MARKET STRUCTURE, TECHNOLOGICAL GAP AND VERTICAL LINKAGE EFFECTS FROM FOREIGN DIRECT INVESTMENT

SERGEY M. KADOCHNIKOV
IGOR M. DRAPKIN

CESIFO WORKING PAPER NO. 2227
CATEGORY 7: TRADE POLICY
FEBRUARY 2008

PRESENTED AT CESIFO AREA CONFERENCE ON GLOBAL ECONOMY, JANUARY 2008

CESifo *Working Paper No. 2227*

MARKET STRUCTURE, TECHNOLOGICAL GAP AND VERTICAL LINKAGE EFFECTS FROM FOREIGN DIRECT INVESTMENT

Abstract

This paper is based on the model of backward linkages from foreign direct investment (FDI) Lin/Saggi (2003), where the market structure of the final goods sector is represented by a monopoly or Cournot oligopoly, and the supplier sector – by a pure monopoly. We extend this model by examining cases of perfect competition and a vertically integrated domestic company in the intermediate goods market. Our analysis shows that coming of foreign companies to the final goods sector provides positive backward linkage effects. Although this result doesn't depend on the market structure in the final goods sector, the latter significantly affects the size of FDI linkage effects – the more competitive is the intermediate goods sector, the larger are the backward linkage effects. They reach their maximum under perfect competition in the intermediate goods market, minimum – under monopoly in this sector, and medium size - when a vertically integrated local firm exists in the market. We have also discovered that a more competitive market structure per se doesn't guarantee larger positive effects of FDI. It is important that in addition to a competitive structure local firms do not significantly lag behind foreign firms in their technological level.

JEL Code: F23, D40.

Keywords: effects from foreign direct investment, vertical linkage effects, market structure, technological gap.

Sergey M. Kadochnikov
Department of Economics
Urals State University
Lenin Ave. 51
620083 Ekaterinburg
Russia
sergey.kadochnikov@usu.ru

Igor M. Drapkin
Department of Economics
Urals State University
Lenin Ave. 51
620083 Ekaterinburg
Russia
igor.drapkin@usu.ru

5th February 2008
We are grateful to participants at the 9th International Conference of the Association for Studies in Public Economics (Saint Petersburg, 2-3 November 2007) and the CESIfo Area Conference on Global Economy (Munich, 25-26 January 2008) for helpful comments and suggestions.

1. Introduction

Governments of many countries consider the attraction of foreign direct investment (hereinafter – FDI) as their priority task. It is believed that by investing companies not only contribute to GDP growth in the host country, but also provide up-to-date technologies of production and management, therefore increasing efficiency of the economy as a whole. Moreover, increases in competition owing to multinational corporations can lead to the reduction of prices, which increases the welfare of domestic consumers.

Traditionally we distinguish between direct and external FDI effects. Direct effects include influences on the volume of production and export in the host economy, real wages, prices of final goods, and the amount of taxes accruing to the state budget, resulting from change in the production volume at these firms with foreign participation. Another group of effects – external effects – are connected to the influence of FDI on the domestic firms in the host economy, and includes market effects (pro-competitive effects, crowding-out effect), diffusion effects (effects of transferring "process", and "product" technology, management and marketing resources). Furthermore, external effects can be divided into horizontal and vertical effects depending on the market in which FDI exerts influence on the domestic sector of the economy: either within the product market where foreign companies operate (horizontal spillover effects) or in a number of sectors interconnected by a vertical technological chain (vertical effects or linkage effects).

Linkage effects are intersectorial effects in a "supplier-consumer" chain ("intermediate goods – final goods"); they emerge in one of the sectors in response to the changes in the other when there is a vertical interconnection between them. According to the direction of influence linkage effects are divided into: backward linkages – from consumer to supplier; forward linkages – from supplier to consumer; feedback effects – effects that originate in response to the original effects of an opposite sign.

In recent years a lot of researchers have come to a conclusion that linkage effects are the main way of positive influence of FDI on the host economy. This conclusion is particularly important for developing and transitional economies. It is based mainly on

the results of empirical research of the FDI conducted using databases on relatively large group of countries from the 1990s to the beginning of the 21st century (Goerg/Strobl, 2001; Goerg/Greenaway, 2002).

Whereas until the middle of the 1990s the majority of empirical papers had been devoted to showing proof of positive horizontal FDI spillover effects both in developed and developing economies, more recent research usually shows the use of more correct econometric methods and panel databases demonstrating that horizontal effects have a negative sign or are statistically insignificant.

Negative horizontal spillover effects revealed themselves particularly pronounced when assessing FDI influence on the domestic sector in transitional economies of the Central and Eastern Europe (CEE) (Goerg/Greenaway, 2002).

Existence of negative intersectorial FDI spillover effects in the CEE transitional economies can be explained by at least three conditions (Kadochnikov, 2005). First, the domestic firms' level of technology in these economies remains insufficient for effective diffusion of the up-to-date technology that the firms with FDI possess. Under these circumstances negative crowding-out effects prevail and exceed possible positive effects of new technology's diffusion. Second, it is very likely that foreign companies use the most qualified labor, drawing specialists from domestic firms, and thus decreasing efficacy of these firms. Third, under conditions of relatively limited time horizons of the available databases on the transitional economies, possible positive influence of foreign firms on the efficacy of domestic firms remains either not revealed yet or difficult to recognize (Djankov/Hoekman, 1999, p. 19).

On the contrary, empirical verification of FDI linkage effects revealed that in most cases they are positive and statistically significant (Georg/Strobl, 2002; Smarzynska, 2004; Schoors/van der Tol, 2001). This result can be explained by the following factors. First, when analyzing vertical effects researchers take into consideration the influence of firms with FDI on domestic firms only in other markets. Intersectorial interaction cannot be accompanied by traditional negative crowding-out effects, since there is no competition for a bigger market share between the considered economic agents. Second, multinational corporations are interested in the technological development of their buyers and suppliers, so they promote (in every way) the transfer

of their up-to-date technologies. Market success of foreign companies essentially depends on the level of technology and quality of production of their partners.

This paper is devoted to the two factors that influence the size of linkage effects – market structure and technological gap. Market structure is supposed to be a very important parameter of intersectorial interaction between foreign and domestic sectors of the economy, as it considerably affects volumes of demand and supply of intermediate goods and thus broadens or narrows the channels for the FDI linkage effects. Technological gap between the foreign and domestic firms reflects the absorptive capacity of the native firms to obtain the foreign advanced technology and thus influences FDI effects.

By now there exists a relatively small number of theoretical papers devoted to the modeling of intersectorial FDI linkage effects and to the analysis of factors influencing the sign and size of these effects in particular.

One of the first theoretical works in this sphere was the paper of Rodriguez-Clare (1996), where it is argued that the coming of multinational corporations leads to the increase of demand for intermediate goods in the local market, which consequently results in the rise of diversity of intermediate goods produced in the country. Increase in the variety of intermediate goods has a positive effect on the local final goods producers by favoring growth of labour productivity in this sector. The size of positive FDI linkage effects is affected positively: first, by the intensity of intermediate goods usage in the production by companies with FDI; second, by the size of communication costs between multinational corporation's headquarters and their subsidiary units; third, by the difference in the variety of intermediate goods produced in the host economy and in the donor country.

The Markusen/Venables (1999) model represents dynamic interaction between multinational corporations and local firms. The coming of multinationals to the sector causes a negative competitive effect, which leads to crowding-out of some local companies. At the same time a positive backward linkage effect arises, which results in the development of local suppliers. Under an assumption of increasing returns to scale, development of suppliers leads to positive forward linkage effect in the sector with multinational corporations and to the development of local firms in the final goods sector. Gradually local companies become more effective in comparison with

multinationals and crowd them out. In that way, expansion of multinational corporations is a catalyst for industrial development of the host economy on the whole.

Matouschek/Venables (2005) in their research on intersectorial FDI effects in varied goods markets, mark out the following factors affecting these effects: degree to which investors are aimed at foreign markets; degree to which they are aimed at domestic suppliers of intermediate goods; openness of the economy receiving the investment; competitiveness of intermediate and final goods markets. As for the latter, the authors have come to a conclusion that the more imperfect the competition in the intermediate goods market is, the stronger are the positive FDI feedback linkage effects.

Lin/Saggi (2003) in their work model demonstrated FDI linkage effects in the case when the market structure of the final goods sector (FDI importing sector) is represented by a local monopoly (case without foreign company) or Cournot oligopoly (case with FDI), and the intermediate goods sector is represented by a monopoly. In this model the coming of multinational corporations to the final goods market of the host economy causes two opposite effects. On the one hand, foreign firms create a demand for intermediate goods, which causes the supply provided by local suppliers to grow (positive demand effect). On the other hand, by crowding local competitors out of the final goods market, multinationals reduce the demand for intermediate goods on the side of local firms – this leads to decrease in supply of intermediate goods (negative demand effect). The authors argue that that the size of the FDI linkage effects significantly depends on the technological gap between multinational corporations and local producers. This gap is measured as a negative difference between the amount of intermediate goods that the foreign company needs in order to produce one unit of final goods versus the same amount for the local firm.

In this paper we extend the Lin/Saggi (2003) model by analyzing linkage effects in the cases of perfect competition and vertically integrated domestic company in the intermediate goods market. Our analysis shows that the coming of foreign companies to the final goods sector provides positive "consumer-supplier" linkage effects. Although this result doesn't depend on the market structure in the final goods sector, the structure significantly affects the size of FDI linkage effects – the more competitive the intermediate goods sector is, the larger the linkage effects are. They reach their maximum under perfect competition in the intermediate goods market, minimum –

under monopoly in this sector, and medium size - when a vertically integrated local firm exists in the market. We have also discovered that a more competitive market structure per se doesn't guarantee larger positive effects of FDI. It is important that in addition to this competitive structure local firms do not significantly lag behind foreign firms in their technological level.

The paper has the following structure. In the second section a basic model of FDI linkage effects where the intermediate goods sector is characterized by a pure monopoly (Lin/Saggi model) is presented. In the third and fourth sections we analyze the cases of perfect competition and vertically integrated domestic company in the intermediate goods market. Comparative analysis of the size of FDI linkage effects for the aforementioned market structures is also given in these sections. The main findings and results are presented in the conclusion.

2. FDI linkage effects under monopoly in the intermediate goods market (basic model)

Basic assumptions

The host economy has three sectors: the first two (x and y) produce final goods, the third (z) – intermediate goods. All the produced goods are consumed within the domestic economy.

Two resources are used in the production of final goods – labor and intermediate product z, which serves as a resource for production of x. In the production of y only one resource is used – labor. Y is used in the economy for measuring product. Production of y is characterized by constant returns to scale and perfect competition in the market.

Under conditions of an open economy, two firms are operating in the sector producing x. They are competing according to the Cournot model: the local firm (denoted with h) and the multinational corporation (denoted with m). Under conditions of closed economy, the product x is produced by a domestic monopolist (firm h). For the production of one unit of x the foreign firm uses λ_m units of labor and μ_m units of intermediate product z. Accordingly, the local firm uses λ_h units of labor and μ_h units of z. It is assumed that the foreign firm possesses a more advanced technology as

compared to the local firm. This means that $\lambda_m \leq \lambda_h$ and $\mu_m \leq \mu_h$. The marginal costs of a firm producing *x* equal:

$$c_i = \lambda_i * 1 + \mu_i * w, \qquad (1)$$

where w is the price of intermediate product *z*.

Intermediate product *z* is produced by a domestic monopolist – the sole firm in the sector. Only labor (r units for every unit of intermediate product) is used in the production of *z*.

The model assumes that the multinational corporation buys at least a share of intermediate product it needs within the host country. In most cases it is true, since even if the foreign firm buys all the material from abroad, there exists a number of products that can't be imported (e.g. banking and communications services), so the firm has to buy them within the host country. The bigger part of intermediate goods the multinational corporation buys within the country, the larger is the vertical FDI effect in the host economy.

Profit functions of firms in the *x* sector are represented by an equation:

$$\pi_i (q_{i,} q_j) = (p (q_{i,} + q_j) - c_i) * q_i \qquad (2)$$

where $i, j = h$ *or* m; $p (q_i + q_j)$ – inverse function of demand for *x*; c_i – marginal costs of the firm *i*; q_i – sales volume (output) of the firm *i*.

The model assumes that the demand for *x* has a linear character:

$$p (q_{i,} + q_j) = \alpha - q_i - q_j.$$

Two states of the domestic economy are analyzed in the model: the case of the closed economy (autarky) and the case of open economy with FDI. For each state of the economy we determine the degree of backward linkage, which is measured in the model as volume of demand for intermediate goods from the side of the goods producers. If the volume of demand for intermediate product in the case of open economy turns out to

be larger than in the case of closed economy, we can draw a conclusion that FDI causes positive linkage effects.

It should be noted that we use the notion of "positive FDI linkage effects" only by convention, as the volume of demand for intermediate product per se is positive in any case – both in closed and in open economies. By using the notion of positive FDI linkage effects we merely emphasize the fact that with the coming of the foreign firm the demand for intermediate goods in the host economy increases, which positively affects the sector that produces them.

The usage of volume of demand for intermediate product as a measure of the backward FDI linkage effect appears to be adequate in the context of this model. First, there are no foreign suppliers in the intermediate goods market, and all the volume of demand is supplied by domestic producers. Second, volume of demand is a sufficiently simple integral index of mutual influence that the sectors exert upon each other in the vertical technological chain – on the basis of this index we can analyze changes in profitability and productivity of firms in the intermediate goods market.

The case of the closed economy

Under autarky product *x* is produced by a sole domestic producer. According to the condition of profit maximization for monopoly, optimum output of the local producer and then the demand for intermediate product from the side of the final goods sector equal:

$$\left[q_h^A(w)\right]_{mon} = \frac{\alpha - \lambda_h - \mu_h w}{2}$$

The producer of intermediate goods, being a monopolist, maximizes its profit:

$$\pi_s^A(w) = (w - r)\mu_h q_h^A(w).$$

$$\left[q_s^A(w)\right]_{mon} = \mu_h q_h^A(w) = \frac{\mu_h(\alpha - \lambda_h - \mu_h w)}{2}$$

We can find from the intermediate goods producer's profit function the first order condition and evaluate *w* – optimum price of intermediate product in the closed economy:

$$w^{A}_{mon} = \frac{\alpha - \lambda_h}{2\mu_h} + \frac{r}{2}$$

On the next step we find the output of the intermediate goods producer in the closed economy (3):

$$b^{A}_{mon} \equiv \mu_h q^{A}_{h}(w^{A}) = \mu_h \left[\frac{\alpha - \lambda_h - \mu_h r}{4} \right] \quad (3)$$

Since, as we have indicated earlier, the size of the backward linkage effect is measured in the model as the volume of demand for intermediate product from the side of the final goods producer, expression (3) describes the size of this effect in the closed economy. We will use for this value parameter b^A.

As we see from the formula (3), in this model the size of the backward linkage effect in the closed economy positively depends on the market size α, negatively depends on the amount of labor r used for production of one unit of the intermediate product, and negatively depends on the amount of labor λ_h used by the local producer. These dependences are easy to interpret. Indeed, no matter what type of market structure we have, with the growth of the final goods market's size its optimum output also grows, which leads to an increase in demand for intermediate goods. In the context of our model this means that the size of the backward linkage effect increases. Negative dependence on the amount of labor used for one unit of intermediate product can be explained by the fact that with the growth of r the costs of producing intermediate goods rise, which causes the demand for them to fall – the size of the backward linkage effect decreases. Other things being equal, the growth of the amount of labor λ_h used by the local final goods producer leads to increase of costs and reduces the optimum output. The latter results in the decrease in demand for resources, which, given our assumptions, causes the size of the backward linkage effect to diminish.

The influence of the share of intermediate product used in the production of x on the size of linkage effects is ambiguous. This influence is positive if the following condition holds (4):

$$\frac{\partial b^A}{\partial \mu_h} = \left[\frac{\alpha - \lambda_h - 2\mu_h r}{4} \right] > 0 \Leftrightarrow \alpha > \lambda_h + 2\mu_h r \,. \qquad (4)$$

It should be noted that under reasonable assumptions about the parameters of demand and costs, the condition (4) holds always, since the parameter of the demand function α should substantially exceed the size of costs (the right-hand member of the inequality is very close by size to marginal costs) in order to ensure optimum volume of output in the market. Economic interpretation of the positive dependence of the linkage effects' size on the share of intermediate product used in production seems obvious. If the share of intermediate product in the cost structure of the final goods production rises, the demand for intermediate goods also increases, which means under our assumptions that the size of the backward linkage effect increases.

The case of the open economy with FDI

Similarly in the case of the closed economy, the size of the backward linkage effect in open economy with FDI is determined by the volume of demand for intermediate goods from the side of the final goods sector. The specific character of this situation lies in the fact that the demand for intermediate goods is formed not only by the domestic firm, but also by the foreign firm:

$$b^F{}_{mon} \equiv q_s{}^F(w^F) = \mu_h q_h{}^F(w^F) + \mu_m q_m{}^F(w^F) \qquad (5)$$

Since the profit functions of the local firm (goods producer) and the multinational corporation are determined by the equation (2), we can find the output of both firms in the goods sector by solving the equations of the first order conditions for profit maximization:

$$\left[q_h^F(w)\right]_{mon} = \frac{\alpha - 2(\lambda_h + \mu_h w) + \lambda_m + \mu_m w}{3},$$

$$\left[q_m^F(w)\right]_{mon} = \frac{\alpha - 2(\lambda_m + \mu_m w) + \lambda_h + \mu_h w}{3}.$$

For the subsequent analysis we need to find the price of the intermediate product that is formed in an open economy. We do it by maximizing the profit function of intermediate goods producer: $\pi_s^F(w) = (w - r)q_s^F(w)$.

Assuming that $\lambda_i = 0$ for simplicity sake:

$$\left[w^F\right]_{mon} = \frac{\alpha}{4}\frac{\mu_h + \mu_m}{\mu_h^2 - \mu_h\mu_m + \mu_m^2} + \frac{r}{2}.$$

Now, when we have found all the parameters that determine the size of the linkage effect in the open economy with FDI (b^F), we can compare it with the corresponding size of the effect in the closed economy (b^A):

$$\left[b^F - b^A\right]_{mon} = \frac{(2\mu_m - \mu_h)(\alpha + r(\mu_h - 2\mu_m))}{12} \qquad (6)$$

hence

$$\left[b^F\right]_{mon} > \left[b^A\right]_{mon} \Leftrightarrow 2\mu_m > \mu_h \qquad (7)$$

Strictly speaking, the positive sign of the expression (6) is determined not only by the condition from (7), but also by the positive sign of the second multiplier in the numerator of the expression (6). The latter holds under common assumptions about parameters of demand and costs functions – we have discussed it earlier.

We can derive an important conclusion from the last inequation: FDI leads to the positive backward linkage effects only if the technical gap between foreign and local final goods producers is not too big.

If, on the contrary, the technology used for final goods production at the multinational corporation substantially surpasses the one used at the local firm, two results occur. First, the market share of the domestic final goods producer sharply declines (negative effect of competition), which decreases the volume of demand for intermediate goods from the side of the local firm. Second, other things being equal, the foreign firm buys smaller amount of intermediate goods for the production of x (negative demand effect). These factors lead to a decrease in the output of the local intermediate goods producer in the open economy, which causes negative backward FDI linkage effects.

The size of FDI linkage effects is substantially affected by the size of the market α: the bigger α is, the bigger is the value $(b^F - b^A)$. This dependency is easy to interpret. Indeed, if the final goods market size grows, the demand for intermediate goods also increases. Moreover, under the conditions of a growing market, the level of competition between the foreign and domestic producers falls, which results in lesser negative horizontal effects of competition.

3. FDI linkage effects under competition in the intermediate goods market

In this section we consider the situation when the intermediate goods sector is characterized not by monopoly, but by perfect competition. We analyze linkage effects in the closed economy and in the open economy (when multinational corporations operate in the final goods sector).

The case of the closed economy

When there is perfect competition in the intermediate goods market, the price of intermediate product *z* is equal to the marginal costs of its production: $w = MC_s = r$.

In autarky equilibrium the local firm maximizes its profit in the final goods market:

$\pi_h^A(w) = (p(q_h) - \lambda_h - \mu_h w)\, q_h$.

Since $w=r$, then:

$$\left[q_h^A\right]_{comp} = \frac{1}{2}(\alpha - \lambda_h - \mu_h r).$$

The size of linkage effects is determined by the following expression:

$$\left[b^A\right]_{comp} \equiv \mu_h q_h^A = \frac{1}{2}\mu_h(\alpha - \lambda_h - \mu_h r) \qquad (8)$$

As in the basic model, the size of linkage effects is affected by: market size (positively), share of labor in the final goods production (negatively), price of intermediate product (negatively). Influence of the share of intermediate product used in the production of *x* on the size of linkage effects is ambiguous. This influence is

positive if the following condition holds (it is identical to the one given above for the case of monopoly in the intermediate goods market, see (4)):

$$\frac{\partial b^A}{\partial \mu_h} = \left[\frac{\alpha - \lambda_h - 2\mu_h r}{2} \right] > 0 \quad <=> \quad \alpha > \lambda_h + 2\mu_h r \, .$$

The case of the open economy with FDI

The profit functions of the local and foreign firms are derived by analogy with the general profit function (2) in the basic model. In order to determine equilibrium outputs we formulate the first order conditions for these functions and solve the equations set. The solution to this set is as follows:

$$\left[q_h^F(w) \right]_{comp} = \frac{\alpha - 2(\lambda_h + \mu_h w) + \lambda_m + \mu_m w}{3},$$

$$\left[q_m^F(w) \right]_{comp} = \frac{\alpha - 2(\lambda_m + \mu_m w) + \lambda_h + \mu_h w}{3}.$$

In the case of two firms in the final goods market, the size of linkage effects is determined by the expression (5), though now $w^F = r$.

We can compare the sizes of linkage effects in autarky and in open economy with FDI:

$$\left[b^F - b^A \right]_{mon} = \frac{1}{6}(2\mu_m - \mu_h)(\alpha + \lambda_h - 2\lambda_m - r(2\mu_m - \mu_h)) \qquad (9)$$

The right-hand member in parentheses of the expression (10) is exactly equal to the numerator of the purchase amount of the intermediate product by the foreign company in the host country - $q_m^F(w)$, which should have a positive sign. Accordingly,

$$\left[b^F - b^A \right]_{mon} > 0 \Leftrightarrow 2\mu_m > \mu_h \, .$$

The latter condition is similar to the condition (7) for the case of monopoly in the intermediate goods market, and it reflects the fact that under perfect competition the

backward FDI linkage effects are positive if and only if the technological gap between the foreign and local companies is not too big.

Now we can compare the sizes of FDI linkage effects for the types of intermediate goods market structure we considered – to be exact, perfect competition and monopoly. Using the values of equilibrium volumes of demand for intermediate product from the side of various types of firms and, correspondingly, the sizes of FDI linkage effects under perfect competition and monopoly (expression (5)), we can calculate the difference between the latter two (expression (10)).

$$(b^F)_{comp} - (b^F)_{mon} = \frac{2}{3}(w_{mon} - w_{comp})(\mu_h^2 - \mu_h\mu_m + \mu_m^2) > 0 \qquad (10)$$

The expression (10) is positive until the intermediate goods price under monopoly exceeds the corresponding price under perfect competition. Since the monopolist fixes the price for its production on a level that is higher than marginal costs, the expression (10) has a positive sign. Thus, the size of FDI linkage effects is larger when there is perfect competition in the intermediate goods market instead of monopoly. It should be noted that the sign of the expression (10) doesn't depend on relative levels of μ_m and μ_h, so it isn't connected to the size of the technological gap between the foreign and domestic companies.

The result we obtained, of course, isn't unexpected. Indeed, since in our model the size of linkage effects is determined by the volume of demand for intermediate product from the side of the final goods sector and the demand is essentially determined by the price, then the growth of prices under monopoly inevitably restricts the demand from the side of the final goods sector. This limits the opportunity to benefit from positive FDI linkage effects. The size of the backward linkage effects is larger if the intermediate goods market is relatively more competitive.

This statement needs to be verified for the case of vertically integrated markets.

4. FDI linkage effects under vertical integration

Let's suppose that there is a vertically integrated domestic firm in the host economy. This firm buys intermediate goods for its needs in its own subdivision without any extra monopoly charge, i.e. at the perfect competition price, which is equal

to marginal costs of production. Under open economy, multinational corporation – another competitor in the final goods market – has to buy intermediate goods at the monopoly price from the sole domestic seller (the subdivision of the vertically integrated domestic company).

We now move on to analyze linkage effects for the case of open economy with FDI in the final goods sector.

The case of the closed economy

The case of vertical integration under closed economy is similar to the case of perfect competition in the intermediate goods market, since the intermediate product price, which is equal to marginal costs of its production, is also an internal transfer price of the vertically integrated domestic firm – this condition holds if the intermediate goods market is perfectly competitive. The size of the vertical linkage effects is determined by the expression (8).

The case of the open economy with FDI

Profit functions of the local and foreign firms are derived by analogy with the general profit function (2) in the basic model. The vertically integrated firm buys intermediate product at the price equal to the marginal costs of its production: $w = r$; and the foreign firm buys intermediate product which price is fixed in the monopoly market: $w = w_v$. In order to determine equilibrium outputs we formulate the first order conditions for these functions and solve the equations set. The solution to this set is as follows:

$$\left[q_h^F(w)\right]_{vi} = \frac{\alpha - 2\lambda_h - 2\mu_h r + \lambda_m + \mu_m w_v}{3},$$

$$\left[q_m^F(w)\right]_{vi} = \frac{\alpha + \lambda_h + \mu_h r - 2\lambda_m - 2\mu_m w_v}{3}.$$

The size of backward linkage effects is determined by the expression (5), where $w^F{}_h = r$ and $w^F{}_m = w_v$. By substituting the obtained equilibrium volumes of demand for intermediate product from the side of two firms to the expression (5), we can compare the sizes of linkage effects under autarky and open economy with FDI:

$$\left[b^F - b^A\right]_{vi} = \frac{1}{6}(2\mu_m - \mu_h)(\alpha + \lambda_h + r + 2\lambda_m) + \frac{1}{3}\mu_m w_v(\mu_h + \mu_m).$$

Since all the parameters of this expression are positive, then, as in cases of other types of market structure, under a vertically integrated domestic company the condition for existence of positive FDI linkage effects goes as follows: the technological gap between the foreign and domestic firms isn't too big, i.e.:

$$\left[b^F - b^A\right]_{vi} > 0 \Leftrightarrow 2\mu_m > \mu_h.$$

By analogy with the previous section, we can compare the size of FDI linkage effects under vertical integration with the corresponding sizes under other types of market structure we have analyzed – monopoly and perfect competition. Using the values we have obtained – equilibrium volumes of demand for intermediate goods from the side of various types of firms and sizes of FDI linkage effects under perfect competition, monopoly and vertical integration (expression (5)) – let's calculate the difference between them.

Expression (11) describes the difference between the sizes of FDI linkage effects under vertical integration and monopoly.

$$(b^F)_{vi} - (b^F)_{mon} = \frac{1}{3}\mu_h(w_m - r)(2\mu_h - \mu_m) + \frac{1}{3}\mu_m(w_m - w_v)(2\mu_m - \mu_h) \qquad (11)$$

Since $\mu_h > \mu_m$ from the assumptions of the model, the sufficient condition for the sign of the expression (11) to be positive is fulfillment of the two following conditions: $2\mu_m > \mu_h$ and $w_m > w_v > r$. The first condition is a standard condition of a positive sign of FDI linkage effects in the context of this model, and it reflects the fact that foreign firms shouldn't be "too advanced" or else they crowd domestic firms out and thus limit the sources of demand for intermediate goods. As for the second condition, we can easily show that it holds. Indeed, as $w_{comp}=r$, and the monopolist in the intermediate goods sector gets a positive profit, then $w_m > w_{comp}$ и $w_v > w_{comp}$. Now let's compare w_m and w_v. In case of monopoly in the intermediate goods market and oligopoly in the final goods market, the demand for intermediate product is created by both the domestic firm

and multinational corporation. If the domestic firm is a vertically integrated structure and gets intermediate product at the internal transfer price, then the demand for intermediate goods is created only by the foreign firm. Of course, the price of the product is higher in the first case, since the market is more monopolized and its size (residual demand for the monopolist) is relatively bigger: $w_m > w_v$. Hence it is true that: $w_m > w_v > w_{comp}$. This means that under a vertically integrated domestic firm the FDI linkage effects are larger than under monopoly in the intermediate goods market.

We can compare the corresponding sizes of linkage effects under vertical integration and perfect competition in the intermediate goods market. The expression (12) determines the difference between the sizes of FDI linkage effects under vertical integration and perfect competition.

$$b^F_{comp} - b^F_{vi} = \tfrac{1}{3}\mu_m\mu_h r - \tfrac{2}{3}\mu_m^2 r - \tfrac{1}{3}\mu_h\mu_m w_v + \tfrac{2}{3}\mu_m^2 w_v$$
$$or \qquad (12)$$
$$b^F_{comp} - b^F_{vi} = \tfrac{1}{3}\mu_m(w_v - r)(2\mu_m - \mu_h)$$

From (12) it follows that FDI provides larger positive linkage effects under perfect competition in the final goods market as compared to the case of the vertically integrated firm, if two conditions hold. First, the price of intermediate product under vertical integration should be higher than the price in the competitive market, which is always true. Second, the technological gap between the foreign and domestic firms is not too big. We used the latter condition when we analyzed positive FDI effects in comparison with closed economy, but now it becomes particularly important – not only sufficient, but also necessary.

Economic interpretation of this condition goes as follows. In the situation when the domestic firm is vertically integrated, it has a broader "margin of safety" in a competitive struggle with the foreign firm as compared to the situation without such integration. For the domestic company, existence of a big technological gap doesn't create any real threat of losing a substantial market share and thus reducing of demand for intermediate product. It's quite another matter when the intermediate goods market is perfectly competitive. Then, in the case of a big technological gap the domestic firm can lose a considerable market share and in that way cut its demand for intermediate

product. It is exactly because of this circumstance that positive FDI linkage effects are larger under perfect competition as compared to the situation with vertical integration if and only if the technological gap isn't too big.

The results we obtained allow us to prove the main finding of our work – the structure of the intermediate goods market is an important factor of FDI linkage effects. The largest positive FDI backward linkage effects occur under perfect competition in the intermediate goods sector, middle-sized – under vertical integration, and the smallest – under monopoly:

$$b^F_{comp} > b^F_{vi} > b^F_{mon} > 0 .$$

6. Conclusion

This paper is devoted to an analysis of how different types of market structure in the host economy affect the size of FDI backward linkage effects. It is based on the assumptions of the Lin/Saggi (2003) model.

We extend this model by examining cases of perfect competition and vertically integrated domestic company in the intermediate goods market. We clarify the following issues. First, how FDI affects the size of backward linkage effects in the host economy (comparing the case of a closed economy to the case of an open economy with FDI, given that the market structure in the intermediate goods sector is fixed). Second, what market structure in the intermediate goods sector provides maximum FDI linkage effects in an open economy. We arrive at the following conclusions.

No matter what market structure exists in the intermediate goods sector, FDI leads to positive backward linkage effects, but only if the technological gap between the foreign and local firms isn't too big. When the gap is sufficiently big, domestic firms are crowded out of the market by foreign firms, and FDI linkage effects can become negative. The sources of these negative signs can be the following: the negative effect of competition (reduction of demand for intermediate product because the domestic companies are crowded out) and the negative demand effect (relatively smaller demand for the intermediate product from the side of the foreign firms as compared to the local ones).

Foreign direct investment causes positive linkage effects under any type of market structure in the intermediate goods sector. However, these effects have different sizes. They reach their maximum under perfect competition in the intermediate goods market, minimum – under monopoly in this sector, and medium size - when a vertically integrated local firm exists in the market. Under vertical integration the size of linkage effects is larger than under monopoly, but smaller than under perfect competition. Thus, the market structure is one of the important factors of FDI linkage effects.

We have also discovered that a more competitive market structure per se doesn't guarantee larger positive effects of FDI. It is important that in addition to this competitive structure local firms do not significantly lag behind foreign firms in their technological level. If such a technological gap exists, vertical integration in the intermediate goods market can provide larger positive FDI linkage effects, as compared to the case of perfect competition.

The latter conclusion can be considered as one of the possible applications of the theory of second-best policy. According to this theory, when there is any distortion (in our case – a substantial technological gap between the companies) in the market, introduction of an additional distortion (vertical integration instead of perfect competition) can lead to an increase in the welfare of economic agents.

These conclusions have an evident application for determining industrial and anti-trust policies in the modern economy of Russia. Government policy aimed at fostering positive foreign direct investment effects in the Russian economy should consist not only of instruments encouraging competition and restricting monopoly, but also of instruments promoting more rapid diffusion of up-to-date technologies and technical re-equipment of Russian firms. In isolation from one another, these policy instruments can not only fail to produce the desired results, but also lead to opposite effect.

References

Djankov, S. and B. Hoekman (1999), Foreign investment and productivity growth in Czech enterprises, *World Bank*.

Goerg, H. and D. Greenaway (2002), Much ado about nothing? Do domestic firms really benefit from foreign direct investment? *CEPR working paper* **3482**, 1-30.

Goerg, H. and E. Strobl (2001) Multinational companies and productivity spillovers: a meta-analysis, *The Economic Journal*, 723-39.

Georg, H. and E. Strobl (2002) Multinational companies and indigenous development: an empirical analysis, *European Economic Review* **46 (7)**, 1305-22.

Kadochnikov, S. (2005) Foreign direct investment in transitional economies of the Central and Eastern Europe: state of empirical research, *Economy of the region* **4**. (In Russian).

Lin, P. and K. Saggi (2003) Backward linkages under foreign direct investment. Mimeo.

Markusen, J. and A. Venables (1999) Foreign direct investment as a catalyst for industrial development, *European Economic Review* **43 (2)**, 335-58.

Matouschek, N. and A. Venables (2005) Evaluation investment projects in the presence of sectoral linkages, *Economics of Transition* **13 (4)**, 573-603.

Rodriguez-Clare, A. (1996) Multinationals, linkages, and economic development, *American Economic Review* **86 (4)**, 852-73.

Schoors, K. and B. van der Tol (2001) The productivity effect of foreign ownership on domestic firms in Hungary, *University of Gent*, Mimeo.

Smarzynska, B. (2004) Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages, *American Economic Review* **94 (3)**, 605-27.

CESifo Working Paper Series

for full list see www.cesifo-group.org/wp
(address: Poschingerstr. 5, 81679 Munich, Germany, office@cesifo.de)

2164 Dieter M. Urban, Terms of Trade, Catch-up, and Home Market Effect: The Example of Japan, December 2007

2165 Marcelo Resende and Rodrigo M. Zeidan, Lionel Robbins: A Methodological Reappraisal, December 2007

2166 Samuel Bentolila, Juan J. Dolado and Juan F. Jimeno, Does Immigration Affect the Phillips Curve? Some Evidence for Spain, December 2007

2167 Rainald Borck, Federalism, Fertility and Growth, December 2007

2168 Erkki Koskela and Jan König, Strategic Outsourcing, Profit Sharing and Equilibrium Unemployment, December 2007

2169 Egil Matsen and Øystein Thøgersen, Habit Formation, Strategic Extremism and Debt Policy, December 2007

2170 Torben M. Andersen and Allan Sørensen, Product Market Integration and Income Taxation: Distortions and Gains from Trade, December 2007

2171 J. Atsu Amegashie, American Idol: Should it be a Singing Contest or a Popularity Contest?, December 2007

2172 Patricia Apps and Ray Rees, Household Models: An Historical Perspective, December 2007

2173 Ben Greiner, Axel Ockenfels and Peter Werner, The Dynamic Interplay of Inequality and Trust – An Experimental Study, December 2007

2174 Michael Melvin and Magali Valero, The Dark Side of International Cross-Listing: Effects on Rival Firms at Home, December 2007

2175 Gebhard Flaig and Horst Rottmann, Labour Market Institutions and the Employment Intensity of Output Growth. An International Comparison, December 2007

2176 Alexander Chudik and M. Hashem Pesaran, Infinite Dimensional VARs and Factor Models, December 2007

2177 Christoph Moser and Axel Dreher, Do Markets Care about Central Bank Governor Changes? Evidence from Emerging Markets, December 2007

2178 Alessandra Sgobbi and Carlo Carraro, A Stochastic Multiple Players Multi-Issues Bargaining Model for the Piave River Basin, December 2007

2179 Christa Hainz, Creditor Passivity: The Effects of Bank Competition and Institutions on the Strategic Use of Bankruptcy Filings, December 2007

2180 Emilia Del Bono, Andrea Weber and Rudolf Winter-Ebmer, Clash of Career and Family: Fertility Decisions after Job Displacement, January 2008

2181 Harald Badinger and Peter Egger, Intra- and Inter-Industry Productivity Spillovers in OECD Manufacturing: A Spatial Econometric Perspective, January 2008

2182 María del Carmen Boado-Penas, Salvador Valdés-Prieto and Carlos Vidal-Meliá, the Actuarial Balance Sheet for Pay-As-You-Go Finance: Solvency Indicators for Spain and Sweden, January 2008

2183 Assar Lindbeck, Economic-Social Interaction in China, January 2008

2184 Pierre Dubois, Bruno Jullien and Thierry Magnac, Formal and Informal Risk Sharing in LDCs: Theory and Empirical Evidence, January 2008

2185 Roel M. W. J. Beetsma, Ward E. Romp and Siert J. Vos, Intergenerational Risk Sharing, Pensions and Endogenous Labor Supply in General Equilibrium, January 2008

2186 Lans Bovenberg and Coen Teulings, Rhineland Exit?, January 2008

2187 Wolfgang Leininger and Axel Ockenfels, The Penalty-Duel and Institutional Design: Is there a Neeskens-Effect?, January 2008

2188 Sándor Csengődi and Dieter M. Urban, Foreign Takeovers and Wage Dispersion in Hungary, January 2008

2189 Joerg Baten and Andreas Böhm, Trends of Children's Height and Parental Unemployment: A Large-Scale Anthropometric Study on Eastern Germany, 1994 – 2006, January 2008

2190 Chris van Klaveren, Bernard van Praag and Henriette Maassen van den Brink, A Public Good Version of the Collective Household Model: An Empirical Approach with an Application to British Household Data, January 2008

2191 Harry Garretsen and Jolanda Peeters, FDI and the Relevance of Spatial Linkages: Do third Country Effects Matter for Dutch FDI?, January 2008

2192 Jan Bouckaert, Hans Degryse and Theon van Dijk, Price Discrimination Bans on Dominant Firms, January 2008

2193 M. Hashem Pesaran, L. Vanessa Smith and Takashi Yamagata, Panel Unit Root Tests in the Presence of a Multifactor Error Structure, January 2008

2194 Tomer Blumkin, Bradley J. Ruffle and Yosef Ganun, Are Income and Consumption Taxes ever really Equivalent? Evidence from a Real-Effort Experiment with Real Goods, January 2008

2195 Mika Widgrén, The Impact of Council's Internal Decision-Making Rules on the Future EU, January 2008

2196 Antonis Adam, Margarita Katsimi and Thomas Moutos, Inequality and the Import Demand Function, January 2008

2197 Helmut Seitz, Democratic Participation and the Size of Regions: An Empirical Study Using Data on German Counties, January 2008

2198 Theresa Fahrenberger and Hans Gersbach, Minority Voting and Long-term Decisions, January 2008

2199 Chiara Dalle Nogare and Roberto Ricciuti, Term Limits: Do they really Affect Fiscal Policy Choices?, January 2008

2200 Andreas Bühn and Friedrich Schneider, MIMIC Models, Cointegration and Error Correction: An Application to the French Shadow Economy, January 2008

2201 Seppo Kari, Hanna Karikallio and Jukka Pirttilä, Anticipating Tax Change: Evidence from the Finnish Corporate Income Tax Reform of 2005, January 2008

2202 Walter Krämer and André Güttler, On Comparing the Accuracy of Default Predictions in the Rating Industry, January 2008

2203 Syed M. Ahsan and Panagiotis Tsigaris, The Efficiency Loss of Capital Income Taxation under Imperfect Loss Offset Provisions, January 2008

2204 P. Mohnen, F. C. Palm, S. Schim van der Loeff and A. Tiwari, Financial Constraints and other Obstacles: Are they a Threat to Innovation Activity?, January 2008

2205 Sascha O. Becker and Mathias Hoffmann, Equity Fund Ownership and the Cross-Regional Diversification of Household Risk, January 2008

2206 Pedro R. D. Bom and Jenny E. Ligthart, How Productive is Public Capital? A Meta-Analysis, January 2008

2207 Martin Werding, Ageing and Productivity Growth: Are there Macro-level Cohort Effects of Human Capital?, January 2008

2208 Frederick van der Ploeg and Steven Poelhekke, Globalization and the Rise of Mega-Cities in the Developing World, February 2008

2209 Sara Biancini, Regulating National Firms in a Common Market, February 2008

2210 Jin Cao and Gerhard Illing, Liquidity Shortages and Monetary Policy, February 2008

2211 Mathias Kifmann, The Design of Pension Pay Out Options when the Health Status during Retirement is Uncertain, February 2008

2212 Laszlo Goerke, Tax Overpayments, Tax Evasion, and Book-Tax Differences, February 2008

2213 Jun-ichi Itaya and Heinrich W. Ursprung, Price and Death, February 2008

2214 Valentina Bosetti, Carlo Carraro and Emanuele Massetti, Banking Permits: Economic Efficiency and Distributional Effects, February 2008

2215 Assar Lindbeck, Mårten Palme and Mats Persson, Social Interaction and Sickness Absence, February 2008

2216 Gary E. Bolton and Axel Ockenfels, The Limits of Trust in Economic Transactions - Investigations of Perfect Reputation Systems, February 2008

2217 Hartmut Egger and Peter Egger, The Trade and Welfare Effects of Mergers in Space, February 2008

2218 Dorothee Crayen and Joerg Baten, Global Trends in Numeracy 1820-1949 and its Implications for Long-Run Growth, February 2008

2219 Stephane Dees, M. Hashem Pesaran, L. Vanessa Smith and Ron P. Smith, Identification of New Keynesian Phillips Curves from a Global Perspective, February 2008

2220 Jerome L. Stein, A Tale of Two Debt Crises: A Stochastic Optimal Control Analysis, February 2008

2221 Michael Melvin, Lukas Menkhoff and Maik Schmeling, Automating Exchange Rate Target Zones: Intervention via an Electronic Limit Order Book, February 2008

2222 Raymond Riezman and Ping Wang, Preference Bias and Outsourcing to Market: A Steady-State Analysis, February 2008

2223 Lars-Erik Borge and Jørn Rattsø, Young and Old Competing for Public Welfare Services, February 2008

2224 Jose Apesteguia, Steffen Huck, Jörg Oechssler and Simon Weidenholzer, Imitation and the Evolution of Walrasian Behavior: Theoretically Fragile but Behaviorally Robust, February 2008

2225 Walter Krämer, Long Memory with Markov-Switching GARCH, February 2008

2226 António Afonso and Christophe Rault, What do we really Know about Fiscal Sustainability in the EU? A Panel Data Diagnostic, February 2008

2227 Sergey M. Kadochnikov and Igor M. Drapkin, Market Structure, Technological Gap and Vertical Linkage Effects from Foreign Direct Investment, February 2008