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Non-Technical Summary

In 1991, Scotland paid 50.75 million pounds for Motorola to locate a mobile-phone factory employing 3,000 people. In the late 1980s, Toyota was offered an incentive package worth 125--147 million dollars in present value for a plant expected to employ 3,000 workers. Other empirical studies have found positive effects of foreign direct investment (FDI) on different indicators of firm's performance in Indonesia, Russia and Lithuania.

These studies show that an increase in FDI leads to an increase in the level of local capability and competition. However, the results vary across countries and across industries within a particular country. Theory suggests that FDI has direct and indirect impacts. Direct FDI effects contribute to the differences in performance of firms with and without FDI. Indirect or spillover effects are spread through specific contacts between multi-national corporations and domestic firms. Negative spillovers have been found, for example, for Venezuela, Romania and Poland. While some empirical work on FDI has been done for several transition countries, this is not the case yet for Ukraine.

In this study, we examine the effect of industry–wide and region–wide spillovers on the optimal level of exports of Ukrainian manufacturing firms. Based on a theoretical model of oligopolistic competition augmented with spillover effects, we hypothesize that a domestic manufacturing firm’s performance, measured by the volume of exports, responds both to industry–wide and region–wide spillover effects. The theoretical predictions concerning the effects of industry–wide spillover are ambiguous, they can be either positive or negative. To test this hypothesis we utilize an unpublished dataset of about 2000 firms for the years 1996–2000 of Ukrainian manufacturing firms.

Our empirical findings show that large firms benefit more from foreign direct investment than small firms. Compared to non–durable goods makers, durable–goods makers are to a higher extent affected by industry–wide FDI spillovers, because production of a durable good is likely to require a larger number of backward and forward linkages within both the same industry and region. Finally, urban area firms benefit more from FDI spillovers compared to firms in non–urban areas. FDI also promotes exports due to regional spillovers.

The Effects of Regional and Industry–Wide FDI Spillovers on Export of Ukrainian Firms

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THE EFFECTS OF REGIONAL AND INDUSTRY–WIDE FDI SPILLOVERS ON EXPORT OF UKRAINIAN FIRMS

Abstract

In this paper we investigate the effects of region and industry–wide spillovers from foreign direct investment (FDI) on the volumes of export of Ukrainian manufacturing firms, using unpublished panel data from 1996–2000. Economic theory suggests that FDI has direct and indirect effects on firm's performance. Our analysis focuses on the indirect effects like competition and linkage effects through industrial and regional spillovers respectively. We use a simple Cournot competition model in order to test for industrial and regional spillovers. The estimation results suggest that large firms, durable–goods makers, and firms located in urban areas benefit most from FDI spillovers.

Keywords: transition economies, Ukraine, foreign direct investment, spillovers.
JEL classification: L60, F23

1 Introduction

„In January 2003 Procter & Gamble announced it would be is closing its Tampax tampon factory in Leigh Park, Havant, Hants, United Kingdom and shifting the production of its factories in Boryspil, Kyiv Region, and Budapest, Hungary. Procter & Gamble says the move is necessary to keep its business competitive. The Tambrands–Ukraine plant in Boryspil was established in the meantime. The plant manufactures Tampax hygienic tampons a high percentage of which are exported into the Eastern and Western European countries. In November of 2002 Procter and Gamble Eastern Europe launched a new Distribution Center in Lviv, Ukraine. The Distribution Center was the first in Ukraine and the second in Eastern Europe. This P&G complex includes customs operations, storage, pre–sale preparation according to the needs of consumers, forming of the orders and loading of goods.“[1]

Indeed, Procter & Gamble have penetrated the Ukrainian market. However, several questions arise: What has happened to Ukrainian companies in the same industry? Have other firms in the same region been affected? Do domestic firms profit from new technologies introduced by P&G or do they exit the market, unable to compete?

Theory tells us about direct and indirect effects of foreign direct investment. Foreign companies hire local workers and increase aggregate demand and supply. At the same time, there are indirect effects also called spillover effects. The channels of these effects are: technology transfer effect, competition effect, backward and forward linkage effect, training effect, and demonstration effect.

The *technology transfer* channel has recently received justification theoretically (Blomström, 1987; Blomström and Kokko, 1997) and empirically through investigations for Indonesia (Sjöholm, 1999) and Russia (Ponomareva, 2000; Yudaeva et al., 2001). It is also found that foreign presence in the sector does not have any significant effects on productivity of Czech manufacturing firms (Kinoshita, 2000) or similar firms in Wroclaw region, Poland (Hardy, 1998).

The *competition effect* is found to have both positive and negative impacts. Positive spillovers are found in Canadian and Australian manufacturing industries (Caves, 1974), and in Indonesian banks (Cho, 1990). However, negative effects are observed in Belgian manufacturing industries (De Backer and Sleuwagen, 2003). Konings (2001) uses firm–level panel data from Poland, Bulgaria and Romania to find that only in Poland foreign firms outperform domestic firms, while there is evidence for negative (Bulgaria and Romania) or no (Poland) spillovers of FDI. He concludes that during earlier stages of transition (Bulgaria and Romania) the positive technology spillover effect seems to be dominated by the negative competition effect of FDI, as inefficient domestic firms will lose market share to foreign firms. In later stages of development (Poland), when domestic firms have started restructuring, and market competition has increased, the competition effect seems to disappear.

FDI–induced *backward and forward linkages* can push industrial development, especially with regard to the formation of small businesses. FDI creates backward linkages, for instance, by foreign firms purchasing local services and subcontracting with domestic firms. Observing small businesses along the border of Mexico, it is found that the linkage approach reasonably describes the development of small business employment (Brown, 2002). On the other hand, there is little evidence for both backward and forward linkages for the German–owned manufacturing sector in the north–east of England (Kirchner, 2000) and for Korean FDI in southeast Asia, (Lee 1994).

The investigation of the *training spillovers* channel has also recently received attention from researchers. Foreign firms invest in human capital, and it is not only the foreign MNC but also domestic firms that benefit from this. Many managerial people in Mexico start their career in a foreign company and are later employed in a domestic firm (Blomström, 1989). Moreover, domestic firms are afraid of loosing their market shares and they too invest in training their workers and managerial personnel (Kinoshita, 1998).

Although the *demonstration effect* is potentially very important, so far there are not enough studies to show this, neither are there enough studies which distinguish demonstration

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[1] Citation: http://www.ukraineinfo.us/business/investment.html

effects in different countries or industries (Blomström and Kokko, 1998). In an analysis of Belgian manufacturing firms it is observed that although in the short term FDI might crowd out domestic firms, in the long run, positive structural effects such as demonstration effects might lessen or even inverse the crowding out effects (de Backer and Sleuwagen, 2003).

However, all empirical papers above have a rather weak theoretical background. We contribute to the existing literature on foreign direct investment by developing a simple Cournot competition model augmented with spillover effects and test this model empirically using data of Ukrainian manufacturing firms.

The dataset used in this paper consists of an unbalanced panel of all manufacturing firms in Ukraine obtained from the Education and Economic Research Consortium (EERC) database over the 1996–2000 period. On balance, we have annual data on 8,500 firms, one quarter of which export their production.

This research provides evidence for a positive relationship between the optimal level of exports and industry–wide spillovers from foreign direct investment. The magnitude of these effects varies between all, large and small firms, durable and non–durable goods makers, large city and small town firms. Another significant and positive factor in most specifications is domestic investment on industry level, while the number of domestic firms in the industry has a significantly negative effect.

The following section presents a simple Cournot competition model augmented with spillover effects. Section 3 describes the data and Section 4 discusses the empirical results. Finally, Section 5 concludes and gives suggestions for policy makers.

2 Augmented Monopolistic Competition Model

2.1 The Model

A simple monopolistic competition model augmented with spillover effects, implies that domestic firm changes its quantities in response to foreign presence in the industry or region.[2] The home country economy consists of n_H domestic firms and n_F foreign firms that compete at third country markets. All firms produce a homogeneous goods and compete in quantities. We assume that the demand, P, for a good produced by both domestic and foreign firm is linear. Let q_{H1} be a representative domestic firm's output and q_{F1} be a representative foreign firm's output.[3]

$$P = a - b(n_H - 1)q_H - bq_{H1} - b(n_F - 1)q_F - by_{F1} \tag{1}$$

Marginal cost of domestic firm is denoted as c_H. Every domestic firm faces marginal cost, but also spends j_H for R&D investment. The firm cannot fully protect its stock of knowledge, and the investment spills over to other firms. We denote q as a spillover coefficient for funds invested by foreign firms (FDI) and z as a spillover coefficient for funds invested by $(n_H - 1)$ other domestic firms. We assume that the more other firms invest, the lower marginal costs of the representative domestic firm are.

Similarly c_F is the marginal cost of the foreign firm, but foreign firms are differently affected by spillovers compared to domestic firms. We denote b as spillover effect from the foreign sector and y as spillover effect from the domestic sector. We also assume $1 > q > z > 0$ and $1 > b > y > 0$, which means that spillover effects from foreign firms are stronger that those from domestic firms for any firm. A foreign firm also invests j_F in R&D. Moreover, domestic firms benefit more from foreign spillovers, which is represented by $q > b$ [4]

$$c_H = w - q\, j_F n_F + j_H \left[1 - z\,(n_H - 1)\right] \tag{2}$$

[2]See for example models by Siotis (1999), Leahy and Pavelin (2002).
[3]Symmetry among domestic firms and symmetry among foreign firms are assumed. However, domestic firms technologies are different from foreign firms' ones.
[4]So far w is the same for both firms domestic and foreign. Later we relax this assumption allowing for different marginal costs.

$$c_F = w + j_F \left[1 - b \left(n_F - 1\right)\right] - y \; j_H n_H \qquad (3)$$

Representative domestic and foreign firms maximize their profits in the current period of time as described in Equations (4) and (5):

$$\max_{q_{H1}} Pq_{H1} - c_H q_{H1} \qquad (4)$$

$$\max_{q_{F1}} Pq_{F1} - c_F q_{F1} \qquad (5)$$

Assuming symmetry we receive the following first order conditions:

$$\begin{aligned} &-2bq_H + a - b(n_H - 1)q_H - b(n_F - 1)q_F - bq_F - w + \\ &n_F q \; j_F - [1 - z \; (n_H - 1)] = 0 \\ &\left[-b(n_F - 1) - b\right] q_F + a - b(n_H - 1)q_H - bq_H - b(n_F - 1)q_F - \\ &bq_F - w - j_F \left[1 - b \,(n_F - 1)\right] + y \; j_H n_H = 0 \end{aligned}$$

Solving this system we receive optimal the quantity, q_H, for the domestic firm:

$$q_H = \frac{n_F \left[j_F (q + b + 1) + j_H n_H (z - y) - j_H (1 + z) \right]}{b(n_H + 1 + n_F)} + \frac{{n_F}^2 j_F (q - b)}{b(n_H + 1 + n_F)} + \frac{-j_H - j_H z + a - w + j_H z \, n_H}{b(n_H + 1 + n_F)} \qquad (6)$$

This equation relates presence of foreign firms in the industry to the output of the representative domestic firm.

Taking the derivative of equation (6) with respect to the number of foreign firms in the industry, n_F, we receive Equation (7), where the sign of the derivative can be either positive or negative:

$$\frac{\partial q_H}{\partial n_F} = \frac{n_F \left[2 j_F (q - b) + 2n_H j_F (q - b) + j_F n_H (q - b) \right]}{b(n_H + 1 + n_F)^2} + \frac{n_H \left[j_F (1 + q + b) - j_H (1 + y + z) + j_H n_H (z - y) \right]}{b(n_H + 1 + n_F)^2} + \frac{-a + w + j_F + j_F b + j_F q}{b(n_H + 1 + n_F)^2} \qquad (7)$$

The entrance of the foreign firm is likely to have positive effects if the spillover effect from foreign to domestic firms is much higher compared to the spillover effect from foreign to foreign firm, $q >> b$.

When the foreign firm enters the market it invests j_F and the more it invests the higher is the domestic firm's output:

$$\frac{\partial q_H}{\partial j_F} = \frac{n_F q + b n_F + n_F + n_F{}^2 (q - b)}{b(n_H + 1 + n_F)} \tag{8}$$

2.2 Model Parametrization

Equation (6) is not linear in n_F , n_H , j_H , j_F or w, and in Appendix 1[5], we transform it into a linearized form:

$$\hat{q}_{H,it} = f_0 + f_{n_F}\hat{n}_{F,it} + f_{n_H}\hat{n}_{H,it} + f_{j_H}\hat{j}_{H,it} + f_{j_F}\hat{j}_{F,it} + f_w \hat{w}_{it} \tag{9}$$

$\hat{w}_{it}$ is parameterized as a linear function of the deviation in several regional spillovers, scale variables and volume of q at $t-1$.[6] The reasoning for this parametrization is the following. Every firm has its specific marginal cost, that depends not only on firm characteristics but also on the firm's environment. This marginal cost is higher if the number of potential customers is low or transaction costs are high. Thus, if a firm is surrounded by a richer variety of other firms who also invest in R&D or have some experience of selling the product, then its costs have to be lower.

$$\hat{w}_{it} = x_{0i} + x_{SC} Scale_{it} + x_{x_F}\hat{x}_{F,it} + x_{x_H}\hat{x}_{H,it} + x_{y_F}\hat{y}_{F,it} + x_{y_H}\hat{y}_{H,it} + x_q \hat{q}_{it-1} + e_{it} \tag{10}$$

where x_{0i} is the firm–specific level of marginal cost, which enters as the firm fixed effect, $Scale_{it}$ is the deviation in the size of the firm, $\hat{x}_{F,it}$ is the deviation in the number of foreign firms in the region, $\hat{x}_{H,it}$ is the deviation in the number of domestic firms in the region, $\hat{y}_{F,it}$ is the deviation in the volume of FDI for a firm in the region, $\hat{y}_{H,it}$ is the deviation in the volume of domestic investment for a firm in the region, $\hat{q}_{it-1}$ is the deviation in the volume of

[5]The coefficients are described there.

[6]We parametrize $\hat{w}_{it}$ because we do not have any data on firm's costs.

production in the previous period and e_{it} is an error term.

Plugging Equation (10) into Equation (9) we receive our econometric model specification:

$$\hat{q}_{H,it} = f_{0t} + f_w x_{0i} + f_{n_F} \hat{n}_{F,it} + f_{n_H} \hat{n}_{H,it} + f_{j_H} \hat{j}_{H,it} + f_{j_F} \hat{j}_{F,it} + f_{sc} + \\ + Scale_{it} + f_w x_{x_F} \hat{x}_{F,it} + f_w x_{x_H} \hat{x}_{H,it} + f_w x_{y_F} \hat{y}_{F,it} + f_w x_{y_H} \hat{y}_{H,it} + \\ + f_W x_q \hat{q}_{i,t-1} + f_w e_{it} \tag{11}$$

The data on firms' investment is not present in our dataset and we transform our model into the final model specification

$$\hat{q}_{it} = f_0 + f_w x_{0i} + (f_{n_F} - f_{j_F})\hat{n}_{F,it} + (f_{n_H} - f_{j_F})\hat{n}_{H,it} + f_{j_H} J_H + \\ + f_{j_F} \hat{J}_{F,it} + f_w x_{sc} Scale_{it} + f_w (x_{x_F} - x_{y_F})\hat{x}_{F,it} + f_w (x_{x_H} - x_{y_H})\hat{x}_{H,it} + \\ + f_w x_{y_F} \hat{Y}_{F,it} + f_w x_{y_H} \hat{Y}_{H,it} + f_W x_q \hat{q}_{i,t-1} + f_w e_{it} \tag{12}$$

where (the natural logarithm of) the volume of export is the dependent variable, J_H is the total volume of domestic investment in the industry, J_F is the total volume of foreign investment in the industry, Y_H is the total volume of domestic investment in the region and Y_F is the volume of foreign investment in the region. Because of our data restrictions we investigate the spillover effect only for exporting firms.[7]

We would expect a positive sign on f_{n_F} if higher levels of export are associated with a higher number of foreign firms in the industry, and a negative sign on f_{n_H} if higher levels of export have a negative correlation with a higher number of domestic firms in the industry. The scale effect is proxied by the number of workers in the firm.

According to our model, the competition effect is captured by industry spillovers variables.[8] This can be explained by the fact that increased foreign presence in the industry forces local firms to act more efficiently, improve the quality of their product, decrease the primary

[7]We made an attempt to employ sales as a dependent variable but received strong misspecification of our model.
[8]In our paper these effect are described by the number of foreign firms in the industry and the volume of foreign direct investment in the industry.

cost of production, and to start exporting the goods. However, it is possible to receive negative effects, namely when foreign firms penetrate the domestic industry in order to buy the exporting firms and capture their shares in third country markets.[9]

Forward-backward linkages effect can appear through regional spillovers.[10] Foreign-owned firms usually require high quality input materials which leads to an improvement of local material supplies. For instance, Oleh Strekal, spokesman for McDonald's Ukraine Limited, said in his interview „.... the fast food monolith has pumped some 70 million USD into its Ukrainian ventures, with most of the funds flowing into the local economy. McDonald's has kept 50 Ukrainian construction companies busy building outlets across Ukraine. Domestic vendors Chumak, Galakton, Slavyansky Dom and the Vinnytsya meat processing plant supply products that find their way into McDonald's hamburgers and shakes. Ukrainian ingredients now account for about 40 percent of McDonald's products. The company plans to increase that figure to 95 percent within two years."[11]

It is very difficult to distinguish the other spillover channels, due to data limitations. Identifying demonstration effect and training effect would require additional firm specific variables such as labor turnover, innovation, et cetera.

3 Data description

We use a dataset of Ukrainian manufacturing firms for testing our hypotheses. It covers on average 8,500 firms for the period 1996 to 2000. 2,100 of these firms export their products. The firms are classified by a two–digit Industrial Classification and represent sixteen industrial sectors: energy, fuel, coal, black metallurgy, color metallurgy, chemical, oil–chemicals, machinery, forest, construction materials, light, food, flavor, microbiology, medical equipment, printing and other. Firms are localized over twenty seven geographical regions, cover-

[9]It can be a case when a foreign firm wants to acquire the domestic company in the same industry in order to close the latter and capture a larger share of the market.
[10]We proxy regional spillovers by the number of foreign firms in the region and the volume of foreign direct investment in the region.
[11]Citation: http://www.artukraine.com/commercial/mcdonalds2.htm

ing Crimea Autonomous Republic, twenty four „oblast“, cities Kyiv and Sevastopil. We utilize EERC's data items „volumes of export“, *Export* in our annotation, and "number of workers", *Labor* here.[12] Moreover, as a proxy for the number of firms in the industry or in the region we use the number of firms in our dataset.[13]

A number of sample selection criteria is applied to the original sample. First, all negative values for volume of export and number of workers variables in the sample are dropped.[14] Secondly, the firms with a volume of exports higher than the 99 percentile or lower than the 1 percentile are also excluded. We prefer to use the screened data to reduce the potential impact of outliers upon the parameter estimates. Table 1 presents descriptive statistics for firm specific variables.

In order to test the effects of spillovers on firms facing similar characteristics, the dataset is split into two categories: large and small firms. A firm is considered to be „large“ if its number of workers is above the 75th percentile by year. If a firm's number of workers is below the 25th percentile by year, then it is classified as „small“.[15] A two–sample paired t–test is used to test for the equality of means and we receive significant differences in the behavior of large and small firms.

Moreover, we investigate the spillover effect for „durable“ and „non–durable“ goods makers. This classification is based on the dichotomy proposed by Sharpe (1994): First, we find the correlation between sales and nominal GNP. Second, firms with an average correlation higher than 60th percentile are considered as durable goods makers, while firms with correlation on average lower than 40th percentile are denoted as non–durable goods makers.

In order to control for agglomeration effects, we consider a subsample of „city“ firms located in regions where there are cities with population one million or more.[16] Compared to the rest of the country's average, all these regions are characterized by much higher volumes

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[12]Export is estimated in 1,000 USD.
[13]Our data are assumed to cover all manufacturing production in Ukraine. However, it is just a proxy for the number of firms in the region or industry because some data could be lost during the process of collecting.
[14]None of our variables can have negative values.
[15]A similar categorization is done by Baum et al. (2003a).
[16]„City“ firms are located in Lviv, Odesa, Kharkiv, Donetsk, Dnipropertrovsk, Zaporizhzhia regions and Kyiv

of FDI and a higher number of manufacturing firms receiving FDI. For example, on average 112 such firms are located in the Dnipropetrovsk region which is more than the total of FDI firms in Kherson, Chernivtsi, Chernigiv, Kirovograd and Volyn region. „Ncity“ firms are located in the remaining regions.

From the data distribution by industry (Table 4) we see that some industries are characterized by high levels of exports but low levels of FDI (e.g. color metallurgy) while some are characterized by high levels of both exports *and* FDI (e.g. black metallurgy).

4 Regional and Industry–Wide Spillovers Effects

We estimate Equation (12) for all firms and several splits of firms, using ordinary least square, fixed-effect, one-step Generalized Method of Moments (GMM), and two-step GMM estimation.[17] The results are given in Tables 5-8. In all estimations, the dependent variable is the logarithm of exports. The independent variables are number of workers; the number of foreign/home firms in the region; the number of foreign/home firms in the industry; the logarithm of investment of foreign/home firms in the region; the logarithm of investment of foreign/home firms in the industry and the lagged level of logarithm of export.

Table 5, column (1) in the Appendix describes the results for OLS estimations. These are ex ante biased but we still add them into the analysis for comparison.[18] According to them, entrance of one foreign firm has a positive effect on exports in the same industry and no significant effect at region level. The level of FDI in an industry is negatively associated with the volume of exports, which is opposite to our anticipations. However, the impact of domestic firms' activity corresponds to our predictions. Higher levels of domestic investment in the industry are correlated with higher levels of export in the same industry, while the entrance of additional firms into the industry decreases volumes of export in the same industry.

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city.

[17]We did not include the estimation using random–effect estimator because because results of the Hausman test strongly support the use of fixed–effect estimators.

[18]OLS results are upwards biased while fixed effect model results are downward biased. The coefficient near lagged value of log of export for GMM estimation is between OLS and WITHIN estimators that supports

Fixed–effect estimation results correspond better to our theoretical anticipations (Table 5, column 2). They provide some evidence that there are positive industrial spillovers from FDI, namely that there is a significantly positive impact of foreign presence on firms' exports in the same industry. This suggests significant linkage effects. There are also significant effects of the number of domestic firms on the volume of exports in the same region (positive) and industry (negative).

Tables 6–8 describe the results of testing our theoretical model using dynamic panel estimator for three different splits: durable–gods makers and non–durable–goods makers; small firms and large firms; city firms and non–city firms. Columns (1) and (3) of each table represent models using one–step estimation, while columns (2) and (4) describe two–step estimation. The model is estimated using an orthogonal transformation instrumented by all available moment restrictions starting from $(t-1)$.[19]

The correctness of the respective model specification is checked using the Sargan test. We compute the Sargan test for each two–step GMM model and we do not receive rejection for our overidentified restrictions at 10% level.[20] Heteroscedasticity and autocorrelation are controlled for by using robust standard errors and by examining the Arellano–Bond second order autocorrelation test. Consistency of GMM in our model relies on the property that we do not have second- (or higher-) order autocorrelation. Otherwise, we would have started with moment restrictions starting from $t-2$.

In the analysis for the „all" firms dataset (Table 5, columns (3) and (4)), we receive

appropriateness of GMM usage. For details, see Bond (2002).

[19] The orthogonal transformation uses

$$x_{it}^{*} = (x_{it} - \frac{x_{i(t+1)} + ... + x_{iT}}{T-t})(\frac{T-t}{T-t-1})^{1/2}$$

where the transformed variable does not depend on its lagged values. If we use first differences instead of an orthogonal transformation we will have to instrument with moment restrictions starting from $t-2$ which will lead to dropping additional 20% of the available data.

[20]Note, we do not report Sargan test results for one–step GMM results. Sargan test has an asymptotic chi–squared distribution only in the case of homoscedastic error terms. Our dataset is very heteroscedastic that is why we receive rejection of overidentifying restrictions in most cases. Arellano and Bond (1991) also mention that the Sargan test on the one–step estimation often leads to rejection of the null hypothesis that the overidentifying restrictions are valid.

evidence for positive industry spillover effects. For instance, the entrance of a foreign firm in a region increases the exports of a company in that region by 0.52 %. Although we do not find strong evidence for regional spillovers of FDI on export, there is significant evidence for regional spillovers from domestic investment.

One interesting contrast is observed for the „durable“ and „non–durable“ goods makers split as described in Table 6. Results for non–durable firms suggest positive regional spillovers from domestic firms, while there seem to be no significant effects from foreign firms at all. On the other hand, the results are much stronger for durable–goods makers: Entrance of one foreign firm into the industry increases the level of exports of a domestic firm in that industry by 0.94 %, while entrance of one foreign firm in the region increases the level of exports of a domestic firm in the same region by 0.44%.

Comparing the results for „small“ and „large“ firms (Table 7), one can see that the number of foreign firms in the region does not seem to have any effect on small domestic firms’ exports, while there are highly significant regional spillovers for large firms (at 1% level): An increase in the number of foreign firms in the region by one increases a domestic firm’s exports by 1.28 %. Concerning industry spillovers, the number of foreign firms does not have a significant effect at 5 %–level in either small or large firms’ subsamples. The effect of a domestic firms’ presence in the region is positive and significant at 1% for large firms only: A one unit rise in the number of domestic firms in the industry raises domestic firms’ exports by 0.76 %. There is little evidence for regional spillovers from domestic investment in the region. A similar picture evolves for the number of domestic firms in the industry: The effect is not significantly different from zero.

The results for „city“ and „ncity“ firms (Table 8) are also quite striking: Firms in the former category are significantly affected by foreign firms’ activities. Entrance of one foreign firm in the region or in the industry leads to an increase of the level of exports by 1.10 % and 0.43 % respectively. The level of domestic investment in the region also has a significant and positive effect, while the number of domestic firms has no effect on volumes of export. At the same time, „ncity“ firms do not seem to benefit from foreign firms in the region or in the industry. However, those firms benefit from both an increase in domestic firms' investment in the region and an increase in the number of firms in the region.

In summary, we find support for the model's predictions on the effect of industry–wide FDI spillovers for the „all firms" data set of considered firms. However, the regional spillover effect is only marginally significant. For different categories of firms, we receive varying results. The results are stronger for large firms, city firms and durable good makers. For any specification, there is no evidence for negative competition effects. Large firms can more easily adjust the quality of their production to meet the requirements of foreign firms in the region or even export their products. Similarly, Sinani and Meyer (2002) argue that large firms have more resources to invest in absorbing new technology of foreign firms, or to attract better qualified labor in order to cope with increased competition from foreign firms. Interestingly, Aitken and Harrison (1999) arrive at quite different results. In a study of 4000 Venezuelan firms, they concluded that only small firms'[21] productivity significantly benefits from FDI, while there is no significant effect on large firms. Most foreign firms are located in the urban area, very few being situated far from large cities. This is likely to decrease transaction costs for firms in urban areas and create an environment in which industry–wide spillovers might be important, so that entrance of a foreign firm in a large city region has a larger effect on exports of a firm in an urban area than on a domestic firm in a non–urban area. Finally, the industry–wide spillover effect might be significant for durable–goods makers because this type of production requires higher level of backward and forward linkages within the same industry.

5 Conclusions

We examine the effect of industry–wide and region–wide spillovers on the optimal level of exports. Based on a simple monopolistic competition model augmented with spillover effects, we hypothesize that a domestic manufacturing firm's performance, measured by the volume of exports, responds both to industry–wide and region–wide spillover effects. If foreign presence in the industry increases, then the volume of exports of a representative firm should increase as well. The theoretical predictions concerning the effects of industry–wide spillover are ambiguous, they can be either positive or negative. To test this hypothesis we utilize a dataset of 8,000 firm years of Ukrainian manufacturing firms.

Our empirical findings show that large firms benefit more from foreign direct investment than small firms, because they have sufficient capacities to absorb foreign firms' technologies. Compared to non–durable goods makers, durable–goods makers are to a higher extent affected by industry–wide FDI spillovers, because production of a durable good is likely to require a larger number of backward and forward linkages within both the same industry and region. Finally, urban area firms benefit more from FDI spillovers compared to firms in non–urban areas. FDI also promotes exports due to regional spillovers. However, there is a threshold level of FDI which seems necessary for indirect FDI effects to occur.

Ukrainian firms do benefit from foreign direct investment, and it seems desirable for policy makers to attract as much of it as possible. Our results suggest that policies to attract FDI might be too strongly concentrated on large firms in urban areas, as it is there that industry– and region–wide spillovers are mostly present. Instead, it might be desirable to also promote FDI inflows into those areas where spillovers are less present: non–urban areas with small, non–durable goods producing firms. This would create even stronger overall spillovers due to further backward and forward linkages, and therefore benefit the Ukrainian economy to a larger extent. The mechanism to achieve this could consist in either the creation of a free trade zone in such areas or in giving additional tax privileges to foreign firms investing there. In a similar manner, Blomström and Kokko (2003) have pointed out that technological spillovers are not an automatic consequence of FDI, and that it is necessary to foster the learning and absorbing capacity of domestic firms.

[21]Defined as firms with less than 50 workers.

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Appendix 1: Variables used in the paper

- EERC database
  - Volume of Export
  - Sales
  - Number of domestic firms in industry or region
- http://upop.irex.ru/eco.asp
  - Nominal Gross Domestic Product
  - Producer Price Index (PPI)
- Ukrainian statistic yearbooks, 1996-2000
  - Volume of domestic investment in industry and region
  - Volume of foreign investment in industry and region
  - Number of manufacturing firms with FDI in industry and region

Appendix 2: Linearization of the expression for optimal production level

Optimal quantity, q for the domestic firm:

$$q = \frac{n_F\,(j_F\,(q+b+1)+j_H n_H\,(z-y)-j_H\,(1+z))}{b(n_H+1+n_F)} + \frac{n_F{}^2 j(q-b)}{b(n_F+1+n_H)} + \frac{-j_H - j_H z + a - w + j_H z\,n_H}{b(n_H+1+n_F)}$$

We linearize this around equilibrium and receive

$$q_H = f_0 + f_{n_F} n_H + f_{n_H} n_H + f_{j_H} j_H + f_{j_F} j_F + f_w \hat{w}$$

where $\hat{k} = dk/K$, $\hat{n} = dn/n$, $\hat{i} = di/i$, $\hat{j} = dj/j$ and $\hat{w} = dw/w$. The coefficients are equal to

$$f_{n_F} = \frac{(n_F)^2(2j_F(q-b)+2n_H j_F(q-b)+j_F n_F(q-b))}{b(n_H+1+n_F)^2} + \\ + \frac{n_F(-a+w+j_F+j_F b+j_F q)}{b(n_H+1+n_F)^2} + \\ + \frac{n_F n_H(j_H(1+q+b)-j_H(1+y+z)+j_H n_H(z-y))}{b(n_H+1+n_F)^2}$$

$$f_{j_F} = \frac{j_F(n_F q + b\,n_F + n_F + n_F{}^2(q-b))}{b(n_H+1+n_F)}$$

$$f_{n_H} = \frac{n_H n_F j_H(3z-y+1) - n_H n_F j_F(q+b+1) - n_H(a-w-j_H-2j_H z)}{b(n_H+1+n_F)^2} + \\ + \frac{n_H n_F^2(j_H(z-y)+j_F(b-q))}{b(n_H+1+n_F)^2}$$

$$f_{j_H} = \frac{j_H(n_H z+1+z) - n_F j_H(1-n_H z+z+n_H y)}{b\left(n_H+1+n_F\right)}$$

$$f_w = -\frac{w}{b(n_H+1+n_F)}$$

Every domestic firm i at time t has

$$\hat{q}_{H,it} = f_0 + f_{n_F}\hat{n}_{F,it} + f_{n_H}\hat{n}_{H,it} + f_{j_H}\hat{j}_{H,it} + f_{j_F}\hat{j}_{F,it} + f_w\hat{w}_{it}$$

Table 1: Descriptive statistics for all, small and large firms

	μ	*s*	*p25*	*p50*	*p75*
all					
Exports, 1000 USD	4199.46	18759.46	63.80	321.25	1674.90
Number of workers	776.23	1304.24	180.00	372.00	808.50
F firms in region	91.39	108.25	33.00	52.00	109.00
F firms in industry	167.79	94.91	107.00	178.65	222.82
H firms in industry	1184.95	734.61	531.00	1384.18	1849.00
H firms in region	242.28	130.81	192.00	237.00	314.00
small					
Exports, 1000 USD	741.50	2710.85	30.10	113.10	456.50
Number of workers	113.07	47.11	77.00	116.00	148.00
F firms in region	91.08	106.10	31.00	51.00	112.00
F firms in industry	175.03	104.59	89.00	178.65	224.00
H firms in industry	1273.95	773.83	568.00	1839.00	2009.00
H firms in region	238.13	121.35	190.00	237.00	310.00
large					
Exports, 1000 USD	7109.07	25912.78	82.00	506.65	2912.00
Number of workers	2181.39	2019.02	1090.00	1535.00	2438.00
F firms in region	90.05	108.79	33.00	52.00	105.00
F firms in industry	153.53	84.31	89.00	178.65	215.00
H firms in industry	1049.48	685.27	501.00	1384.18	1839.00
H firms in region	240.31	135.16	190.00	237.00	303.00

Note: (i) p25, p50 and p75 represent the quartiles of the distribution, while s and μ represent its standard deviation and mean respectively, (ii) F denotes "foreign" and H stands for ``home".

Table 2: Descriptive statistics for durable, non—durable goods makers, city and non-city firms.

Variable	*μ*	*s*	p25	p50	p75
durable					
Exports, 1000 USD	4756.43	22099.45	46.65	251.00	1612.25
Number of workers	691.28	1290.19	161.00	316.00	662.00
F firms in region	89.68	110.04	33.00	51.00	104.00
F firms in industry	164.41	92.31	107.00	178.65	222.82
H firms in industry	1140.18	731.79	531.00	1384.18	1849.00
H firms in region	236.13	128.62	190.00	237.00	303.00
non-durable					
Exports, 1000 USD	2782.76	10385.52	78.00	321.50	1297.00
Number of workers	801.15	1197.31	197.00	415.00	910.00
F firms in region	90.51	101.66	34.00	59.00	112.00
F firms in industry	171.02	97.39	89.00	203.00	222.82
H firms in industry	1233.71	737.15	568.00	1404.00	1849.00
H firms in region	250.37	128.50	193.00	243.00	329.00
city					
Exports, 1000 USD	5491.93	22794.02	76.15	425.70	2161.80
Number of workers	967.40	1638.95	201.00	426.00	1049.00
F firms in region	161.10	138.03	80.00	113.00	160.00
F firms in industry	159.41	95.09	59.00	203.00	222.82
H firms in industry	1133.77	739.53	489.30	1384.18	1848.00
H firms in region	270.61	187.59	240.00	297.00	390.00
non-city					
Exports, 1000USD	3314.32	15337.29	56.60	265.80	1369.40
Number of workers	635.93	965.35	170.00	345.00	694.00
F firms in region	43.65	33.02	24.00	35.00	51.00
F firms in industry	173.52	94.37	108.00	178.65	222.82
H firms in industry	1220.00	729.21	538.80	1384.18	1849.00
H firms in region	222.88	61.69	187.00	220.00	250.00

Note: (i) p25, p50 and p75 represent the quartiles of the distribution, while s and μ represent its standard deviation and mean respectively, (ii) F denotes "foreign" and H stands for ``home".

Table 3: Descriptive statistics by region.

Variable	Observa-tions	Export, 1000 USD	Labor	F Firms	FDI, 1000 USD
Crimea	255	4287.36	637.14	43.6	26285.25
Sebastopol	82	543.30	271.11	3.8	2828.23
Vinnitsa	527	3151.69	484.60	28.6	3319.25
Volyn	292	1613.33	600.40	22.2	9275.58
Dnipropetrovsk	702	12978.69	1557.10	111.8	22247.36
Donetsk	886	7182.00	1260.43	101.1	41995.08
Zhytomyr	552	1778.49	602.83	34.8	4762.37
Zakarpattia	610	2800.53	438.86	133.4	13981.86
Zaporizhzhia	485	8983.56	1175.71	46.8	41098.11
Ivano-Frankivsk	396	3563.93	621.58	67.8	4406.80
Kyiv-city	727	3568.15	664.04	468.0	202988.80
Kyivregion	474	2459.85	495.66	64.8	43715.80
Kirovograd	256	1355.28	532.25	13.6	2551.80
Lugansk	488	6341.76	930.78	35.6	1532.92
Lviv	862	1795.17	598.26	170.0	21168.68
Mykolayiv	216	6575.36	1036.35	41.2	4933.74
Odesa	506	2136.08	433.98	113.6	25498.87
Poltava	463	5325.92	716.66	49.8	40003.81
Rivne	323	1930.70	540.50	23.8	6314.97
Sumy	410	4378.26	889.60	30.0	3702.03
Ternopil	256	1601.48	509.84	31.0	2532.29
Kharkiv	756	2630.41	966.15	72.8	15069.69
Kherson	151	2706.47	1097.91	48.2	6609.32
Khmelnytsky	414	2558.86	659.46	32.8	1675.11
Cherkasy	423	4888.08	605.59	48.2	2514.16
Chernivtsi	384	3115.57	563.14	17.2	5052.36
Chernigiv	218	1853.71	504.19	18.8	4379.49

Note: All variables are averaged over the period 1996-2000 for each region.

Table 4: Descriptive statistics by industry.

Variable	Observa-tions	Export, 1000 USD	Labor	F Firms	FDI
Energy	46	1203.42	2794.00	1.8	1944.17
Fuel	96	19364.66	1261.24	15.6	50235.07
Ferrous metallurgy	491	20923.36	2032.58	27.6	34991.29
Non-ferrous metallurgy	105	20593.62	1138.44	14.0	23.45
Chemicals	498	10272.15	1139.57	90.6	8794.23
Oil-Chemicals	103	4431.05	833.66	6.4	6131.91
Metal processing	4237	3304.07	1002.01	242.6	59189.58
Wood and Paper	1308	1258.62	458.67	122.0	9043.57
Construction materials	906	1463.32	608.27	59.8	1276.98
Light	1285	4173.12	617.87	150.4	3517.94
Food	2420	2920.44	380.23	320.6	125075.00
Flavor	193	728.40	205.89	2.8	4.67
Microbiology	43	736.07	345.71	19.4	1316.25
Medical equipment	178	1782.20	567.60	19.8	5056.05
Printing	79	891.11	302.63	28.4	1214.89
Others	126	7849.95	381.95	28.2	1885.76

Note: All variables are averaged over the period 1996-2000 for each industry.

Table 5: OLS, Within and GMM estimations for all firms.

Independent variable	OLS (1)	WITHIN (2)	ONE-STEP (3)	TWO-STEP (4)
$Export_{t-1}$	0.6761***	0.0075	0.0635*	0.0240
	(0.0142)	(0.021)	(0.0370)	(0.0392)
$Labor_t$	0.2888***	0.9447***	0.3739	0.5562
	(0.0231)	(0.1234)	(0.3826)	(0.3956)
F firms in $region_t$	-0.0001	0.0059***	0.0056**	0.0039
	(0.0003)	(0.0013)	(0.0029)	(0.0029)
F firms in $industry_t$	0.0052***	0.0075***	0.0052***	0.0064***
	(0.0005)	(0.0022)	(0.0015)	(0.0015)
H firms in $industry_t$	-0.0008***	-0.0010***	-0.0008***	-0.0007**
	(0.0000)	(0.0002)	(0.0003)	(0.0003)
H firms in $region_t$	0.0000	0.0036***	0.0031**	0.0039***
	(0.0002)	(0.0011)	(0.0013)	(0.0013)
F investment in $region_t$	0.0017	-0.0277	-0.0038	-0.0364
	(0.0397)	(0.0373)	(0.0554)	(0.0534)
F investment in $industry_t$	-0.2044***	-0.0754***	-0.0491	-0.0360
	(0.0278)	(0.0281)	(0.0386)	(0.0381)
H investment in $region_t$	0.0705*	0.4922***	0.8613***	0.6773***
	(0.0409)	(0.1361)	(0.2659)	(0.2504)
H investment in $industry_t$	0.1841***	0.3958***	0.1111	0.0265
	(0.0256)	(0.0637)	(0.1137)	(0.1062)
N	6009	5244	3545	3545
Sargan test	-	-	-	0.109
SOC	-	-	0.964	0.863
R-sq	0.6176	0.0794	-	-

Note. (i) Dependent variable: log of export; all independent variable, besides numbers of H/F firms in region/industry are in log form, (ii) all equations include time dummies and constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) SOC is Arellano-Bond test for second order autocorrelation, (viii) all estimations calculated using DPD package for Ox.

Table 6: GMM estimations for durable and non-durable goods makers.

	durable		non-durable	
	one-step	two-step	one-step	two-step
Independent variable	(1)	(2)	(3)	(4)
$Export_{t-1}$	0.0160	0.017	0.1647**	0.1235
	(0.0506)	(0.0524)	(0.0678)	(0.0777)
$Labor_t$	0.1183	0.0015	0.3545	0.0041
	(0.4937)	(0.5150)	(0.7672)	(0.8634)
F firms in $industry_t$	0.0094**	0.0064***	0.0012	-0.0003
	(0.0039)	(0.0042)	(0.0047)	(0.0049)
F firms in $region_t$	0.0044*	0.0069***	0.0003	0.0042
	(0.0025)	(0.0025)	(0.0030)	(0.0029)
H firms in $industry_t$	-0.0010**	-0.0011***	0.0000	-0.0001
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
H firms in $region_t$	0.0024	0.0055	-0.0013	0.0012
	(0.0021)	(0.0021)	(0.0021)	(0.0021)
F investment in $region_t$	0.02557	0.0338	0.0067	0.0054
	(0.0745)	(0.0693)	(0.1002)	(0.0969)
F investment in $industry_t$	-0.0004	0.0263	-0.0480	-0.0348
	(0.0609)	(0.0590)	(0.0632)	(0.0564)
H investment in $region_t$	0.0608	-0.0115	1.0282**	0.8948*
	(0.3176)	(0.3286)	(0.4954)	(0.4616)
H investment in $industry_t$	-0.0905	-0.0011	0.1131	0.2364
	(0.1544)	(0.1348)	(0.2068)	(0.1997)
N	1396	1396	1186	1186
Sargan test	-	0.140	-	0.363
SOC	0.871	0.829	0.132	0.185

Note. (i) Dependent variable: log of export; all independent variable, besides numbers of H/F firms in region/industry are in log form, (ii) all equations include time dummies and constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) SOC is Arellano-Bond test for second order autocorrelation, (viii) all estimations calculated using DPD package for Ox.

Table 7: GMM estimations for small and large firms.

	small		large	
	one-step	two-step	one-step	two-step
Independent variable	(1)	(2)	(3)	(4)
$Export_{t-1}$	-0.1595	-0.1592**	-0.0084	-0.0038
	(0.0561)	(0.0652)	(0.0660)	(0.0373)
$Labor_t$	0.1832	0.3185	0.2974	0.8868
	(0.4010)	(0.9579)	(0.8127)	(0.7684)
F firms in $industry_t$	0.0042	0.0072*	-0.0035	0.0026
	(0.0044)	(0.0042)	(0.0076)	(0.0074)
F firms in $region_t$	-0.0004	0.0026	0.0128***	0.0123***
	(0.0035)	(0.0045)	(0.0035)	(0.0036)
H firms in $industry_t$	-0.0006	-0.0004	-0.0007	-0.0007
	(0.0007)	(0.0009)	(0.0005)	(0.0004)
H firms in $region_t$	0.0002	0.0021	0.0076***	0.0079***
	(0.0027)	(0.0041)	(0.0022)	(0.0020)
F investment in $region_t$	-0.1671	-0.0493	-0.0781	-0.1324
	(0.1826)	(0.1904)	(0.0901)	(0.0877)
F investment in $industry_t$	0.0724	-0.0129	-0.0058	-0.0229
	(0.1408)	(0.1416)	(0.0649)	(0.0579)
H investment in $region_t$	0.5246	-0.0931	1.4159**	10.123
	(0.7106)	(0.5678)	(0.5886)	(0.6176)
H investment in $industry_t$	0.3142	0.3078	0.2491	0.1998
	(0.3100)	(0.3927)	(0.1840)	(0.1895)
N	431	431	1023	1023
Sargan test	-	0.671	-	0.453
SOC	0.831	0.760	0.187	0.229

Note. (i) Dependent variable: log of export; all independent variable, besides numbers of H/F firms in region/industry are in log form, (ii) all equations include time dummies and constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) SOC is Arellano-Bond test for second order autocorrelation, (viii) all estimations calculated using DPD package for Ox.

Table 8: GMM estimations for city and non-city firms.

	city		non-city	
	one-step	two-step	one-step	two-step
Independent variable	-1	-2	-3	-4
$Export_{t-1}$	0.1340***	0.0884	0.0394	0.0369
	(0.0498)	(0.0596)	(0.0497)	(0.0568)
$Labor_t$	0.0097	0.2592	0.7724	0.1333
	(0.4932)	(0.4498)	(0.4849)	(0.4870)
F firms in $industry_t$	0.0110***	0.0092**	0.0044	0.0031
	(0.0036)	(0.0041)	(0.0038)	(0.0039)
F firms in $region_t$	0.0043**	0.0049**	0.0009	0.0038
	(0.002)	(0.0023)	(0.004)	(0.0043)
H firms in $industry_t$	-0.0005	-0.0003	-0.0007	-0.0007
	(0.0003)	(0.0003)	(0.0004)	(0.0004)
H firms in $region_t$	0.0019	0.0020	0.0111***	0.0103***
	(0.0018)	(0.0021)	(0.0027)	(0.0027)
F investment in $region_t$	-0.0641	-0.0419	0.0571	0.0046
	(0.0556)	(0.0567)	(0.0849)	(0.0846)
F investment in $industry_t$	-0.0746	-0.0846*	-0.0402	-0.0045
	(0.0521)	(0.0505)	(0.580)	(0.0580)
H investment in $region_t$	0.9195***	0.8821***	1.9932***	1.4743***
	(0.3060)	(0.3122)	(0.5749)	(0.5409)
H investment in $industry_t$	0.1907	-0.0063	0.0951	-0.0041
	(0.1577)	(0.1549)	(0.1642)	(0.1524)
N	1603	1603	1946	1946
Sargan test	0.202	0.687	0.000	0.048
FOC	0.000	0.000	0.000	0.000
SOC	0.857	0.874	0.747	0.843

Note. (i) Dependent variable: log of export; all independent variable, besides numbers of H/F firms in region/industry are in log form, (ii) all equations include time dummies and constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) SOC is Arellano-Bond test for second order autocorrelation, (viii) all estimations calculated using DPD package for Ox.