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The Concentric-Circle Model with Application to Hungarian Firm-Level Data*

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Abstract: In this paper, we empirically examine the impact of foreign direct investment (FDI) on the export decision of domestic firms using large-scale panel data from Hungary. In comparison with the conventional model that expresses the export propensity of multinational enterprises (MNEs) with a single variable, the concentric-circle model, considering the nested structure of industrial classification, more precisely specifies the source, extent, and direction of information spillovers from MNEs to indigenous firms. We also confirmed the close relationship between the information spillover effect and the heterogeneity of FDI and domestic firms.

JEL classification numbers: F14, F21, F23, L16, L60, L80, O19, P23
Key words: FDI, information spillover, export decision, concentric-circle model, Hungary

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1. Introduction

Export promotion for domestic firms enriches the nation's foreign reserves. It also contributes to stability in the management and employment of these firms by obtaining a broad and diversified product market (Bernard and Jensen, 1999; Das et al., 2007). This is an important policy effect, especially for developing and post-communist transition economies that suffer from a great shortage of capital and the vulnerability of domestic economies. It is, therefore, natural for these countries to intently seek the benefits of export promotion. In the context of linkages with the global market, another economic policy intensely promoted by the governments of developing and transitional countries is the attraction of foreign direct investment (FDI). Multinational enterprises (MNEs) from developed economies not only contribute to the creation of new markets and jobs in the host counties but also have great potential to vitalize the domestic economies through the cross-border transfer of advanced technology and knowledge.

A number of recent studies have revealed that these two policy measures for deepening integration with the world economy are closely connected to each other in the sense that the attraction of FDI stimulates the export activity of local firms. It is argued that there are two main channels that tie FDI and the overseas advancement of domestic companies through the export of products and services. One is the direct participation of foreign investors in company management. This works as an internal channel that increases the trading business-related information and know-how of a domestic firm with foreign participation and has the effect of significantly increasing the company's export potential. Another is an externality that is brought to indigenous firms by the export activity of MNEs. Domestic firms might be able to more easily overcome various barriers associated with new entry into export markets by observing and imitating the sophisticated export operations of foreign companies. This positive externality of FDI is considered to have originated mainly in the reduction of information costs that domestic firms would have had to bear without the MNEs, and it is, consequently, called the "information spillover effect" (Aitken et al., 1997; Kneller and Pisu, 2007).

The export-promoting effect of FDI through the two channels above has greatly attracted academic interest. The number of empirical analyses on this topic, however, remains at a low level compared to that of studies concerning the productivity spillover effect (Görg and Greenaway, 2004). Studies on transition economies are even more limited, and they tend to concentrate on China (Ma, 2006; Swenson, 2007; Sun, 2009). Lutz et al. (2008), who analyzed the effect of FDI on the export activity of Ukrainian manufacturing firms, is probably the only previous study on an Eastern European country. However, as the authors recognize, their study does not discriminate externalities from the export-promoting effects of direct investment due to data limitations.

In this paper, we empirically examine the direct and indirect impacts of FDI on the export decision of domestic firms using census-type data of Hungarian firms and make a contribution to this research field from the standpoint of European transition economies. Hungary has received quite massive direct investment from the early stages of its transition to a market economy. With its drastic market liberalization and the open privatization of state-owned enterprises, many foreign joint-venture (JV) firms as well as wholly-owned subsidiaries of MNEs were established in Hungary (Iwasaki, 2007; Kiss, 2007). As of 2002, 1,718 firms (7.0%) out of a total of 24,555 manufacturing firms were operating as firms that were 100 percent owned by foreign investors (fully foreign-owned firms), and 1,447 firms (5.9%), as foreign JV firms. In Hungary, direct investment in the service industry is also very vigorous. In fact, the 114,313 firms in the service industry included 8,777 (7.7%) fully foreign-owned firms and 4,576 (4.0%) foreign JV firms in 2002.[1] With regard to the export-promoting effect of FDI on domestic firms, it is a more notable fact that the foreign companies in Hungary have a substantial export orientation compared to local firms. **Table 1** reports the export intensity by ownership structure in 2002. As the table shows, the percentage of export firms in the total number of foreign companies substantially surpasses that of fully domestically owned firms in almost all subsectors constituting the manufacturing and service industries. This fact suggests that Hungary is an ideal research subject to assess the effects of FDI on the export behavior of domestic firms under systemic transformation. As we expected, the empirical analysis in this paper detected a statistically significant positive effect of FDI on the entry of domestic firms into export markets.

This paper also makes a contribution from a methodological aspect by proposing and estimating a new empirical model focusing on the multi-layered structure of the NACE industrial classification. Our new model is designed to identify the externality of the export propensity of MNEs in relation to domestic firms according to the industrial sector at different depths using multiple variables corresponding to the nested structure of NACE. We confirmed that the new model makes it possible to detect an information spillover effect that is difficult to identify using a conventional model expressing the presence of FDI in the export market with a single variable.

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[1] Author's calculation based on the census data reported in Section 2.

Furthermore, in this paper, we examine the relationship of the heterogeneity of FDI and domestic firms with regard to the information spillover. The transferability of knowledge and technology from MNEs to domestic firms greatly depends on the firm-level characteristics of both sides. This fact has been repeatedly demonstrated by Blomström and Kokko (1998) and other preceding studies on the productivity spillover effect of FDI. It is an important viewpoint also for the empirical examination of FDI externality with respect to the export activity of domestic firms. We found that the investment mode and size of a foreign organization and ownership structure and size of a domestic organization, as well as differences in the human resource and organizational capacity, are closely associated with the potential for information spillover from MNEs to local firms.

The remainder of this paper is organized as follows: Section 2 describes the data employed for this study. Section 3 discusses the empirical methodology. Section 4 examines the characteristics of export firms and their possible endogeneity with the export market entry. Section 5 reports the baseline estimation results of the export decision model. Section 6 looks at the relationship between the heterogeneity of FDI and domestic firms with the information spillover effect. Section 7 summarizes the major findings and concludes the paper.

2. Data

The data underlying the empirical analysis in this paper are the annual census-type data of Hungarian firms, which were compiled from financial statements associated with tax reporting submitted to the National Tax Authority in Hungary by legal entities performing accounting and tax procedures using double-entry bookkeeping. The observation period covers four years from 2002 through 2005. The data includes all industries from manufacturing and service and contains basic information for each sample firm, including the NACE 4-digit codes, the annual average number of employees, overseas turnover, and other major financial indices. In addition, the locations of the sample firms are identifiable to the extent that they are divided into the capital, western, and eastern regions.[2]

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[2] The individual regions consist of the following city and counties, respectively: the capital region consists of Budapest and Pest County. The western region consists of the following nine counties: Győr-Moson-Sopron; Komarom-Esztergom; Vas; Veszprem; Fejer; Zala; Somogy; Tolna; and Baranya. The eastern region consists of nine counties as well: Nograd; Bacs-Kiskun; Csongrad; Bekes; Jasz-Nagykun-Szolnok; Hajdu-Bihar; Szabolcs-Szatmar-Bereg;

Information about the ownership structure includes the total amount of equity capital (prescribed capital) at the end of the term and the proportional share held by the state, domestic private investors, and foreign investors.

All nominal values in the Hungarian forint are deflated with the base year being 2002.[3] The consumer price index, the industrial producer price index, and the investment price index reported by the Hungarian Central Statistical Office are used as deflators. In addition, sample firms with unrealistic and inconsistent input and missing values that are impediments to our empirical analysis have been removed, and the cleansing procedures have been diligently performed.

The data form an unbalanced panel with the new entry and exit of firms during the observation period. All of the effective data values concerning these newly entering and exiting firms are used for the computation of industry-level aggregated values including the FDI spillover variables discussed later. The observations used for our estimation of empirical models are limited to those concerning foreign JV firms and fully domestically owned firms available in the data for two or more consecutive terms in the observation period with an average number of employees of five or more. This aims to exclude so-called "one-man companies" and micro firms from the panel data estimation of the export decision model for domestic firms.

As a result of data cleaning and the exclusion of small-scale companies, our final sample consists of 12,854 firm-year observations in the manufacturing industry and 26,692 firm-year observations in the service industry. According to the official statistics, the proportion of our sample in the total number of employees in 2003 is 35.0% for manufacturing firms (4,276 companies including 456 foreign JV firms with 261,837 employees) and 33.9% for service firms (8,916 companies including 576 foreign JV firms with 261,958 employees). An almost identical proportion had been confirmed for the other years. In other words, the panel data used for our empirical analysis consist of sample firms that are representative of the manufacturing and service industries in Hungary.

3. Empirical Methodology

The export of products and services to overseas markets requires an initial investment which cannot be diverted or recouped, including the development of distribution

Borsod-Abauj-Zemplen; and Heves.

[3] The unit used for the price data is 1,000 HUF.

channels and customers, research and expertise in trading and customs business, and the development of products and product packages adapted to foreign markets (Baldwin, 1989; Dixit, 1989). The disregard of this aspect of export activity may lead to a serious omitted-variable bias when estimating the impact of FDI on export decisions made by domestic firms. Thus, we adopt a model of exporting with sunk costs of market entry to underlie the empirical analysis in this paper.

We assume that a firm always selects the volume of exports that maximizes its profits depending on the market conditions once it enters foreign markets and can consequently achieve sales s^*. The firm may engage in exports $(y = 1)$ when the sales exceed the total costs consisting of fixed costs F for market entry and variable costs c. We also assume that the firm does not need to bear fixed costs F again in the current year when it has actual experience of exporting in the previous year. The net profit of the *i*-th firm in year *t* is:

$$\pi_{it}^* = s_{it}^* - c_{it} - F(1 - y_{it-1}) = s(\boldsymbol{V}_t) - c(\boldsymbol{X}_{it}, \boldsymbol{Z}_{it} | s_{it}^*) - F(1 - y_{it-1}), \quad (1)$$

where $\boldsymbol{V}_t$ is a vector of the exogenous factors that affect overseas sales, $\boldsymbol{X}_{it}$ and $\boldsymbol{Z}_{it}$ are vectors of the exogenous market conditions and firm-specific factors that determine variable costs, respectively.

The *i*-th firm implements exports if the expected net profit is positive, namely,

$$y_{it} = \begin{cases} 1 & \text{if } \pi_{it}^* > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

In the empirical analysis, we estimate a binary-choice model of the form:

$$y_{it} = \begin{cases} 1 & \text{if } \boldsymbol{\beta}_V' \boldsymbol{V}_t + \boldsymbol{\beta}_X' \boldsymbol{X}_{it} + \boldsymbol{\beta}_Z' \boldsymbol{Z}_{it} - F(1 - y_{it-1}) + \varepsilon_{it} > 0, \\ 0 & \text{otherwise,} \end{cases} \quad (3)$$

where $\boldsymbol{\beta}_V$, $\boldsymbol{\beta}_X$ and $\boldsymbol{\beta}_Z$ are vectors of the parameters, and ε_{it} is an error term.[4]

In this paper, we focus on two factors as exogenous factors that affect the overseas sales of Hungarian domestic firms. One is the terms of trade (*TT*) defined as the ratio of the export price index to the import price index. The other is the annual GDP real growth rate of 15 EU countries (*EU15*) weighted according to the market size of those countries, which are major destinations for Hungarian exports. Hereinafter, we refer to

[4] This simple model that restricts the company managers' time horizon to one year can be easily generalized by adopting a profit function that maximizes the unlimited profit stream facing the future. For details, see Roberts and Tybout (1997) and Clerides et al. (1998). Nevertheless, the empirical model derived from a generalized theoretical model also results in the same estimation model as formula (3).

these two variables as the "trade environment variables" for simplicity.

The market environment determining the variable costs for product and service exports denotes the presence of MNEs in an export market, which is one of the main research interests in this paper. **Figure 1** illustrates the relationship between the share of the foreign firms, which is weighted according to the foreign ownership share, of the total export volume for the NACE 2-digit level sectors for 2002 through 2005 and the proportion of export firms in the total number of domestic firms. As shown in Panels (a) to (d) of **Figure 1**, in the manufacturing industry, there is a relationship in which the greater the FDI presence in export markets, the higher the probability that domestic firms in the same sector will export their products. In fact, the correlation coefficient is always positive through the four years, and all the approximation lines slope upwards from left to right. On the other hand, Panels (e) to (h) of the same figure indicate that, in the service industry, there is a negative correlation between the FDI presence in the export market and the probability that domestic firms will enter foreign markets.

To examine this relationship by multivariate regression analysis, we use the so-called "FDI spillover variable." It is argued that the greater the presence of MNEs in the export market, the greater the information spillover effect brought to domestic firms by MNEs (Ruane and Sutherland, 2004). To capture this externality, it is appropriate to use the degree of the contribution of foreign capital to the total export volume in the entire industrial sector to which the *i*-th firm belongs as the proxy for the FDI presence in the export market. In particular, if the *i*-th firm belongs in NACE with sector *R* for the 2-digit level, the presence of FDI for the *i*-th firm in year *t* is defined by:

$$SPILL2_{it} = \frac{\sum_{r \text{ for all } r \in R} s_{rt} \cdot FS_{rt} - s_{it} \cdot FS_{it}}{\sum_{r \text{ for all } r \in R} s_{rt} - s_{it}}, \quad (4)$$

where *FS* stands for the foreign ownership share of the total equity capital.

The originality of this study is, in addition to the spillover variable computed using formula (4), to estimate different types of the FDI spillover variable that considers the nested structure of the NACE industrial classification. We argue that there is a close relationship between the industrial-organizational proximity of the MNEs to domestic firms and the transferability of export-related technology and knowledge from the former to the latter (**Table 2**). The closer the position of a domestic firm to an MNE in terms of business type, the more likely that the domestic firm can obtain industry (sector)-specific information on foreign markets from the MNE. On the other hand, if the MNE has a significantly higher level of general technology and knowledge concerning export operation than the domestic firms, even though the MNE is in a remote position in terms of business type, an indigenous firm can still greatly increase its chances for exporting its products or services by emulating such an MNE. At the same time, we also expect that the more homogenous an MNE is with respect to a domestic counterpart in terms of business type, the greater and more intense the competition between them will be in export markets. Hence, the possibility cannot be ruled out that the crowding-out effect of the competition between MNEs and domestic companies may eliminate all or part of the FDI export-promoting effect due to the transfer of industry-specific technology and knowledge.

The externality brought to domestic firms by the export activity of MNEs will be actualized as an accumulation effect of all the factors described above. In other words, it is possible that FDI with a different industrial-organizational proximity may have a different impact in terms of not only extent but also direction. Standing on this premise, we adapt a set of FDI spillover variables reflecting the nested structure of the industrial classification to detect the source of the information spillover effect more effectively and precisely. Specifically, if the *i*-th firm belongs in NACE with sector *P* for the 4-digit level and sector *Q* for the 3-digit level, the export propensity of foreign firms in sector *P* for the *i*-th firm is defined as:

$$SPILL4_{it} = \frac{\sum_{p \text{ for all } p \in P} s_{pt} \cdot FS_{pt} - s_{it} \cdot FS_{it}}{\sum_{p \text{ for all } p \in P} s_{pt} - s_{it}}. \tag{5}$$

In addition, the export propensity of foreign firms in sector *Q*, excluding the lower subsector *P*, is measured using the following formula:

$$SPILL3N_{it} = \frac{\sum_{q \text{ for all } q \in Q} s_{qt} \cdot FS_{qt} - \sum_{p \text{ for all } p \in P} s_{pt} \cdot FS_{pt}}{\sum_{q \text{ for all } q \in Q} s_{qt} - \sum_{p \text{ for all } p \in P} s_{pt}}. \tag{6}$$

Similarly, the export propensity of foreign firms in sector *R*, excluding lower subsector *Q*, is given by:

$$SPILL2N_{it} = \frac{\sum_{r \text{ for all } r \in R} s_{rt} \cdot FS_{rt} - \sum_{q \text{ for all } q \in Q} s_{qt} \cdot FS_{qt}}{\sum_{r \text{ for all } r \in R} s_{rt} - \sum_{q \text{ for all } q \in Q} s_{qt}}. \tag{7}$$

As shown in **Figure 2**, the above spillover variables express the triple concentric-circle structure with boundaries set by the difference in the industrial classification of the foreign firm group surrounding the *i*-th firm. Namely, the numbers 2, 3, and 4 included in the variable names stand for the levels of aggregation in NACE, and N at the end denotes that the variable has a nested structure in the relationship with the lower categories. As in our previous paper (Iwasaki et al., 2009), the empirical model including these three nested spillover variables in the right-hand side is hereinafter called the "concentric-circle model" and is distinguished from the conventional model expressing the export propensity of foreign firms with only a single variable, namely, *SPILL2*. **Table 3** reports the correlation matrices of the four types of FDI spillover variables that are actually calculated using the census data described in the previous section. As the table shows, the correlation coefficient of the nested variables, *SPILL2N*, *SPILL3N*, and *SPILL4*, is a little under 0.228 even with the maximum combination. It is, hence, unlikely that the simultaneous estimation of these spillover variables may cause a serious multicollinearity problem.

Together with the direct management participation of foreign investors, which is another matter of concern in this paper, we pay attention to the organizational and technological innovativeness, capital intensity, quality of human capital, research and development capacity, organization size, and company location as firm-specific factors affecting the level of variable costs. The extent of management participation by foreign investors is captured using the aforementioned foreign ownership share (*FS*). The organizational and technological innovativeness is measured by the total factor productivity *(TFP*) estimated using the semi-parametric method first developed by Olley and Parks (1996) and further improved by Levinsohn and Petrin (2003).[5] As proxies for the capital intensity, the human capital quality, and the research and development capacity, we use the total assets per employee (*K/L*), labor costs per employee (*LC*), and intangible assets per employee (*R&D*), respectively. The organizational size is measured by the annual average number of employees (*SIZE*). In the empirical analysis, the natural logarithms of these four variables are used. As for the company location, the fixed-effects of the capital region and the eastern region are controlled by the capital region location dummy variable (*CAPITAL*) and the eastern region location dummy variable (*EAST*), respectively. The default category consists of the firms located in the western region. Hereinafter, *FS* and the other seven variables are collectively called the "firm characteristics variable" for brevity.

When estimating formula (3), in addition to the three groups of independent

[5] The Levinsohn-Petrin estimator is widely used as the means to accurately measure TFP, since it treats simultaneous bias arising from the endogenous relationship between factor inputs and productivity by adopting intermediate inputs as the firm-specific proxy of the productivity shock, which is unobservable for econometricians. Petrin et al. (2007) describe a specific estimation method using econometric software.

variables specified above, the time fixed-effects dummy variable and industry fixed-effects dummy variable are also included in the right-hand side of the estimation equation. The firm-level individual effects are controlled by using the random-effects probit panel estimator following Heckman (1981).[6]

Our empirical analysis proceeds through a three-step approach: first, we identify the specific characteristics of export firms and check the possibility of reverse causality between such firm-level characteristics and the probability of export market entry. Second, we estimate the baseline model of export decision. Finally, by extending the empirical model, we analyze the relationship of the heterogeneity of FDI and domestic firms to the information spillover effect.

4. Export Premia and Market Entry

A series of previous studies repeatedly confirms the predominance of export firms over non-export firms, beyond the difference of countries and industrial sector, in terms of productivity, capital and technology intensity, human capital, and firm size. In addition, according to Bernard et al. (2007), such differences in firm characteristics between the two firm categories precede entry into foreign markets. In addition, some empirical studies strongly suggest that foreign ownership is one of the outstanding characteristics of exporters (Willmore, 1992; Kimura and Kiyota, 2006; Blanes-Cristóbal et al., 2008).

Using the firm characteristics variables mentioned in the previous section, we examine whether the above relationship can also be observed in Hungarian firms. **Table 4** presents the results. Here, sample firms are divided into the "exporters" $(y_{i2002} = 1)$ and the "nonexporters" $(y_{i2002} = 0)$ depending on an actual export experience in the current term (i.e., 2002 in the case of **Table 4**). Furthermore, the exporters are split into two subgroups depending on their actual export experience in the subsequent term (i.e., in 2003), the "always exporters," which continued their export business for two consecutive terms $(y_{i2002} = 1; y_{i2003} = 1)$ and the "export stoppers," which exited the export market in the subsequent term $(y_{i2002} = 1; y_{i2003} = 0)$. Similarly, the nonexporters are split into two subgroups, the "never exporters," which have had no

[6] The dynamic bivariate dichotomous choice model can be estimated by the fixed-effects linear probability model besides the random-effects probit model propounded by Heckman (1981). However, the former is an estimation method using two terms of the lagged value of independent variables as instruments, and it is difficult to use this method with data with an insufficient length of time-series. Therefore, as in other previous studies, we apply the random-effects probit estimator to all export decision models reported in this paper.

actual export experience for two consecutive terms $(y_{i2002} = 0; y_{i2003} = 0)$ and the "export starters," which entered foreign markets in the subsequent term $(y_{i2002} = 0; y_{i2003} = 1)$.

Table 4 shows that, with the only exception of the comparison based on the *TFP* variable in the manufacturing industry, exporters significantly outperform nonexporters in terms of firm characteristics variables. The difference between the two groups of firms is statistically significant at the 1% level according to the *t* test or Wilcoxon rank-sum test. Among the four subgroups, the always exporters outstrip the three remaining groups of firms in all cases excluding the comparative results on the basis of the *TFP* variable in the manufacturing industry and the *R&D* variable in the service industry. On the other hand, the never exporters are inferior to the other groups of firms. The export stoppers and export starters lie between the always exporters and the never exporters, and it is difficult to determine which is better. According to the results of the ANOVA or Kruskal Wallis test, this relationship is also statistically significant at levels of 5% or less. In addition, regarding the *R&D* variable in the service industry, the difference between the export starters and the always exporters is very narrow (2.6925 versus 2.6673).

Next, we examine whether the relationship indicated in **Table 4** between the actual export experience and the firm characteristics can be confirmed for the whole analysis period. To this end, we regress the pooled firm characteristics variable (z_{it}) into the export statuses defined above while controlling the firm size (*SIZE*) (except for those cases in which the firm size itself is a dependent variable), location fixed-effects (*CAPITAL* and *EAST*), industry fixed-effects, and time fixed-effects, as in:

$$z_{it} = \mu + \gamma y_{it} + \boldsymbol{\sigma}'\boldsymbol{W}_i + \varphi_i + \varepsilon_{it}, \tag{8}$$

and in:

$$z_{it} = \mu + \delta ALWAYS_{it} + \theta STOP_{it} + \vartheta START_{it} + \boldsymbol{\sigma}'\boldsymbol{W}_i + \varphi_i + \varepsilon_{it}, \tag{9}$$

where

$$ALWAYS_{\text{it}} = 1 \text{ if } (y_{it} = 1) \text{ and } (y_{it+1} = 1),$$
$$STOP_{\text{it}} = 1 \text{ if } (y_{it} = 1) \text{ and } (y_{it+1} = 0),$$
$$START_{\text{it}} = 1 \text{ if } (y_{it} = 0) \text{ and } (y_{it+1} = 1),$$

and μ is a constant term, γ, δ, θ and ϑ are parameters of the export statuses, $\boldsymbol{\sigma}$ is a parameter vector of the control variables, $\boldsymbol{W}_i$ is a vector of the control variables, and φ_i is the firm-level individual effects.

Panel (a) of **Table 5** shows the estimation results. We use White's heteroskedasticity-consistent standard errors for all specifications. As the time-invariant variables are contained in the part of the control variables of Equations (8) and (9), the pooling OLS or random-effects model are the available estimation methods for them. Because the Breusch-Pagan test rejected the null hypothesis that the variance of the individual effects is zero for all models at the 5% significance level, the estimation results of the random-effects model are reported in **Table 5**.

The estimation results of Equation (8) show that the exporters in both the manufacturing and service industries have a significantly higher value of all the six firm characteristics variables than the nonexporters. Furthermore, according to the estimation results of Equation (9), the firms with actual export experience either in the current term or the subsequent term outperform the never exporters in all cases except the *TFP* variable of the export stoppers and export starters. Moreover, we confirm that the always exporters have variable values that leave those in other firm categories far behind. The estimation results, in which a clear relationship of superiority or inferiority cannot be observed between the export stoppers and the export starters, also closely correspond to the results of the univariate analysis reported in **Table 4**.

The estimation results above support the self-selection hypothesis in the sense that, with respect to Hungarian firms in the early 2000s, the better the organization and human capital, the higher the productivity, and the larger the firm size, the greater the probability of export market entry (Clerides et al., 1998; Bernard and Jensen, 1999). In theory, however, the learning-by-exporting hypothesis, according to which the export activity triggers fierce market competition overseas and contact with the foreign firms and customers and, consequently, such activity brings ex-post positive changes to the exporter's firm organization and management, can also hold true (Wagner, 2002; Girma et al., 2004). It is conceivable that the larger the ex-ante gap in productivity and technological level is between the domestic firms and their counterparts in foreign countries, the more the potential learning-by-exporting effect is enhanced. In this sense, it is not a coincidence that studies of developing economies provide strong supporting evidence for the learning-by-exporting hypothesis (Biesebroeck, 2005; Yasar and Rejesus, 2005).

The learning-by-exporting hypothesis can also be applied to Hungary, which belongs to the former communist bloc, which was regarded as a technologically underdeveloped region. In addition, there may be a reverse causality between the actual export experience and the ownership structure in the sense that the foreign investors willingly sink their capital into prospective firms entering foreign markets by overcoming the significant sunk costs. To examine this possibility, we re-estimate Equations (8) and (9) by replacing their left-hand side with the ex-post change in the firm characteristics variable. From the estimation results in Panel (b) of **Table 5**, it is difficult to determine whether the start of an export business by a Hungarian local firm brings about a notable ex-post improvement in the firm's characteristics, including the foreign ownership share.[7] The only exception is firm size measured by the annual average number of employees, suggesting that Hungarian exporters tend to keep increasing employment after an overseas advance.

In contrast to the self-selection hypothesis, we cannot obtain strong supporting evidence for the learning-by-exporting hypothesis in the case of Hungary. However, an endogenous relationship between the export activity and the firm characteristics is not completely ruled out. In addition, it is natural to assume that an information transfer from an MNE to a local firm will exert actual influence on the latter's export activity with a certain time-lag interval. Thus, in order to avoid the endogeneity of export market entry and the firm characteristics and other possible simultaneity problems and to take the possible time-lag effect of information spillover into consideration, we lag all the independent variable one year following Bernard and Jensen (2004). Accordingly, the goal of our empirical analysis is to estimate the export decision model of the form:

$$\Pr[y_{it} = 1] = \alpha + \boldsymbol{\beta}_V'\boldsymbol{V}_{t-1} + \boldsymbol{\beta}_X'\boldsymbol{X}_{it-1} + \boldsymbol{\beta}_Z'\boldsymbol{Z}_{it-1} + Fy_{it-1} + \varphi_i + \varepsilon_{it}, \qquad (10)$$

where α is a constant term.

5. Determinants of Export Decision: Baseline Estimation

We first present the estimation results of the baseline model. **Table 6** contains the estimated parameters for the conventional model expressing the export propensity of MNEs with a single variable as Models [1] and [3] and those of the concentric-circle model considering the nested structure of the NACE industrial classification as Models [2] and [4]. Since lagged variables are used as independent variables, the dependent variable is limited to the export market entry probability of domestic firms for the three years from 2003 through 2005.

From the estimation of the FDI spillover variables, we obtained interesting evidence: in the conventional model [1], the spillover variable *SPILL2* is estimated with a positive

7 Although the details are omitted due to space limitations, we obtained a similar result from a comparative analysis of export firms and non-export firms using the propensity score matching method practiced by Yasar and Rejesus (2005) and Wagner (2002).

sign with statistical significance at the 5% level. In other words, the domestic firms in the manufacturing industry enjoy a positive externality promoting the export of products from MNEs belonging to the same sector of the industrial classification at the 2-digit level. In other words, the export activity of foreign-owned manufacturing firms, as a whole, brings to domestically owned companies an information spillover effect that overtops the crowding-out effect arising from interfirm competition. The concentric-circle model [2] presents more detailed information about its source. The information spillover effect on domestic firms comes not only from the foreign firms belonging to the same sector at the NACE 4-digit level (Enterprise Layer I in **Figure 2**) but also from the foreign firms operating at the most peripheral position in the industrial classification (Enterprise Layer III). At the same time, Model [2] also indicates that the foreign firms covered by *SPILL3N* variables (Enterprise Layer II) have a negative externality on domestic firms. However, we confirmed that the FDI externalities coming from these three different enterprise layers are positive by rejecting the null hypothesis that the sum of the coefficients of the nested FDI spillover variables is zero at the 1% significance level according to the Wald test (χ^2=7.93, p=0.005).

Meanwhile, a statistically significant FDI externality is not detected by the conventional model [3] that deals with the service industry. However, according to the estimation result of the concentric-circle model [4], domestic firms enjoy a positive export-promoting effect from the foreign firms with the most distant proximity in terms of industrial classification, and, in addition, the Wald test strongly rejects the null hypothesis that the FDI spillover effect is zero as a whole (χ^2=16.35, p=0.000). We interpret these results as evidence that the information spillover effect originating from the export activity of MNEs certainly exists in both the manufacturing and service industries in Hungary even though the channels and extent are largely different.

We also obtained supporting evidence for another FDI export-promoting effect which is examined in this paper, namely, the effect of direct participation of foreign investors in company management. Indeed, the foreign ownership share (*FS*) is positive and significant at the 1% level in all specifications, and its regression coefficient presents an economically meaningful value, suggesting that FDI into Hungary also plays a very important role as an internal channel for converting domestic firms into exporters.[8]

The trade environment variables do not exert a significant impact on the export

[8] However, in our preliminary estimation work, the state ownership share did not produce a significant estimate for the manufacturing and service industries.

activity of domestic firms in either the manufacturing or the service industries. On the other hand, among the firm characteristics variables, in addition to foreign ownership share, the *K/L*, *LC*, *R&D*, and *SIZE* variables, which are the proxies for capital intensity, human capital quality, research and development capacity, and organizational size, respectively, obtain relatively robust and positive estimates. These results are consistent with the large majority of previous studies on developed and developing economies. However, the *TFP* variable, which reflects the organizational and technological innovativeness, contrary to our expectations, is insignificant for the manufacturing industry and negative at the 5% significance level for the service industry.

The location fixed-effects presented by the *CAPITAL* and *EAST* variables vary considerably between manufacturing firms and service firms: in the case of the manufacturing industry, the further west in the country a firm is located, the greater the potential for product export is, *ceteris paribus*. In the service industry, the export market entry probability of firms located in the capital region is significantly higher than that of firms located in the western and eastern regions. The physical accessibility to the EU market, the most important market for Hungarian exports, may exercise a considerable effect on the export activity of manufacturing firms, probably through the impact on logistics costs. In contrast, service firms are relatively free from such physical restraints, and the possibility of having a home base in the capital region suggests an advantageous effect on the acquisition of market information and customers of foreign countries. This is an interesting empirical finding from the viewpoint of firm location theory.

The estimation results reported in **Table 6** further demonstrate that the burden of an initial investment concerning export market entry is a critical management issue to be overcome for Hungarian domestic firms. In both industries, the estimate of the lagged endogenous dependent variable is positive and significant at the 1% level, and its coefficient exceeds the value of 2.00 in all specifications. The coefficient of the lagged endogenous dependent variable in the export decision model of U.S. firms estimated by Bernard and Jensen (2004) is from 0.203 through 0.665 (Table 5, p. 567). The estimate in the study of Blanes-Cristóbal et al. (2008) concerning the sunk costs for Spanish exporters is 1.316 (Table 2, p. 112). Therefore, although it is not a precise comparison, we conjecture that the sunk costs of export market entry, which Hungarian domestic firms face, are likely to be much higher than those in the U.S. and Western Europe. The relatively high initial cost of advancing overseas may be a characteristic of former socialist transition economies, where the market economy was still underdeveloped even in the early 2000s.

6. Information Spillover and Heterogeneity of FDI and Domestic Firms

The estimation results of the baseline models reported in the previous section strongly suggest a close association between the industrial-organizational proximity of MNEs to domestic firms and the information spillover effect. The emergence of the FDI spillover, however, can also be greatly influenced by the heterogeneity of the foreign firms, as originators of the externality, and domestic firms, as benefit recipients. In this section, we empirically examine this issue through the extension of the empirical model.

6.1 Heterogeneity of FDI

From the viewpoint of the heterogeneity of foreign firms, we pay attention to their investment mode and organizational size. Compared to a wholly-owned local subsidiary, it is relatively difficult for a joint venture with domestic investors to maintain secrecy with respect to its technology or information provided by the parent firm. In addition, JV firms tend to have a stronger organizational and human connection with the local business community. Consequently, as a channel for information diffusion from MNEs to domestic firms, a JV firm is assumed to play a more active role than that played by a wholly-owned local subsidiary, *ceteris paribus*. Indeed, Javorcik and Spatareanu (2008) found a strong positive externality of JV firms in comparison with fully foreign-owned firms from their empirical analysis on the FDI productivity spillover effect in Romania.

The firm size is also relevant to the information spillover effect. If other conditions are equal, the possibility of the leakage of internal knowledge and information may increase along with the expansion of the firm organization and operation. In addition, it is believed that because of its major presence in business communities and the strong social disclosure requirements, including government regulations in incoming countries, a large firm can easily become the target of information extraction by local firms.

To examine the above hypothesis, we divide foreign firm samples into two groups depending on investment mode or organizational size and estimate the FDI spillover variables calculated for each individual sample group. The division by investment mode is based on whether the foreign ownership share is 100%, and that by organizational size is based on the 75 percentile of the annual average number of employees.

The estimation results are shown in **Table 7**. Although all models include the same trade environment variables, firm characteristics variables, lagged endogenous dependent variable, and time and industry fixed-effects dummy variables as the baseline model in their right-hand sides, the table reports solely the estimated parameters of the FDI spillover variables for brevity. Panel (a) of **Table 7** shows the estimate of the spillover variables of fully foreign-owned firms and foreign JV firms; *FUL* is added to the variable name of the former, and *JV* is added to that of the latter. Panel (b) of the same table reports the estimation results of the spillover variables of large MNEs and small MNEs in terms of the total number of employees; *BIG* is added to the variable name of the upper group, and *SME* is added to that of the lower one.

From these results, we confirm that an information spillover effect in the manufacturing industry, regardless of its extent and direction, is strongly originated from fully foreign-owned large firms. In the case of Hungary, these firms represent the fully-owned subsidiaries of the world's major international enterprises. However, Panel (a) of **Table 7** indicates that foreign JV firms also generate a significant positive externality. According to the estimation results of the concentric-circle model [2], this is mainly brought about by firms with the most distant proximity in terms of industrial classification (Enterprise Layer III in **Figure 2**). In the service industry, as compared to manufacturing firms, the role of small and medium-sized foreign companies is very distinctive as the economic entities promoting the export activity of domestic firms. According to the estimation results of Model [8], the foreign firms belonging to the lower group in terms of the organizational size produce a significantly positive information spillover effect in each and every enterprise layer comprising the 2-digit level industrial classification. This result demonstrates that, in the case of the service industry, it is much easier for domestic firms to understand and imitate the export operation of small and medium-sized foreign companies than that of larger ones. In sum, we found that the source and extent of the information spillover effect may vary greatly depending on the industrial sector, even in the same country.

6.2 Heterogeneity of Domestic Firms

Next, we look at the relationship of the heterogeneity of domestic firms to the information spillover effect. Here, we focus on the presence of a foreign investor(s) as a business partner, the firm size, and the human resource and organizational capacity. We expect that these factors will positively affect the export potential of domestic firms by improving their ability to collect external information and their adaptive capacity in the export business.

To validate this hypothesis, we estimated the interacted terms of the firm characteristics variables reflecting the above three factors and the FDI spillover variables. As with the baseline model, we use foreign ownership share (*FS*) and the annual average number of employees (*SIZE*) to represent the management participation of foreign investors and the firm size, respectively. On the other hand, it is difficult to express the human resource and organizational capacity of a domestic firm using any one of the firm characteristics variables. Thus, we perform the principal component analysis of the *TFP*, *K/L*, *LC*, and *R&D* variables and use its first component score (*ORG*) as a proxy of a firm's capacity for human resources and organization. As shown in **Table 8**, the *ORG* variable explains nearly 50% of the total variance of the four variables in both industries and adds original variables in a balanced manner.

The estimation results of the extension model, containing the interacted terms of *FS, SIZE*, and the newly introduced *ORG* variable and the FDI spillover variable(s) in its right-hand side, are listed in **Table 9**.[9] The results demonstrate that each factor, i.e., foreign ownership, firm size, and human resource and organizational capacity, is effective in the absorption of know-how and technology diffusing from the export activity of MNEs. However, there is a significant difference in the extent among factors and industrial sectors. For instance, in Models [1] and [2] reported in Panel (a) of **Table 9**, the interacted terms of the *FS*, *SPILL2*, and *SPILL2N* variables produce statistically significant and positive coefficients. The information suggests that the participation of foreign investors in the management of a manufacturing firm is an effective means of enjoying FDI externality more efficiently. However, the same effect cannot be observed in the service industry. On the other hand, it is highly probable that human resource and organizational capacity are more critical for service firms than for manufacturing firms to absorb the information spillover effect and apply it to export business. Indeed, Panel (c) of **Table 8** shows that all interacted terms of *ORG* variable and FDI spillover variables in Models [7] and [8] dealing with the service industry are estimated with a positive sign, and the statistical significance of their estimates is substantially higher than that for manufacturing firms reported in Models [5] and [6].

As described above, although the heterogeneity of domestic firms is closely related to the information spillover from MNEs, there is a difference in its extent depending on the nature of the heterogeneity or the industrial sector.

7. Conclusions

In this paper, we empirically examined the determinants of export market entry by

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9 To avoid multicollinearity, four firm characteristics variables are removed from the right-hand side of the regression model with the *ORG* variable.

domestic firms using large-scale panel data on Hungarian firms for the early 2000s. We found that direct transnational investment greatly stimulates the export activity of domestic firms in Hungary through two channels, that is, direct management participation by foreign investors and the information spillover originated from incoming MNEs. The concentric-circle model, which has a set of spillover variables reflecting the nested structure of the NACE industrial classification in its right-hand side, can more precisely specify the source, extent, and direction of the FDI externality affecting the export decision of domestic firms than the conventional model, which expresses the export propensity of foreign firms with a single variable.

The estimation results of the concentric-circle model reported in Section 5 strongly suggest that there is a close causality between the industrial-organizational proximity of MNEs to domestic firms and the information spillover effect. In addition, the empirical analysis conducted in the previous section reveals that the investment mode and organizational size of foreign firms and the ownership structure and organizational size of domestic firms as well as the human resource and organizational capacity greatly affect the possibility and extent of the information spillover effect.

We also confirmed that the findings of previous studies on developed and developing economies are generally applicable to Hungary, a post-socialist transitional country. Specifically, the exporters in Hungary possess superior characteristics in terms of capital intensity, quality of human capital, research and development capacity, and firm size in comparison to nonexporters. In addition, we found that Hungarian domestic firms face substantial sunk costs incurred by new entries into export markets.

By subjecting not only the manufacturing industry, which has been addressed in the large majority of previous studies, but also the service industry to empirical analysis, this study gave great attention to the differences a distinction in the industrial sector brings to the structure of the export decision model. The empirical analysis in this paper revealed that the mechanisms generating the information spillover effect and the effects of firm location are very different between the two industries. The cost-benefit performance of export promotion policies for domestic firms can be improved through modification of their institutional frameworks by taking this empirical evidence into account.

References

Aitken, Brian, Gordon H. Hanson and Ann E. Harrison, 1997, Spillovers, foreign investment, and export behavior, Journal of International Economics 43:1, pp. 103-132.

Baldwin, Richard E., 1989, Sunk-cost hysteresis, Working Paper No. 2911, National Bureau of

Economic Research: Cambridge, MA.

Bernard, Andrew B. and J. Bradford Jensen, 1999, Exceptional exporter performance: Cause, effect, or both?, Journal of International Economics 47:1, pp. 1-25.

Bernard, Andrew B. and J. Bradford Jensen, 2004, Why some firms export, Review of Economics and Statistics 86:2, pp. 561-569.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding and Peter K. Schott, 2007, Firms in international trade, Journal of Economic Perspectives 21:3, pp. 105-130.

Biesebroeck, Johannes Van, 2005, Exporting raises productivity in sub-Saharan African manufacturing firms, Journal of International Economics 67:2, pp. 373–391.

Blanes-Cristóbal, José Vicente, Marion Dovis, Juliette Milgram-Baleix and Ana I. Moro-Egido, 2008, Do sunk exporting costs differ among markets? Evidence from Spanish manufacturing firms, Economics Letters 101:2, pp. 110-112.

Blomström, Magnus and Ari Kokko, 1998, Multinational corporations and spillovers, Journal of Economic Surveys 12:2, pp. 1-31.

Clerides, Sofronis K., Saul Lach and James R. Tybout, 1998, Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco, Quarterly Journal of Economics 113:3, pp. 903-947.

Das, Sanghamitra, Mark J. Roberts and James R. Tybout, 2007, Market entry costs, producer heterogeneity, and export dynamics, Econometrica 75:3, pp. 837-873.

Dixit, Avinash, 1989, Entry and exit decisions under uncertainly, Journal of Political Economy 97:3, pp. 620-638.

Girma, Sourafel, David Greenaway and Richard Kneller, 2004, Does exporting increase productivity? A microeconometric analysis of matched firms, Review of International Economics 12:5, pp. 855–866.

Görg, Holger and David Greenaway, 2004, Much ado about nothing? Do domestic firms really benefit from foreign direct investment?, World Bank Research Observer 19:2, pp. 171-197.

Heckman, James J., 1981, The incidental parameters problem and the problem of initial conditions in estimating a discrete time-discrete data stochastic process, In: Manski, Charles and Daniel MacFadden (eds.), The Structural Analysis of Discrete Data, MIT Press: Cambridge, MA., pp. 179-195.

Iwasaki, Ichiro, 2007, Corporate restructuring and the role of foreign direct investment in Hungary, In: Dallago, Bruno and Ichiro Iwasaki (eds.), Corporate Restructuring and Governance in Transition Economies, Palgrave Macmillan: Basingstoke, pp. 178-210.

Iwasaki, Ichiro, Péter Csizmadia, Miklós Illéssy, Csaba Makó and Miklós Szanyi, 2009, The concentric-circle model of FDI spillover effects: Estimation using Hungarian panel data, Working Paper No. A521, Institute of Economic Research, Hitotsubashi University: Tokyo.

Javorcik, Beata Smarzynska and Mariana Spatareanu, 2008, To share or not to share: Does local participation matter for spillovers from foreign direct investment? Journal of Development Economics 85:1-2, pp. 194-217.

Kimura, Fukunari and Kozo Kiyota, 2006, Exports, FDI, and productivity: Dynamic evidence from Japanese firms, Review of World Economics 142:4, pp. 695-719.

Kiss, Eva, 2007, Foreign direct investment in Hungary: Industry and its spatial effects, Eastern European Economics 45:1, pp. 6-28.

Kneller, Richard and Mauro Pisu, 2007, Industrial linkages and export spillovers from FDI, World Economy 30:1, pp. 105-134.

Levinsohn, James and Amil Petrin, 2003, Estimating production functions using inputs to control for unobservables, Review of Economic Studies 70:2, pp. 317-341.

Lutz, Stefan, Oleksandr Talavera and Sang-Min Park, 2008, Effects of a foreign presence in a transition economy: Regional and industry-wide investments and firm-level exports in Ukrainian manufacturing, Emerging Markets Finance and Trade 44:5, pp. 82–98.

Ma, Alyson C., 2006, Export spillovers to Chinese firms: Evidence from provincial data, Journal of Chinese Economic and Business Studies 4:2, pp. 127-149.

Olley, G. Steven and Ariel Pakes, 1996, The dynamics of productivity in the telecommunications equipment industry, Econometrica 64:6, pp. 1263-1297.

Petrin, Amil, Brian P. Poi and James Levinsohn, 2004, Production function estimation in Stata using inputs to control for unobservables, Stata Journal 4:2, pp. 113-123.

Roberts, Mark J. and James R. Tybout, 1997, The decision to export in Colombia: An empirical model of entry with sunk costs, American Economic Review 87:4, pp. 545-564.

Ruane, Frances and Julie Sutherland, 2004, Foreign direct investment and export spillovers: How do export platforms fare? Discussion Paper No. 58, Institute for International Integration Studies at Trinity College, University of Dublin: Dublin.

Sun, Sizhong, 2009, How does FDI affect domestic firms' exports? Industrial evidence, World Economy 32:8, pp. 1203-1222.

Swenson, Deborah L., 2007, Multinationals and the creation of Chinese trade linkages, Working Paper No. 13271, National Bureau of Economic Research: Cambridge, MA.

Wagner, Joachim, 2002, The causal effects of exports on firm size and labor productivity: First evidence from a matching approach, Economics Letters 77:2, pp. 287–292.

Willmore, Larry, 1992, Transnationals and foreign trade: Evidence from Brazil, Journal of Development Studies 28:2, pp. 314-335.

Yasar, Mahmut and Roderick M. Rejesus, 2005, Exporting status and firm performance: Evidence from a matched sample, Economics Letters 88:3, pp. 397-402.

Table 1. Export intensity by ownership structure in the Hungarian manufacturing and service industries, 2002

(a) Manufacturing (N=24555)

NACE industry	Percent of firms	Percent of export firms			
		All firms	Foreign firm		Fully domestically owned firm
			Fully foreign-owned firm	Foreign joint-venture firm	
15 Food products and beverages	12.31	19.85	52.69	55.37	15.45
16 Tobacco products	0.02	83.33	100.00	100.00	50.00
17 Textiles	3.32	35.17	74.00	68.75	25.92
18 Apparel	5.77	29.10	67.89	68.12	23.51
19 Leather tanning and dressing	1.49	44.38	76.92	69.70	33.33
20 Wood, wood products, and cork, except furniture	6.38	22.92	69.88	63.01	18.09
21 Pulp, paper, and paper products	1.38	29.88	87.50	55.56	21.88
22 Publishing, printing, and reproduction of recorded media	14.31	11.55	36.50	30.77	9.64
23 Coke, refined petroleum products, and nuclear fuel	0.03	37.50	100.00	100.00	0.00
24 Chemicals and chemical products	2.20	43.70	75.71	82.35	33.65
25 Rubber and plastic products	5.03	42.38	80.27	74.75	33.50
26 Other non-metallic mineral products	3.92	20.06	64.06	46.15	14.65
27 Basic metals	1.02	51.60	87.10	77.78	43.78
28 Fabricated metal products, except machinery and equipment	14.88	29.41	80.66	68.97	23.58
29 Machinery and equipment	8.98	31.16	70.27	74.48	24.84
30 Office machinery and computers	0.83	15.27	53.85	41.67	10.67
31 Electrical machinery and apparatuses	3.03	31.59	82.56	85.11	20.29
32 Radio, television, and communication equipment and apparatus	2.45	33.39	89.29	81.58	19.79
33 Medical, precision and optical instruments, watches, and clocks	3.99	23.06	72.09	71.43	17.59
34 Motor vehicles, trailers, and semi-trailers	0.91	52.91	85.42	80.00	38.00
35 Other transport equipment	0.68	31.33	100.00	72.73	26.49
36 Furniture	6.56	20.79	57.97	66.28	16.35
37 Recycling	0.52	19.69	50.00	66.67	14.91
Manufacturing total	100.00	26.07	70.37	64.41	19.92

(b) Services (N=114313)

NACE industry	Percent of firms	Percent of export firms			
		All firms	Foreign firm		Fully domestically owned firm
			Fully foreign-owned firm	Foreign joint-venture firm	
50 Sale, maintenance, and repair of motor vehicles and motorcycles	6.64	8.38	37.78	30.73	6.77
51 Wholesale trade and commission trade, except for motor vehicles and motorcycles	18.68	22.46	34.52	42.22	18.39
52 Retail trade, except for motor vehicles and motorcycles; repair	19.87	4.04	6.00	19.87	3.49
55 Hotels and restaurants	6.43	1.10	3.38	5.18	0.78
60 Land transport; transport via pipelines	3.70	21.32	64.38	51.25	19.96
61 Water transport	0.07	17.11	100.00	42.86	11.94
62 Air transport	0.04	34.78	75.00	28.57	31.43
63 Supporting and auxiliary transport activities; activities of travel agencies	2.20	23.65	49.03	44.00	19.52
64 Post and telecommunications	0.54	8.59	50.00	40.91	4.65
70 Real estate activities	9.30	3.10	6.14	5.58	2.35
71 Rental of machinery, equipment, and personal and household goods	0.87	5.92	28.57	16.22	4.29
72 Computer and related activities	5.87	8.63	47.11	41.90	6.14
73 Research and development	0.79	20.33	41.94	47.22	18.38
74 Other business activities	25.01	5.76	35.60	26.01	4.23
Service industry total [a]	100.00	9.45	22.57	28.82	7.43

Note: [a] Excluding financial intermediation.

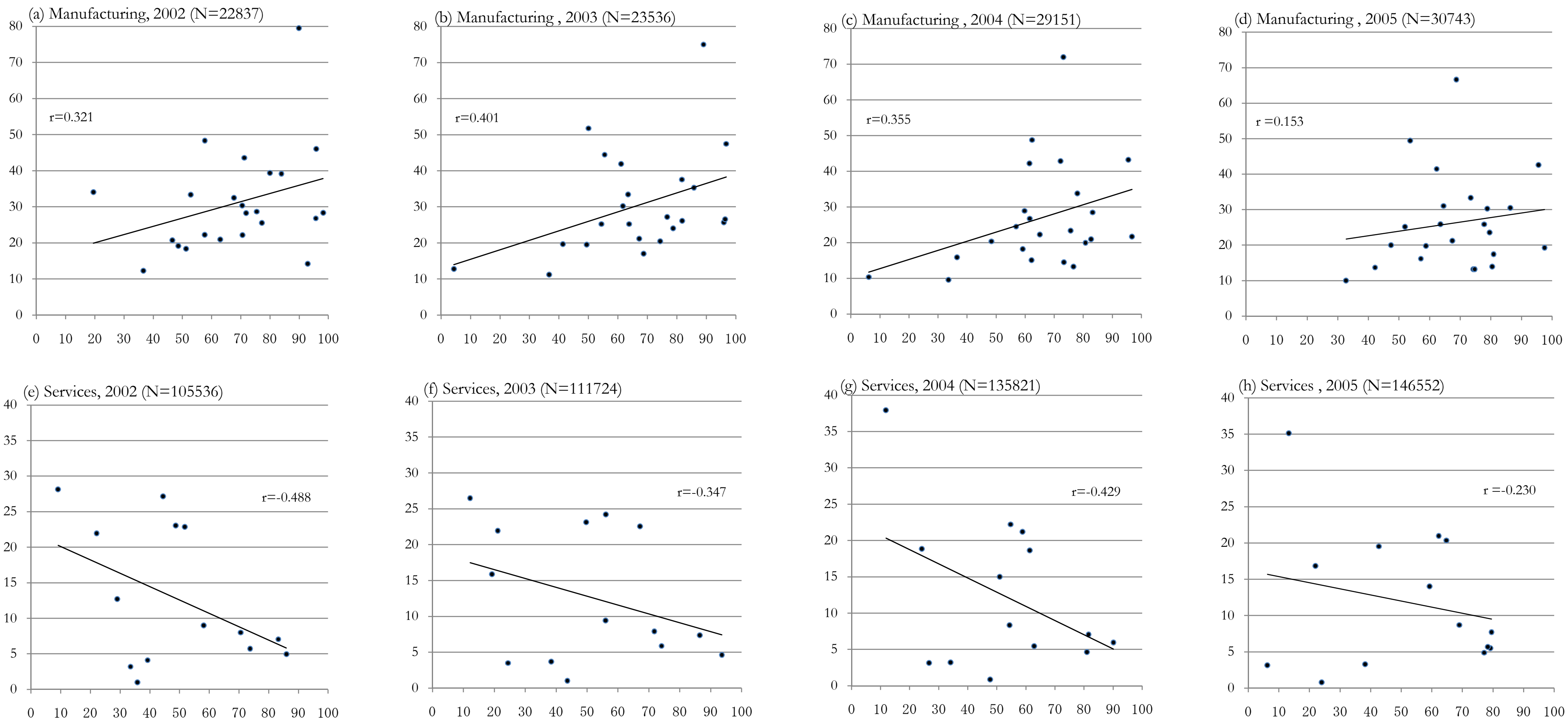
Source: Author's calculation.

Table 2. Relationships among industrial-organizational proximity, probability of export-related knowledge/technology transfer from MNEs to domestic firms, and degree of competitiveness between both sides in export markets

Industrial-organizational proximity	Probability of export-related technology/knowledge transfer from MNEs to domestic firms		Degree of competitiveness between MNEs and domestic firms in export markets
	Probability of industry-specific technology and knowledge transfer	Probability of general technology and knowledge transfer	
Close	High		Strong
Moderate	Moderate	Homogenous	Moderate
Far	Low		Weak

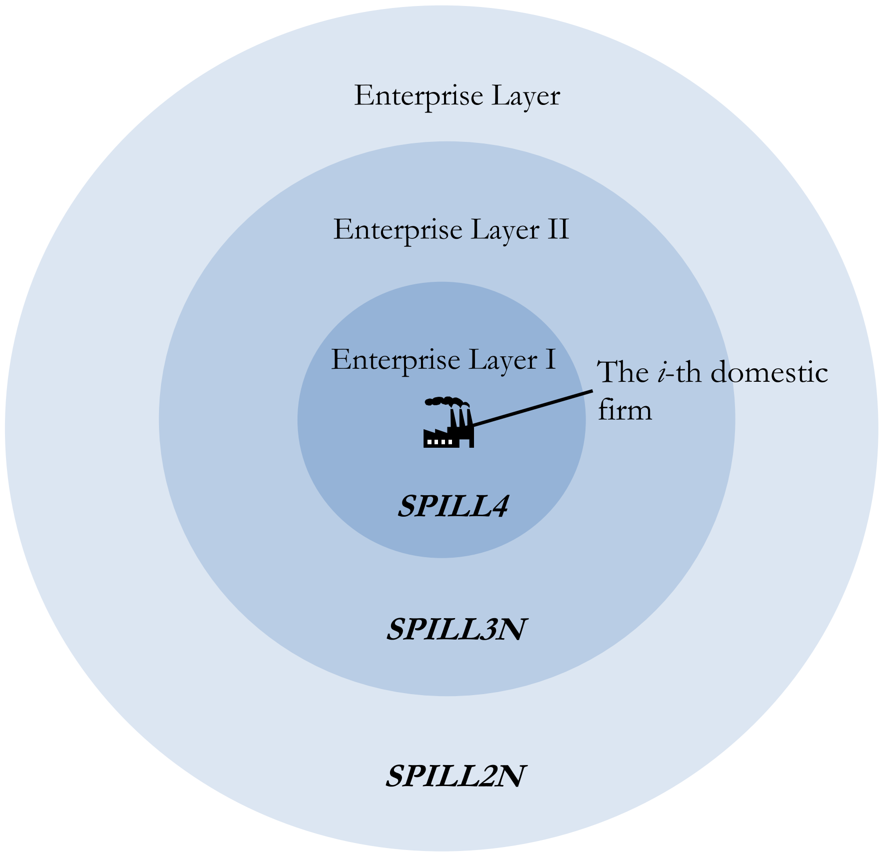
Source: Authors' compilation. See text for details.

Figure 1. Correlation between the export propensity of foreign firms and the probability of export market entry of domestic firms, 2002-2005



Note: The vertical axis is the share of foreign firms weighted by the foreign ownership share of the total export volume in each of the NACE 2-digit level sectors, and the horizontal axis is the percentage of export firms in the total number of domestic firms in that sector.
Source: Author's illustration.

Figure 2. The concentric-circle structure of FDI spillover variables



Source: Author's illustration. See text for details.

Table 3. Correlation matrices of FDI spillover variables

(a) Manufacturing (N=12854)

	SPILL2	*SPILL2N*	*SPILL3N*	*SPILL4*
SPILL2	1.000			
SPILL2N	0.691	1.000		
SPILL3N	0.023	-0.087	1.000	
SPILL4	0.495	0.228	-0.107	1.000

(b) Services (N=26692)

	SPILL2	*SPILL2N*	*SPILL3N*	*SPILL4*
SPILL2	1.000			
SPILL2N	0.683	1.000		
SPILL3N	0.025	0.054	1.000	
SPILL4	0.457	0.105	0.107	1.000

Source: Author's calculation. For definitions and descriptive statistics of the variables, see Appendix.

Table 4. Univariate analysis of the relationship between the actual export experience of domestic firms and the firm-specific factors, 2002

(a) Manufacturing (N=4276)

Export status	*FS*	*TFP*	*K/L*	*LC*	*R&D*	*SIZE*
All firms	0.0696	0.0299	8.4650	7.2312	1.9522	3.2877
	(0.000)	(0.015)	(8.452)	(7.171)	(1.700)	(3.091)
Exporters	0.1201	0.0254	8.6081	7.3373	2.1791	3.7497
	(0.000)	(0.013)	(8.622)	(7.307)	(2.003)	(3.638)
Always exporters	0.1302	0.0245	8.6273	7.3542	2.2051	3.8376
	(0.000)	(0.011)	(8.641)	(7.323)	(2.031)	(3.738)
Export stoppers	0.0391	0.0323	8.4542	7.2028	1.9714	3.0471
	(0.000)	(0.027)	(8.445)	(7.131)	(1.674)	(2.890)
Nonexporters	0.0204	0.0344	8.3253	7.1276	1.7307	2.8369
	(0.000)	(0.017)	(8.298)	(7.046)	(1.488)	(2.708)
Never exporters	0.0158	0.0349	8.2820	7.1134	1.6996	2.8144
	(0.000)	(0.017)	(8.243)	(7.037)	(1.447)	(2.708)
Export starters	0.0606	0.0297	8.7025	7.2512	2.0008	3.0326
	(0.000)	(0.018)	(8.672)	(7.147)	(1.692)	(2.944)
Comparative analysis between exporters and nonexporters						
t test on the equality of mear	15.386 ***	-1.573	9.880 ***	15.352 ***	11.020 ***	28.796 ***
Wilcoxon rank-sum test	16.588 ***	-1.935 *	10.619 ***	15.853 ***	10.778 ***	26.304 ***
Multipul comparison of four subcategories						
ANOVA (*F*)	95.800 ***	1.000	48.900 ***	93.810 ***	46.200 ***	329.780 ***
Bartlett test (χ^2)	1700.000 ***	11.885 ***	2.865	12.133 ***	31.717 ***	241.603 ***
Kruskal-Wallis test (χ^2)	318.316 ***	4.105	160.331 ***	292.426 ***	131.989 ***	796.148 ***

(b) Services (N=8916)

Export status	*FS*	*TFP*	*K/L*	*LC*	*R&D*	*SIZE*
All firms	0.0367	0.0349	8.8100	7.2463	2.2336	2.6979
	(0.000)	(0.013)	(8.828)	(7.165)	(2.028)	(2.485)
Exporters	0.0918	0.0391	9.3105	7.4639	2.6491	2.8836
	(0.000)	(0.019)	(9.344)	(7.421)	(2.485)	(2.708)
Always exporters	0.1010	0.0392	9.3532	7.4935	2.6673	2.9317
	(0.000)	(0.020)	(9.374)	(7.462)	(2.494)	(2.773)
Export stoppers	0.0490	0.0387	9.1130	7.3270	2.5649	2.6610
	(0.000)	(0.014)	(9.176)	(7.225)	(2.451)	(2.565)
Nonexporters	0.0203	0.0336	8.6614	7.1817	2.1102	2.6428
	(0.000)	(0.011)	(8.665)	(7.104)	(1.904)	(2.398)
Never exporters	0.0181	0.0335	8.6274	7.1719	2.0750	2.6423
	(0.000)	(0.011)	(8.638)	(7.094)	(1.865)	(2.398)
Export starters	0.0571	0.0360	9.2244	7.3441	2.6925	2.6513
	(0.000)	(0.015)	(9.228)	(7.286)	(2.555)	(2.485)
Comparative analysis between exporters and nonexporters						
t test on the equality of mear	18.320 ***	1.104	25.442 ***	21.757 ***	15.461 ***	10.554 ***
Wilcoxon rank-sum test	19.488 ***	3.205 ***	26.682 ***	21.477 ***	15.580 ***	11.152 ***
Multipul comparison of four subcategories						
ANOVA (*F*)	131.780 ***	0.430	268.420 ***	183.420 ***	105.590 ***	46.160 ***
Bartlett test (χ^2)	2400.000 ***	27.809 **	81.211 ***	43.523 ***	21.423 ***	44.316 ***
Kruskal-Wallis test (χ^2)	434.977 ***	10.869 **	853.706 ***	534.409 ***	312.272 ***	146.998 ***

Notes: The upper values are means, and the lower values in parentheses are medians. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Author's estimation.

Table 5. Panel data analysis of the characteristics of export firms and endogeneous relationship between firm characteristics and actual export experience, 2002-2005

(a) Level

Industrial sector	Manufacturing (N=12854)				Services (N=26692)			
Estimation equation	(9)	(10)			(9)	(10)		
Export status	Export firms	Always exporters	Export stoppers	Export starters	Export firms	Always exporters	Export stoppers	Export starters
FS	0.0106 ***	0.0238 ***	0.0091 ***	0.0110 ***	0.0108 ***	0.0239 ***	0.0087 ***	0.0101 ***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
TFP	0.0065 *	0.0079 *	-0.0013	-0.0059	0.0084 ***	0.0111 ***	0.0022	-0.0027
	(0.004)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.003)
K/L	0.0848 ***	0.2088 ***	0.0871 ***	0.1147 ***	0.1027 ***	0.2165 ***	0.1127 ***	0.1133 ***
	(0.011)	(0.015)	(0.014)	(0.013)	(0.009)	(0.013)	(0.012)	(0.011)
LC	0.0664 ***	0.1117 ***	0.0536 ***	0.0363 ***	0.0736 ***	0.1453 ***	0.0636 ***	0.0701 ***
	(0.009)	(0.011)	(0.010)	(0.009)	(0.007)	(0.009)	(0.009)	(0.008)
R&D	0.1536 ***	0.2911 ***	0.1335 ***	0.1558 ***	0.2038 ***	0.3749 ***	0.2020 ***	0.2297 ***
	(0.024)	(0.031)	(0.033)	(0.031)	(0.020)	(0.026)	(0.028)	(0.026)
SIZE	0.1246 ***	0.2513 ***	0.1042 ***	0.0926 ***	0.0733 ***	0.1380 ***	0.0723 ***	0.0588 ***
	(0.011)	(0.017)	(0.014)	(0.013)	(0.008)	(0.012)	(0.011)	(0.010)

(b) Ex-post change

Industrial sector	Manufacturing (N=12854)				Services (N=26692)			
Estimation equation	(9)	(10)			(9)	(10)		
Export status	Export firms	Always exporters	Export stoppers	Export starters	Export firms	Always exporters	Export stoppers	Export starters
ΔFS	0.1109 *	0.1168 *	0.0730	0.0018	0.0001	0.0268	0.0201	0.1071
	(0.057)	(0.066)	(0.058)	(0.061)	(0.036)	(0.034)	(0.047)	(0.083)
ΔTFP	0.4147	0.3644	-0.1164	-0.8776	-0.6674	-1.5015	3.4386	1.0879
	(0.641)	(0.748)	(0.848)	(0.719)	(3.847)	(4.545)	(3.573)	(1.426)
$\Delta K/L$	-0.0041 ***	-0.0048 ***	0.0005	0.0007	-0.0008	-0.0010	-0.0024	-0.0051 *
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)
ΔLC	-0.0015	-0.0009	-0.0013	0.0035 *	0.0020	0.0047	-0.0149	-0.0109
	(0.001)	(0.001)	(0.002)	(0.002)	(0.005)	(0.007)	(0.012)	(0.012)
$\Delta R\&D$	-0.0478	-0.0378	0.0393	0.1545 *	-0.0811 **	-0.0962 **	-0.0576	-0.0841 **
	(0.035)	(0.039)	(0.064)	(0.081)	(0.035)	(0.040)	(0.054)	(0.043)
$\Delta SIZE$	0.0126 ***	0.0193 ***	-0.0007	0.0130 **	0.0069 ***	0.0136 ***	-0.0005	0.0228 ***
	(0.003)	(0.003)	(0.005)	(0.006)	(0.002)	(0.003)	(0.004)	(0.005)

Notes: All models are estimated using the random-effects estimator. The estimation results of control variables are not reported here. The robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Author's estimation. See text for details.

Table 6. Baseline estimation of the export decision model

Industrial sector	Manufacturing		Services	
Model [a]	[1]	[2]	[3]	[4]
Trade environment variables				
TT_{t-1}	0.0117	0.0085	-0.0470	-0.0222
	(0.074)	(0.075)	(0.061)	(0.057)
$EU15_{t-1}$	0.0519	0.0456	-0.0334	-0.0040
	(0.070)	(0.070)	(0.057)	(0.054)
FDI spillover variables				
$SPILL2_{it-1}$	0.5639 **		0.0230	
	(0.233)		(0.266)	
$SPILL2N_{it-1}$		0.6907 ***		0.6859 ***
		(0.192)		(0.131)
$SPILL3N_{it-1}$		-0.1458 **		-0.0489
		(0.072)		(0.050)
$SPILL4_{it-1}$		0.1315 *		0.0564
		(0.068)		(0.054)
Firm characteristics variables				
FS_{it-1}	0.5665 ***	0.5655 ***	0.5194 ***	0.5142 ***
	(0.091)	(0.092)	(0.070)	(0.070)
TFP_{it-1}	-0.0930	-0.0985	-0.1627 **	-0.1569 **
	(0.095)	(0.095)	(0.075)	(0.075)
K/L_{it-1}	0.2101 ***	0.2060 ***	0.1862 ***	0.1877 ***
	(0.020)	(0.020)	(0.015)	(0.015)
LC_{it-1}	0.0789 *	0.0872 *	0.1046 ***	0.1107 ***
	(0.045)	(0.046)	(0.029)	(0.029)
$R\&D_{it-1}$	0.0304 **	0.0320 **	0.0395 ***	0.0387 ***
	(0.013)	(0.013)	(0.009)	(0.009)
$SIZE_{it-1}$	0.3375 ***	0.3360 ***	0.1266 ***	0.1318 ***
	(0.018)	(0.018)	(0.013)	(0.013)
$CAPITAL_{it-1}$	-0.0665 *	-0.0658 *	0.0688 **	0.0679 **
	(0.038)	(0.038)	(0.029)	(0.029)
$EAST_{it-1}$	-0.0850 **	-0.0860 **	-0.0441	-0.0459
	(0.040)	(0.040)	(0.033)	(0.033)
Lagged endogenous dependent variable				
y_{it-1}	2.0504 ***	2.0466 ***	2.1804 ***	2.1723 ***
	(0.031)	(0.032)	(0.025)	(0.025)
Const.	-6.3453	-6.0569	0.3227	-2.7008
	(7.523)	(7.534)	(6.217)	(5.812)
Time fixed-effects	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes
Firm-level individual effects	Yes	Yes	Yes	Yes
N	12854	12854	26692	26692
Log likelihood	-4259.46	-4251.80	-7147.02	-7131.27
Wald test [b]	6196.55 ***	6188.17 ***	10669.01 ***	10648.19 ***

Notes: [a] All models are estimated using the random-effects probit estimator. The robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[b] Null hypothesis: All coefficients are zero.

Source: Author's estimation. For definitions and descriptive statistics of the variables, see Appendix.

Table 7. FDI heterogeneity and information spillover effect

(a) Investment mode

Industrial sector	Manufacturing		Services	
Model [a]	[1]	[2]	[3]	[4]
SPILL2FUL $_{it-1}$	0.6102 **		0.0349	
	(0.239)		(0.280)	
SPILL2FULN $_{it-1}$		0.7182 ***		0.6676 ***
		(0.193)		(0.134)
SPILL3FULN $_{it-1}$		-0.1715 **		0.0029
		(0.074)		(0.053)
SPILL4FUL $_{it-1}$		0.1348 **		0.0362
		(0.069)		(0.054)
SPILL2JV $_{it-1}$	0.8337 **		0.1206	
	(0.403)		(0.753)	
SPILL2JVN $_{it-1}$		0.8113 ***		1.0034 ***
		(0.256)		(0.261)
SPILL3JVN $_{it-1}$		0.1330		-0.6782 ***
		(0.154)		(0.188)
SPILL4JV $_{it-1}$		0.1120		0.1589
		(0.138)		(0.138)
N	12854	12854	26692	26692
Log likelihood	-4259.12	-4249.51	-7147.01	-7122.42
Wald test [b]	6196.68 ***	6185.31 ***	10668.98 ***	10622.53 ***

(b) Organizational size

Industrial sector	Manufacturing		Services	
Model [a]	[5]	[6]	[7]	[8]
SPILL2BIG $_{it-1}$	0.5523 **		0.4618	
	(0.235)		(0.371)	
SPILL2BIGN $_{it-1}$		0.6472 ***		0.5621 ***
		(0.199)		(0.135)
SPILL3BIGN $_{it-1}$		-0.1928 **		-0.2668 ***
		(0.076)		(0.073)
SPILL4BIG $_{it-1}$		0.1787 **		-0.0100
		(0.071)		(0.057)
SPILL2SME $_{it-1}$	0.7689		0.7403 *	
	(0.682)		(0.442)	
SPILL2SMEN $_{it-1}$		0.4302		0.5886 ***
		(0.366)		(0.207)
SPILL3SMEN $_{it-1}$		0.0060		0.1748 *
		(0.118)		(0.091)
SPILL4SME $_{it-1}$		-0.0816		0.3151 ***
		(0.127)		(0.087)
N	12854	12854	26692	26692
Log likelihood	-4259.41	-4247.22	-7146.80	-7118.48
Wald test [b]	6196.45 ***	6180.82 ***	10668.32 ***	10626.65 ***

Notes: [a] All models are estimated using the random-effects probit estimator. The estimates of the constant term and other independent variables are not reported here. The robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[b] Null hypothesis: All coefficients are zero.

Source: Author's estimation. For definitions and descriptive statistics of the variables, see Appendix.

Table 8. Principal component analysis of the human resource and organizational capacity of domestic firms

(a) Manufacturing (N=12854)

Eigenvalue of the correlation matrix				Eigenvectors and component loadings of the first component		
Component no.	Eigenvalue	Accounted for variance	Cumulative percentage of total variance	Variables	Eigenvector	Component loading
1	1.9589	48.97	48.97	*TFP*	0.2066	0.2892
2	1.0988	27.47	76.44	*K/L*	0.5008	0.5249
3	0.5599	14.00	90.44	*LC*	0.8018	0.6000
4	0.3825	9.56	100.00	*R&D*	0.8570	0.5300

(b) Services (N=22692)

Eigenvalue of the correlation matrix				Eigenvectors and component loadings of the first component		
Component no.	Eigenvalue	Accounted for variance	Cumulative percentage of total variance	Variables	Eigenvector	Component loading
1	1.8617	46.54	46.54	*TFP*	0.2660	0.3629
2	1.1044	27.61	74.15	*K/L*	0.4261	0.4478
3	0.6413	16.03	90.19	*LC*	0.7761	0.6215
4	0.3926	9.81	100.00	*R&D*	0.8468	0.5306

Source: Author's estimation. For definitions and descriptive statistics of the variables, see Appendix.

Table 9. Heterogeneity of domestic firms and information spillover effect

(a) Foreign ownership share

Industrial sector	Manufacturing		Services	
Model [a]	[1]	[2]	[3]	[4]
FS_{it-1}	-0.2993	0.0039	0.4876 **	0.3424
	(0.314)	(0.351)	(0.241)	(0.262)
$SPILL2_{it-1}$	0.4769 **		0.0201	
	(0.235)		(0.267)	
$SPILL2N_{it-1}$		0.6442 ***		0.6979 ***
		(0.193)		(0.133)
$SPILL3N_{it-1}$		-0.1512 **		-0.0653
		(0.073)		(0.051)
$SPILL4_{it-1}$		0.1327 *		0.0434
		(0.070)		(0.055)
$FS \times SPILL2_{it-1}$	1.4244 ***		0.0561	
	(0.500)		(0.406)	
$FS \times SPILL2N_{it-1}$		0.8027 *		-0.1120
		(0.420)		(0.370)
$FS \times SPILL3N_{it-1}$		0.1124		0.2857
		(0.280)		(0.231)
$FS \times SPILL4_{it-1}$		0.0351		0.3094
		(0.335)		(0.270)
N	12854	12854	26692	26692
Log likelihood	-4255.33	-4249.87	-7147.01	-7129.57
Wald test [b]	6171.22 ***	6173.04 ***	10669.67 ***	10647.84 ***

(b) Organizational size

Industrial sector	Manufacturing		Services	
Model [a]	[5]	[6]	[7]	[8]
$SIZE_{it-1}$	0.2225 ***	0.1690 ***	0.0638 *	0.0541
	(0.065)	(0.063)	(0.038)	(0.035)
$SPILL2_{it-1}$	-0.0114		-0.3198	
	(0.390)		(0.329)	
$SPILL2N_{it-1}$		0.3592		0.4522 **
		(0.311)		(0.224)
$SPILL3N_{it-1}$		-0.1836		-0.1682
		(0.174)		(0.138)
$SPILL4_{it-1}$		-0.4308 **		-0.1257
		(0.197)		(0.139)
$SIZE \times SPILL2_{it-1}$	0.1814 *		0.1215 *	
	(0.099)		(0.068)	
$SIZE \times SPILL2N_{it-1}$		0.1051		0.0817
		(0.078)		(0.064)
$SIZE \times SPILL3N_{it-1}$		0.0119		0.0468
		(0.049)		(0.047)
$SIZE \times SPILL4_{it-1}$		0.1769 ***		0.0647
		(0.058)		(0.046)
N	12854	12854	26692	26692
Log likelihood	-4257.77	-4245.63	-7145.43	-7127.98
Wald test [b]	6189.36 ***	6170.94 ***	10670.33 ***	10647.25 ***

(Continued)

Table 9 (Continued)

(c) Human resource and organizational capacity

Industrial sector	Manufacturing		Services	
Model [a]	[5]	[6]	[7]	[8]
ORG $_{it-1}$	0.0549	0.0930 *	0.0472	0.1069 ***
	(0.049)	(0.050)	(0.033)	(0.031)
SPILL2 $_{it-1}$	0.5533 **		-0.0048	
	(0.232)		(0.266)	
SPILL2N $_{it-1}$		0.7333 ***		0.6481 ***
		(0.191)		(0.130)
SPILL3N $_{it-1}$		-0.1396 *		-0.1052 **
		(0.072)		(0.051)
SPILL4 $_{it-1}$		0.1359 **		0.0972 *
		(0.068)		(0.053)
ORG × *SPILL2* $_{it-1}$	0.1450 *		0.1683 ***	
	(0.075)		(0.057)	
ORG × *SPILL2N* $_{it-1}$		0.0709		0.1484 ***
		(0.063)		(0.048)
ORG × *SPILL3N* $_{it-1}$		0.0594		0.0198
		(0.039)		(0.032)
ORG × *SPILL4* $_{it-1}$		-0.0350		0.1037 ***
		(0.046)		(0.035)
N	12854	12854	26692	26692
Log likelihood	-4294.10	-4284.57	-7213.15	-7191.27
Wald test [b]	6249.71 ***	6240.32 ***	10766.66 ***	10719.27 ***

Notes : [a] All models are estimated using the random-effects probit estimator. The estimates of the constant term and other independent variables are not reported here. The robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[b] Null hypothesis: All coefficients are zero.

Source : Author's estimation. For definitions and descriptive statistics of the variables, see Appendix.

Appendix. Definitions and descriptive statistics of the variables used in the empirical analysis

Variable name	Definition	Descriptive statistics			
		Manufacturing (N=12854)		Services (N=26692)	
		Mean	S. D.	Mean	S. D.
Firm category variable					
y	Exporter dummy variable	0.491	0.500	0.233	0.423
ALWAYS	Always exporter dummy variable (y_{it} =1; y_{it+1} =1)	0.434	0.496	0.192	0.394
STOP	Export stopper dummy variable (y_{it} =1; y_{it+1} =0)	0.057	0.232	0.041	0.199
START	Export starter dummy variable (y_{it} =0; y_{it+1} =1)	0.061	0.239	0.048	0.215
Trade environment variables					
TT	Terms of trade (export price index/import price index × 100)	99.434	0.490	99.435	0.491
EU15	Annual GDP real growth rate of 15 EU countries	1.567	0.519	1.566	0.518
FDI spillover variables					
SPILL2	Share of foreign firms in the export volume (NACE 2-digit level)	0.642	0.166	0.529	0.174
SPILL2N	Share of foreign firms in the export volume (NACE 2-digit level: nested variable)	0.638	0.207	0.532	0.178
SPILL3N	Share of foreign firms in the export volume (NACE 3-digit level: nested variable)	0.490	0.331	0.240	0.283
SPILL4	Share of foreign firms in the export volume (NACE 4-digit level)	0.557	0.281	0.436	0.292
Firm characteristics variables					
FS	Foreign ownership share of the total equity capital	0.064	0.209	0.036	0.157
TFP	Total factor productivity estimated using the Levinsohn-Petrin semi-parametric method	0.025	0.187	0.029	0.190
K/L	Assets per employee (natural logarithm)	8.544	0.952	8.870	1.051
LC	Labor costs per employee (natural logarithm)	7.269	0.465	7.291	0.526
R&D	Intangible assets per employee (natural logarithm)	2.010	1.372	2.256	1.423
SIZE	Annual average number of employees (natural logarithm)	3.293	1.105	2.739	0.897
CAPITAL	Dummy variable for firms located in the capital region	0.394	0.489	0.463	0.499
EAST	Dummy variable for firms located in the eastern region	0.332	0.471	0.278	0.448
ORG	Human resource and organizational capacity (first principal component of *TFP*, *K/L*, *LC* and *R&D*	-0.140	1.333	-0.089	1.308

Source: Author's calculation. *TT* and *EU15* are from the Hungarian Central Statistical Office's website (http://portal.ksh.hu/) and Statistical Office of the European Union's website (http://epp.eurostat.ec.europa.eu/), respectively. The other variables come from census data of Hungarian firms. See text for details.