilde{P})},$$

that is, if (i) market demand is very elastic (the inverse demand curve is flat), and/or (ii) in per unit additional transaction/management costs associated with production abroad are negligible (t is close to zero).

We may conclude from the above analysis that decrease in per unit additional transaction/management costs associated with production abroad, which allows countries to increase the scale of international production, improves expected total welfare if market demand is elastic enough, and reduces expected total welfare in the opposite case.

6. Conclusion

Existing literature on the subject cites a large number of different factors that have an impact on the flow of FDI. Economists agree that the most important determinants for the location of FDI are economic considerations. Following from the principal motivations for investing in foreign countries, economic determinants can be grouped into three clusters, such as resource-seeking, market-seeking and efficiency-seeking. A main stream of the research in the area, however, entirely ignores risk – the other important aspect of economic activity – resulting from the fact that in real life firms always operate in uncertain environment and are not neutral towards risk (typically firms are risk averse).

The analysis presented in this paper provides an interesting way to gain insight into this issue. The results show that risk-averse firms prefer to operate in different, spatially distributed countries, even when they are completely identical (but with independent demand shocks) and if additional transaction/management costs associated with foreign production are positive (but small). Hence flow of FDI can be observed even if *location specific advantage* is not present (countries are identical) and there is no *ownership specific advantage* (firms operate in perfectly competitive markets and production technology is a common knowledge). Thus, in contrary to the results described in the literature, the present paper shows that flow of FDI can be entirely driven by rational behavior of firms operating in uncertain environment, and consequently, except of *the internationalization advantage* no other conditions need to be fulfilled in order to observe FDI inflow. In a novel setting, it is shown that *the internationalization advantage* may result exclusively from the reduction of market risk following from geographical diversification of production activities, and thus, existence of *the internationalization advantage* is sufficient to justify location of production activities in other countries. The basic motivation for risk reducing FDI is to rationalize the structure of production facilities in such a way that the investing firm can gain from the risk reduction following from geographically dispersed activities.

The results of the analysis concerning welfare effects of FDI inflow on the host country reveal that risk reducing FDI has always positive impact on expected consumer surplus but not always increases expected producer surplus measured as expected profit of the production sector (at the same time each individual producer/investor is always better off). Therefore, a total welfare effect of risk reducing FDI on the host country may not always be positive.

The basic idea of the paper: risk reduction by market diversification has been adopted from the theory of portfolio choice with risk aversion. However, in the model above we focused on risk-averse firms that may operate a production plant in the home country and a higher cost production plant in a foreign country, without international trade taking place. We should note, however, that the result would be similar if tradable goods are considered and transportation costs are introduced explicitly in the similar analytical framework, and if the model is analyzed in typical international trade setting (Cukrowski, Aksen and Fischer, 2002; and Cukrowski and Aksen, 2003). Similarly, free trade in shares of the firms would be a vehicle to diversify risk without incurring additional transaction/management or transportation costs.

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