

# **Exporting Behavior of Firms: How Do Multinationals Change International Trade?**

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## **Abstract**

This paper analyzes a firm's decision to enter and exit foreign markets through exporting. Employing firm-level data from the Czech Republic, results suggest that entry sunk costs are significant and substantial, although no significant differences are found between sunk costs incurred by domestic and foreign-owned firms. Exchange rate level is an important factor influencing participation in export, though firms with a foreign owner are twice less responsive to exchange rate changes than are domestic private and domestic state firms. Higher volatility of exchange rate significantly decreases the probability of future exporting for firms with a foreign owner. In the search for spillovers, the results are mixed. Proximity to an exporting firm (either in geographic or sectoral terms) has, surprisingly, a negative effect on the decision of a firm to export in four specifications and a positive effect in one specification.

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## 1 Introduction

The purpose of the present study is to examine the exporting behavior of firms in the Czech Republic, with an emphasis on the differences between firms controlled by domestic and foreign owners. Taking into account the high ratio of inward and outward foreign direct investments in the Czech Republic, foreign ownership is a good indicator of the multinational status of a firm<sup>3</sup>. Results of the paper thus suggest how increasingly important multinational corporations change the patterns of international trade in small open economies. Three major areas are investigated: First, the importance of sunk costs of exporting is estimated. Second, the responsiveness of firms to changes in exchange rate levels and volatility is explored. Finally, the role of spillovers that influence the exporting of other firms is investigated.

The paper is organized as follows. Section 2 provides a motivation focused primarily on the responsiveness of a firm's exporting behavior to exchange rate changes, while the literature review section surveys firm-level studies of exporting behavior as well as other related trade literature. Section 4 focuses on the estimation strategy. Data used in the study are described in section 5, section 6 summarizes empirical results, and the final section outlines further work on the paper.

## 2 Motivation

In all countries, but specifically in small open economies, a change of exchange rate leading to a significant change in aggregate export can strongly influence that country's macroeconomic development. Due to hysteresis in trade, even temporary changes in exchange rates can lead to permanent changes in international trade flows<sup>4</sup>. In the case of transition countries, the effects of exchange rate changes on aggregate export are even more pronounced due to the relatively high vulnerability of firms. Therefore, politicians and central bankers of small transition countries are likely to be concerned about the level of exchange rate and its effect on exporters.

Indeed, when in 2001 the exchange rate of the Czech koruna against the Euro appreciated by 8.5% over twelve months and, due to the recession in Germany, the foreign trade deficit of the Czech Republic reached an all-time high of CZK 22 billion in December 2001, a discussion about the “correct” level of exchange was already underway. “The current exchange rate and mainly the trend is, I’m not afraid to say it, homicidal<sup>5</sup>”, suggested Vratislav Kulhánek, former CEO of Škoda Auto a.s., the largest Czech exporter (the firm is owned by a German-based multinational). One month later, the Czech National Bank in cooperation with the government announced measures aimed at stopping the appreciation of the Czech currency<sup>6</sup>.

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<sup>3</sup> In their seminal work on the role of multinationals in exporting behavior, Aitken, Hanson and Harrison (1997) define multinational enterprises as firms with positive foreign equity ownership.

<sup>4</sup> Hysteresis in trade describes the situation in which suitable conditions (e.g. the depreciation of the exchange rate or the removal of tariffs) enable a firm to enter foreign markets (because expected returns exceed sunk costs), but the firm doesn’t exit foreign markets when initial conditions are re-established.

<sup>5</sup> Interview for ČRo 1, Radiožurnál , 22.11.2001. Available in Czech at [www.cnb.cz](http://www.cnb.cz), web page of the Czech National Bank.

<sup>6</sup> These included the transfer of privatization proceeds directly into the foreign exchange reserves of the central bank.

But was the exchange rate “homicidal” for all exporters? Certainly not. At the end of 2001, CzechTrade (a government agency promoting export) surveyed 1500 exporting firms<sup>7</sup>. Although nearly half of the firms (mostly small and medium enterprises) perceived the currency appreciation negatively, most reported that they had nevertheless continued to export the same volume; only their profits had been reduced. On the other hand, 27% of exporting firms regarded the appreciation positively. Most of these were medium and large enterprises that are likely to hedge against exchange rate risk.

What are the determinants of a firm’s export responsiveness to exchange rate changes? Does ownership matter? Are firms owned by a foreign owner more likely to export? There are several reasons to expect that ownership matters in exporting. Foreign owners can provide exporting know-how and information about target markets, which can decrease the initial sunk costs of entry to a foreign market. Multinationals are likely to be less responsive to exchange rate changes due to internal pricing or long-run decisions about locations of plants in different countries. Reputation can also play a role – once exchange rates change and production of the same good is no longer profitable in one country, a reputable multinational may prefer to produce with a loss for an extended period of time than to stop supplying the market with that good. With the increasing importance of multinationals, knowledge of differences in export responsiveness between domestic and foreign-owned firms can predict changes in aggregate responsiveness as well as influence policy-making.

Besides inspecting the responsiveness of exporters to exchange rate changes, I devote part of this paper to examining how spillovers influence exporters. The general idea behind this is relatively simple. Knowledge of foreign markets can spread from firm to firm through contacts between firms in a region, through migration of employees within an industry, or through the contacts between suppliers and their clients. Also, an increased concentration of exporters in a region can foster the formation of a transportation infrastructure that subsequently increases the likelihood of neighboring firms to export. Possible spillovers from the presence of multinationals or the presence of exporting firms are important from a policy-making perspective, yet the literature on the issue is relatively scant.

This paper connects to previous studies that employ firm-level panel data to identify and quantify the determinants of a firm’s decision to export and to study the firm’s export responsiveness to exchange rate changes in terms of both level and volatility. In particular, I am looking for differences between domestic and foreign-owned firms. In addition, I plan to inspect possible spillovers from the presence of foreign firms or exporting firms on the exporting behavior of firms.

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<sup>7</sup> Available in Czech at [www.czechtrade.cz](http://www.czechtrade.cz)

### 3 Overview of the Literature

Relevant literature on the exporting behavior of firms starts<sup>8</sup> with the theoretical frameworks built by Baldwin (1989), Baldwin and Krugman (1989), and Dixit (1989), who emphasize that the presence of sunk costs leads to hysteresis in trade. Hysteresis describes the situation in which suitable conditions (e.g. the depreciation of the exchange rate or the removal of tariffs) enable a firm to enter foreign markets (because expected returns exceed sunk costs), but the firm doesn't exit foreign markets when initial conditions are re-established. Hysteresis has clear implications for international trade, in that macroeconomic shocks, temporary changes in exchange rate, or policy changes could permanently change the pattern of international trade flows and consequently equilibrium exchange rates.

The first empirical support for the trade hysteresis hypothesis (i.e. the hypothesis that sunk costs are important in international trade) to employ firm-level data was that of Roberts and Tybout (1997). The authors estimate a dynamic discrete-choice model that explains the exporting status of a firm by its exporting history, observed characteristics, and unobserved serially correlated shocks. Using panel data on Colombian manufacturing firms, Roberts and Tybout confirm the trade hysteresis hypothesis. In addition, the authors show that the benefit of the exporting experience decreases once a firm exits foreign markets, and becomes irrelevant after two years. As for the other characteristics of exporting firms, the authors indicate that firms that are large and old are more likely to export. In reaction to the paper of Roberts and Tybout, Campa (2004) employs data on Spanish manufacturers and extends the research by breaking down the adjustments of export supply into intensive and extensive margin, i.e. the changes in volume exported by firms that are already exporting and adjustments caused by the change in the number of exporters. In accordance with Roberts and Tybout (1997), Campa supports the relevance of sunk costs, but shows that the effect of hysteresis is relatively small. He emphasizes that the bulk of changes in aggregate exported volume comes from changes in the exported volumes of existing exporters rather than from a change in the number of exporters. In addition, Campa's results indicate that neither the firm's decision to participate in exporting nor the decision about the exported volume depends on the exchange rate volatility.

In a related study of exporting behavior that employs firm-level panel data, Bernard and Jensen (2004) build on a similar strategy as Roberts and Tybout (1997) and examine the effects of entry costs, firm characteristics, but also spillovers from neighboring exporters and the effects of government export promotion policies on the decision to export. Using data on U.S. firms for the years 1984-1992, Bernard and Jensen support the results of Roberts and Tybout (1997) by showing that entry sunk costs are significant. On the other hand, the effects of export promotion policies examined in Bernard and Jensen (2004) are insignificant and geographic and industry spillovers turn out to be negative. Regarding the effects of ownership, the authors find the effect of belonging to a multinational to be significant and to increase the probability of participation in export by 1.7%.

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<sup>8</sup> For a survey of earlier studies on exporting behavior, see Bilkey (1978)

Bernard and Jensen (2004) are, however, not the first to study the role of spillovers in exporting behavior. In the context of exporting, spillovers can occur for instance when information about foreign markets or about bureaucratic procedures connected with exporting leaks from one firm to another, either through contacts between firms or through movements of the labor force. Another form of spillover occurs when the regional concentration of exporters makes it feasible to build a transportation infrastructure that increases the probability of exporting for other firms. Aitken, Hanson and Harrison (1997) in their seminal paper test the hypothesis that the exporting activity of one firm increases the likelihood that other firms export. In particular, the authors study whether proximity to multinationals increases a firm's probability of exporting. Their findings show that multinationals indeed act as an export catalyst for domestic firms; however, the authors conclude that no spillovers are generated by the exporting firm in general. The hypothesis that domestic firms learn to export from multinationals is tested also by Greenaway, Sousa and Wakelin (2004), who find positive spillovers in the behavior of UK firms. According to their results, multinationals increase not only the probability of domestic firms to export, but also the export propensity of exporting firms.

Damijan, Polanec and Prasnikar (2004) employ data on Slovenian firms to evaluate the importance of fixed costs and to test a hypothesis about the different directions of causality between exporting and productivity. Since the Slovenian data allow the authors to differentiate between different foreign markets, they examine how firms enter additional foreign markets over time and whether there exists any link between the choice of foreign market and productivity level. Damijan, Polanec and Prasnikar show that firms enter additional foreign markets gradually – one new market in two years on average. In addition, they show that a higher productivity level is required for firms to start exporting to advanced countries compared to less developed countries. As for the productivity gains induced by exporting, the authors suggest that a firm can improve its productivity significantly, but only if it exports to advanced countries.

In terms of empirical strategy, an interesting addition to the research outlined above is the paper of Das, Roberts and Tybout (2001). Unlike Roberts and Tybout (1997), Campa (2004) or Bernard and Jensen (2004), who used a non-structural approach to the probability of exporting, Das, Roberts and Tybout (2001) opted for a structural approach. Although the methodology differs, the results are in accordance with studies employing non-structural estimation. Using a small sample of Colombian chemical producers, the authors confirm that sunk entry costs are substantial. As for export promotion policies, the authors argue that subsidies proportional to export revenues are more efficient than subsidies reducing the entry sunk costs.

The role of innovation as an important factor in the exporting decision of a heterogeneous firm has been recognized in several studies, e.g. in Basile (2001) who shows that innovations increase the probability that Italian firms export. On the contrary, Wakelin (1996), using a sample of UK firms, concludes that more innovative firms are less likely to export, although the number of innovations increases the probability of innovative firms to export. Finally, employing data on Spanish firms, Barrios, Goerg and Strobl (2003) find that the R&D activity of a firm positively influences its decision to export as well as its propensity to export. However, according to the results of their estimations, only foreign firms benefit from

the R&D spillovers produced by other foreign firms in terms of export participation. As for the export propensity, both foreign and domestic firms are positively influenced by the R&D spillovers.

Another stream of literature reacts to the common view that exporting increases technological productivity, and is based on numerous observations that exporters are more efficient than non-exporters. In an effort to explain the positive relationship between exporting experience and efficiency, Clerides, Lach and Tybout (1998) investigate whether exporters become more efficient after they enter foreign markets or whether self-selection is behind the positive correlation and firms become exporters due to their superior characteristics. Firm-level panel data are employed in their paper to build an export participation model needed to test for self-selection. The results, based on a sample of firms from Colombia, Mexico and Morocco, support the first direction in causality, i.e. that more productive firms become exporters. The opposite causal direction turns out to be insignificant, so that exporting experience in fact does not improve efficiency. In an attempt to answer the question of causality between export and productivity, several studies follow the seminal work of Clerides, Lach and Tybout (1998). While Bernard and Jensen (1999), Isgut (2001) as well as Arnold and Hussinger (2004) find self-selection significant, no support is found for learning-by-exporting. Delgado, Farinas and Ruano (2002) find evidence of self-selection along with evidence of learning-by-exporting limited to young exporters. Learning-by exporting has been further studied in Girma, Greenway and Kneller (2002), Castellani (2002), Bigsten et al. (2004), Wagner (2002) and Saxa (2007).

#### 4 Estimation strategy

The model is based on the theoretical frameworks built by Baldwin (1989), Baldwin and Krugman (1989), and Dixit (1989) and follows the models used by Campa (2004), Bernard and Jensen (2004), or Roberts and Tybout (1997)<sup>9</sup>. In each period  $t$ , a profit-maximizing firm  $i$  operating in monopolistic competition has to decide whether to export or not. If the firm enters the foreign market (exporting in the current period but not exporting in the previous period), it incurs entry costs  $C_{ENTER}$ . Entry costs can include the costs of market research or the costs of building a distributional network. Let  $Q_{it}$ ,  $e_t$  be the volume exported by firm  $i$  in period  $t$  and exchange rate in period  $t$ , respectively. Let  $\pi_{it}(Q_{it}, e_t)$  be the profit from exporting earned in period  $t$  by firm  $i$  (without entry and exit costs) and let  $I_{ik}$  indicate whether firm  $i$  exports in period  $k$  ( $I_{ik} = 1$ ) or not ( $I_{ik} = 0$ ). Then the net expected revenue  $R_{it}$  of firm  $i$  in period  $t$  is defined as

$$R_{it}(I_{it}) = \pi_{it}(Q_{it}, e_t) - (1 - I_{it-1})C_{ENTER,i} \quad (1)$$

Each period, the firm maximizes the present discounted value of future profits. The condition indicating the export participation of firm  $i$  in period  $t$  is then:

$$\pi_{it}(Q_{it}, e_t) + \beta(E_t[V_{it+1}(\Omega_{it}) | I_{it} = 1] - E_t[V_{it+1}(\Omega_{it}) | I_{it} = 0]) + (C_{ENTER,i}(I_{it-1} - 1)) \geq 0 \quad (2)$$

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<sup>9</sup> A noticeable difference in the model employed by Roberts and Tybout (1997) is the presence of time-dependent re-entry costs that allow for differentiating the costs of entry after a different number of periods since the last exporting experience. In contrast, Bernard and Jensen (2004) assume time invariant entry costs and no exit costs. Campa (2004) assumes time invariant entry and exit costs.

where  $\beta$  is the discount factor and  $\Omega_{ik}$  is the information set available to firm  $i$  in period  $k$ . Firm  $i$  exports in period  $t$  ( $I_{it} = 1$ ) if the latter condition is fulfilled, otherwise the firm does not export ( $I_{it} = 0$ ). The estimation equation of the export participation decision is then derived from (2) and can be written as:

$$I_{it} = \begin{cases} 1 & \text{if } \dots L \geq 0 \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

where

$$L = \pi_{it} + \beta(E_t[V_{it+1}(\Omega_{it}) | I_{it} = 1] - E_t[V_{it+1}(\Omega_{it}) | I_{it} = 0]) + C_{ENTER,i}(I_{it} - 1) \quad (4)$$

Although it is possible to estimate (3) in structural form, I follow the strategy advocated by Roberts and Tybout (1997) as well as Bernard and Jensen (2004) and Campa (2004), all of whom estimate a reduced form of (3) to quantify the influence of different factors on the probability of exporting. Basic equation used for the estimation of export participation is following:

$$\begin{aligned} exp_{i,t} = & \alpha exp_{i,t-1} + \beta_1 iser_{i,t} + \beta_2 empl_{i,t-1} + \beta_3 wage_{i,t-1} + \beta_4 inv_{i,t-1} + \\ & \sum_j \gamma_j own_{i,t,j} + \sum_k \gamma_k year_{i,t,k} + \sum_l \gamma_l ind_{i,l} + \varepsilon_{i,t} \end{aligned} \quad (5)$$

where  $exp_{i,t}$  denotes exporting status of the firm  $i$  in the year  $t$ ,  $iser_{i,t}$  is industry-specific exchange rate,  $empl_{i,t}$  is employment,  $wage_{i,t}$  is average wage of employee,  $inv_{i,t}$  denotes investments,  $own_{i,t,j}$ ,  $year_{i,t,k}$  and  $ind_{i,l}$  are dummies for the type of ownership, year and industry. An error term  $\varepsilon_{i,t}$  is described in the next paragraph.

The decision regarding the estimation strategy of (5) is far from being unambiguous. The unobserved heterogeneity of firms (e.g. managerial ability or product quality) is likely to be correlated over time and ignoring this serial correlation would produce bias in the estimation of the coefficient  $\alpha$ . Therefore, the error term is allowed to consist of two parts,  $\varepsilon_{it} = \alpha_i + \omega_{it}$ , where  $\alpha_i$  is firm-specific. The studies mentioned above employ different approaches to estimating the equation of interest. While Roberts and Tybout (1997) use the method of simulated moments, Campa (2004) suggests a random effect probit estimated using maximum likelihood. Bernard and Jensen (2004) advocate an Arellano-Bond GMM estimator to avoid problems with modeling the unobserved effects as fixed, but provide also linear probability estimates as well as fixed effects estimates. The linear probability model is appealing, since it allows for the use of instrumental variables and is generally more robust (Angrist and Krueger 2001).

To analyze the responsiveness of exporting status to exchange rate levels and volatility with respect to different types of ownership, the right side of (7) is augmented. In the first step, interactions between  $iser_{i,t}$  and  $own_{i,t,j}$  are included. Another three specifications include interactions between  $iser_{i,t}$  lagged by one year and  $own_{i,t,j}$  as well as interactions between the measure of exchange rate volatility  $isvolatility_{i,t}$  and  $own_{i,t,j}$  and lagged  $isvolatility_{i,t}$  and  $own_{i,t,j}$ , respectively.

## 5 Data and Basic Statistics

### 5.1 Firm-level data

Firm-level panel data provided by the Czech Statistical Office are employed in the study. Due to the absence of foreign trade data prior to 1997, the study is based on the years 1997-2002. To maintain consistency, detailed data cleaning was performed. Firms that do not occur in the sample every year over the six-year period and non-manufacturing firms<sup>10</sup> were eliminated. Also, due to the relatively small number of firms owned by municipalities, associations and cooperatives, those were eliminated as well. In the end, I have a continuing sample of 1796 manufacturing firms employing in total 611 755 – 717 492 people in different years, i.e. roughly 50% of all people working in Czech manufacturing firms.

For each firm, ownership is defined as follows. If domestic private, domestic state or foreign owners control more than 50% of a firm, then the ownership indicator takes the value of private, state, or foreign, respectively. If a firm is owned by domestic owners only, but no ownership type controls more than 50%, the ownership indicator takes the value of mixed. Finally, if foreign owners control not more than 50% of a firm, the ownership indicator is international.

Besides other firm characteristics, a three-digit NACE code is available for each firm as well as a four-digit regional code identifying one of 86 counties. Employment figures are recomputed on an eight-hour-day basis. For estimation purposes, output is defined as revenue from production plus a change in inventories of the firm's production, both deflated by industry-specific PPI. Capital is defined as tangible and intangible fixed assets, deflated by CPI. Finally, material is here defined as the cost of production of goods sold, deflated by industry-specific PPI.

Basic firm characteristics with an emphasis on the differences between exporters and non-exporters are reported in Table 1. In the sample, 86% of manufacturers export in 1997 as well as in 2002. Exporters are substantially bigger than non-exporters both in terms of sales and employment. While exporters paid roughly the same wages as non-exporters in 1997, the wage gap widened in favor of exporters' employees over the six years.

Although the relative number of exporters and non-exporters is almost the same at the beginning and at the end of the observed period, the transition between exporting and non-exporting is sizeable. Out of the total 1796 firms, 372 firms changed status from exporting to non-exporting or vice versa at least once over the period 1997-2002. A detailed distribution of exporting patterns is listed in Table 2. Figure 1 shows the number of firms entering and exiting export every year. Entering and exiting firms are on average smaller than all firms in the sample (with the average number of employees at 206 and 126, respectively, compared to the sample average of 374). Firms owned by a domestic private owner prevail among entering and exiting firms with approximately a 66% share, compared to a 56% share in the whole sample. Details are provided in Table 3.

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<sup>10</sup> Firms with NACE codes in the range of 150-366 are considered to be manufacturing firms for the purpose of this study.

## 5.2 Exchange rates

When the Czechoslovak currency split in February 1993, the Czech koruna remained pegged to the currency basket of four European currencies and the American dollar<sup>11</sup>. Three months later, the band width was set to  $\pm 0.5\%$  and the composition of the basket was narrowed to two currencies only, the Deutsche mark and the American dollar. The band was widened to  $\pm 7.5\%$  in February 1996. After a period of strong depreciation and decrease in the foreign exchange reserves held by the central bank, the bank in agreement with the government decided to replace the currency basket with a floating regime. The managed float was adopted on May 27, 1997, with the Deutsche mark (and later the euro<sup>12</sup>) as a reference currency.

From that time, the activity of the central bank on the foreign exchange market has been limited. Except for two interventions in 1998 and 2000 and a series of interventions in 2002 when the central bank attempted to slow down the pace of appreciation, monthly foreign exchange trading of the central bank typically amounted to less than USD 100 million during 1997-2004<sup>13</sup>. In comparison to the average daily market turnover of more than USD 2900<sup>14</sup> million during the same period, the influence of the central bank is negligible.

The Czech currency experienced two episodes of strong depreciation against its reference currency between 1997-2004. In 1997, the koruna depreciated by more than 16% in three months, resulting in an end-of-year depreciation of 9.8%. In 1999, a decline of more than 10% in three months ended at a benign 2.6% end-of-year figure. On the other hand, the most pronounced appreciation occurred at the end of 2001 and in 2002, when the currency gained more than 15% over ten months until the central bank and government announced measures to be taken against sharp appreciation. Among others, measures included the transfer of future privatization proceeds directly into the foreign exchange reserves of the central bank (so that market rates were not influenced).

To test hypotheses on the influence of exchange rate level and volatility, industry-specific exchange rates were constructed. Two datasets were combined in construction. Bilateral exchange rates for the Czech currency and currencies of its 26 main trading partners come from the database of the Czech National Bank. Detailed data on bilateral trade at the 3-digit SITC level were provided by the Ministry of Industry and Trade of the Czech Republic. Having SITC categories linked to NACE industry codes, industry-specific exchange rates for each industry were constructed as the weighted average of exchange rate indexes with the weights based on the relative importance of export destinations. Average yearly exchange rates were used to compute the index of industry-specific exchange rate level (variable *iser*), while daily exchange rates were used to compute the index of industry-specific exchange rate volatility (variable *isvolatility*). An increase in *iser* indicates depreciation of the Czech currency, and an increase in *isvolatility* indicates an increase in the volatility of the

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<sup>11</sup> The weights of the currencies were the following: USD: 49.07%, DEM 36.15%, ATS 8.07%, FRF 2.92%, CHF 3.79%

<sup>12</sup> The fixed parity is EUR 1 = DEM 1.95583

<sup>13</sup> Source: [www.cnb.cz](http://www.cnb.cz)

<sup>14</sup> Source: [www.cnb.cz](http://www.cnb.cz) and author's calculations

exchange rate. The index of industry-specific exchange rate level is equal to one in the year 1997. Figure 2 documents inter-industry differences in the evolution of industry-specific exchange rates<sup>15</sup>.

## 6 Empirical Results

The probability that a firm exports is estimated here. The focus is on three areas: the importance of sunk costs for firms owned by domestic and foreign owners, different reactions to exchange rate movements and production of spillovers that influence the exporting decisions of other firms.

### 6.1 Sunk costs

Table 4 reports estimation results for the basic specification, i.e. modeling the decision to export on the lagged exporting status, industry-specific exchange rate, firm size represented by number of employees, average wage, investments and ownership dummies. The number of employees is recomputed on an eight-hour-day basis, wages are in logs, and investments enter as a ratio of intangible investments over sales. All three variables are lagged one year. In addition, year and industry dummies are included where applicable.

Since the estimation of the coefficient on the lagged exporting status involves several complications, I proceed in four steps. First, linear probability model estimation should provide an upper bound on the coefficient on the lagged exporting status, since it captures all unobserved firm-specific effects that influence participation in exporting and are likely to be highly serially correlated. On the contrary, fixed-effects estimation is assumed to result in a downward bias in the coefficient on the lagged exporting status. To address the problem of serial correlation in unobserved firm-specific effects, the first differences Arellano-Bond GMM estimator is employed as a preferred specification. Finally, the results of probit estimation are reported.

In all four specifications, the sunk costs of entering foreign markets appear to be huge. OLS and probit coefficients on the lagged exporting status suggest that exporting experience from the previous year increases the probability of exporting by 71% and 65%, respectively. While this is considered to be an upper bound for the coefficient on the lagged exporting status, the estimate of fixed-effects specification gave a lower bound of 16%. The preferred first differences GMM estimator indicates that exporting in one year increases the probability of exporting in the next year by 43%.

In a search for differences in sunk costs across different ownership types, specifications involving interactions between lagged exporting status and ownership types were estimated. Although negative signs of the coefficients are in line with the expectation that sunk costs of firms with foreign and international ownership are lower than sunk costs of firms with a domestic owner, coefficients are insignificant across all estimation methods (estimation results are not reported in this draft).

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<sup>15</sup> Note that evolution of industry-specific exchange rate is plotted for 2-digit NACE industries in Figure 2, although more precise 3-digit industry differentiation is used for estimation.

Estimates of other coefficients from Table 4 suggest that bigger firms and firms paying higher wages are more likely to export. Foreign-owned firms, firms with international ownership, and firms with domestic mixed ownership are also more likely to export than other domestic firms.

## 6.2 Exchange rates and foreign owners

To assess the role of exchange rate level and volatility in a firm's decision to export, four specifications are estimated and summarized in Table 5. To reflect the possibility that it may take some time for a firm to react to exchange rate changes (due to lasting contracts or sluggish adjustment of production), both industry-specific level and industry-specific volatility variables are included either with no lag or with the lag of one year. For the level of exchange rate, specifications (1) and (2) suggest that the current exchange rate level is more important than the lagged one, in terms of significance as well as magnitude. The signs are in line with expectations: depreciation (increase in *iser*) increases the probability of exporting substantially (10% depreciation increases the probability by roughly 4%). Changes in exchange rate levels exert greater influence on domestic firms than on firms with either foreign or international ownership. With foreign owners, the interaction coefficient is significant and reduces the effect of exchange rate level changes to half compared to domestically-owned firms. Correlation of exporting status and changes in exchange rate level lagged by one year is smaller, and differences between different ownership types play no or marginal role.

Results are not that intuitive in the case of the effects of changes in exchange rate volatility. Coefficients obtained from specification (3) in Table 5 show, in line with theory, that higher volatility significantly decreases the probability of exporting for foreign-owned and internationally-owned firms. On the other hand, although insignificant, the coefficient on the effect of volatility on the exporting status of the base group (domestic private owner and state ownership) is positive, suggesting that higher volatility increases the probability of exporting. Similar results, albeit with a smaller magnitude, are estimated using specification (4). One should be cautious, however, when drawing conclusions from the results above due to the relatively high correlation between lagged volatility and exchange rate level either lagged or with no lags (66% and 47%, respectively).

## 6.3 Spillovers

To assess the role of spillovers in exporting, the following specifications have been considered. First, spillovers influencing the exporting status of other firms are assumed to be produced either by firms with foreign or international ownership, or by exporting firms. The rationale for spillovers produced by firms controlled by some foreign owner stems mainly from the migration of employees possessing the knowledge of foreign markets from multinational corporations to domestic firms. On the other hand, the rationale for spillovers produced by exporting firms assumes, in addition to migration, that the existing infrastructure used by exporters (e.g. transport networks) is accessible to other firms and facilitates their entry to foreign markets.

Second, spillovers can occur within a group of firms, where group can be defined as an industry, county, region, industry and county, or industry and region<sup>16</sup>. Concentration of foreign-owned firms in the group is computed for each firm either as the number of foreign-owned firms over the number of all firms or as the sum of revenues of foreign-owned firms over the sum of revenues of all firms in the group. Concentration of exporters is computed either as the number of exporting firms over the number of all firms or as the sum of exports over the sum of revenues of all firms in the group. The firm whose concentration is computed is obviously not included in the computation.

The probability of exporting is then estimated using the basic model with concentration entering the right side of the equation either without any lag or with the lag of one year, to reflect the time needed to begin with exporting. To control for geographic, industry-specific and time-specific differences as well as for ownership, appropriate dummies are included (county or region dummies for geographic differences, 2- or 3-digit industry dummies, year and ownership dummies).

Assuming that the presence of exporting firms could increase other firms' probability of exporting, coefficients at the concentrations are expected to be positive. However, coefficients in actual estimations are in most cases negative. As reported in Table 7, which comprise specifications with lagged concentration measures and only domestic firms included a coefficient at the ratio of the number of exporters and number of all firms in the group is negative and significant in the case of four groups: county, 2-digit industry, 3-digit industry, and combination of region and 3-digit industry. The pattern of results does not change meaningfully even if all firms (not only domestic) are included in the estimation. In the specification without any lag for concentration measures (Table 6), two coefficients based on the revenues and exports, instead of the number of firms, becomes significant and positive.

Although negative spillovers are surprising, they are in line with two other studies focused on exporting spillovers. Bernard and Jensen (2004) report that all spillover measures except one have negative coefficients. In the two-stage probit estimation of Aitken, Hanson and Harrison (1997), coefficients on local export concentration are negative in all four considered specifications and significant in two of them. The issue of negative spillovers thus deserves further attention.

Tables 8 and 9 include the results of the estimation of spillovers produced by multinationals and influencing the exporting status of domestic firms within a group. In this case, most of the significant coefficients are negative again, suggesting that proximity to a multinational has negative influence on a firm's decision to export.

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<sup>16</sup> Throughout the text, I use the term "firm-level" to refer to units with a unique Standard Identification Number (ICO). If a firm has several plants operating in different locations, only the location of headquarters appears in the data. This creates problems with controlling for regional differences, since there is no information about actual plant location.

## Conclusion

Estimation on the sample of Czech firms confirms the results of previous studies that the sunk costs of exporting are large and significant. However, no significant differences are found between sunk costs incurred by domestic and foreign firms. On the contrary, domestic and foreign firms differ significantly only in their responsiveness to exchange rate changes. The probability of exporting of a domestic firm is twice more sensitive to the changes in the exchange rate level than a probability of exporting in the case of similar foreign-owned firm. Exchange rate volatility, in line with expectations, negatively influences the exporting decision of a firm. In the search for spillovers, the results are mixed. Proximity to an exporting firm (either in geographic or sectoral terms) has, surprisingly, a negative effect on the decision of a firm to export in most of specifications.

## References

- Aitken, B., Hanson, G.H., Harrison, A.E. (1997).** *Spillovers, Foreign Investment, and Export Behavior.* Journal of International Economics 43: 103-132.
- Angrist, J.D., Krueger, A.B. (2001).** *Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments.* Journal of Economic Perspectives 15(4): 69-85.
- Baldwin, R.E. (1989).** *Sunk-Cost Hysteresis.* NBER Working Paper No. W2911.
- Baldwin, R.E., Krugman, P. (1989).** *Persistent Trade Effects of Large Exchange Rate Shocks.* Quarterly Journal of Economics 104: 635-654.
- Barrios, S., Goerg, H., Strobl, E. (2003).** *Explaining Firms' Export Behaviour: R&D, Spillovers and the Destination Market.* Oxford Bulletin of Economics and Statistics, 65(4): 475-496.
- Basile, R. (2001).** *Export Behavior of Italian Manufacturing Firms Over the Nineties: The Role of Innovation.* Research Policy 30:1185-1201.
- Bernard, A.B., Jensen J. B. (2004).** *Why Some Firms Export.* The Review of Economics and Statistics 86(2): 561-569.
- Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Gunning, J.W., Oduro, A., Oostendorp, R., Pattillo, C., Söderbom, M., Teal, F., Zeufack, A. (2004).** *Do African Manufacturing Firms Learn from Exporting?* Journal of Development Studies 40(3): 115-141.
- Bilkey, W.J. (1978).** *An Attempted Integration of the Literature on the Export Behavior of Firms.* Journal of International Business Studies 9(1): 33-46.
- Campa, J.M. (2004).** *Exchange Rates and Trade: How Important is Hysteresis in Trade?* European Economic Review 48: 527– 548.
- Castellani, D. (2003).** *Export Behavior and Productivity Growth: Evidence from Italian Manufacturing Firms.* Weltwirtschaftliches Archiv 138(4).
- Clerides, S.K., Lach, S., Tybout, J.R. (1998).** *Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico and Morocco.* Quarterly Journal of Economics 113: 903-948.
- Damijan, J.P., Polanec, S., Prasnikar, J. (2004).** *Self-selection, Export Market Heterogeneity and Productivity Improvements: Firm Level Evidence from Slovenia.*

LICOS Discussion Paper 14804, LICOS - Centre for Transition Economics, K.U.Leuven.

**Das, S., Roberts, M.J., Tybout, J.R. (2001).** *Market Entry Costs, Producer Heterogeneity, and Export Dynamics*. NBER Working Paper 8629.

**Dixit, A.K. (1989).** *Entry and Exit Decisions Under Uncertainty*. Journal of Political Economy 97(3): 620-638.

**Girma, S., Greenaway, D., Kneller, R. (2004).** *Does Exporting Increase Productivity? A Microeconometric Analysis of Matched Firms*. Review of International Economics 12 (5): 855-866.

**Greenaway, D., Sousa, N., Wakelin, K. (2004).** *Do Domestic Firms Learn to Export from Multinationals?* European Journal of Political Economy 20(4): 1027-1043.

**Hanousek, J., Kocenda, E., Svejnar J. (2004).** *Ownership, Control and Corporate Performance After Large-Scale Privatization*. William Davidson Institute Working Paper No. 652.

**Hanousek, J., Kocenda, E., Svejnar J. (2005).** *Privatization and Performance over the Transition: A Reassessment*. CERGE-EI Working Paper, forthcoming.

**Heckman, J. (1981).** *Heterogeneity and State Dependence*. Studies in Labor Markets, University of Chicago Press.

**Javorcik, B. S. (2004).** *Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages*. American Economic Review 94(3): 605-627.

**Lopez, R.A., Alvarez, R. (2005).** *Productivity Spillovers from Exporting through Vertical and Horizontal Linkages*. [Http://ssrn.com/abstract=749367](http://ssrn.com/abstract=749367)

**Roberts, M., Tybout, J. (1997).** *The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs*. American Economic Review 87(4): 545–564.

**Sabirianova, K., Svejnar, J., Terrell, K. (2005).** *Foreign Investment, Corporate Ownership, and Development: Are Firms in Emerging Markets Catching Up to the World Standard?* William Davidson Institute Working Paper No. 734

**Saxa, B. (2007).** *Learning-by-Exporting or Managerial Quality? Evidence from the Czech Republic*. CERGE-EI Discussion Paper No. 177.

**Wakelin, K. (1998).** *Innovation and Export Behaviour at the Firm Level*. Research Policy 26(7-8):829-841.

Table 1: Firm characteristics (continuing sample, 1997-2002)

	Number of firms		Average Employment <sup>a</sup>		Average Sales <sup>b</sup>		Average Wages <sup>b,c</sup>	
	1997	2002	1997	2002	1997	2002	1997	2002
All	1796		396	337	540869	607799	127.66	141.74
Exporters (% of all)	86%	86%	109%	112%	110%	112%	100%	101%
Non-Exporters (% of all)	14%	14%	42%	36%	37%	26%	100%	92%

Notes:

<sup>a</sup> Recomputed on an eight hour day basis

<sup>b</sup> Thousands of CZK, constant prices of 1997

<sup>c</sup> Annual wage

Table 2  
**Patterns of Transitions between Exporting and Non-Exporting**  
 (total number of firms in the continuing sample: 1796)

Percentage of firms	Pattern	Percentage of firms	Pattern	Percentage of firms	Pattern
75.17%	111111	0.39%	.11...	0.11%	.1..1..
4.12%	.....	0.33%	...1..	0.11%	.1.111
2.67%	11111.	0.33%	1..111	0.11%	.11..1
1.84%	.11111	0.28%	.111.1	0.11%	1....1
1.50%	..1111	0.28%	.1111.	0.11%	1..11.
1.34%	1..1111	0.28%	111..1	0.11%	1.1...
1.17%	1111..	0.22%	.1....	0.11%	11.1..
0.95%	111...	0.22%	1..11..	0.11%	11..11.
0.89%	..11..	0.22%	11....	0.06%	....11.
0.84%	1.....	0.22%	111..1	0.06%	..1.1..
0.72%	....11	0.17%	....1.	0.06%	..1.111
0.67%	.....1	0.17%	.1111..	0.06%	.1..111
0.67%	...111	0.17%	.111..	0.06%	1...1..
0.61%	..1...	0.17%	1...11	0.06%	1..1.1
0.61%	11..111	0.17%	11..11	0.06%	1.1..1
0.50%	111..11	0.11%	..1..1	0.06%	1.1.11
0.50%	1111..1	0.11%	.11..1	0.06%	1..11..1

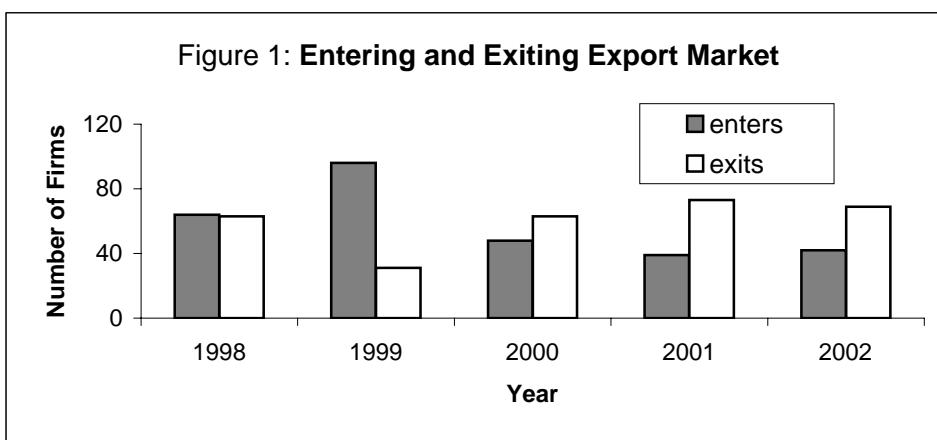
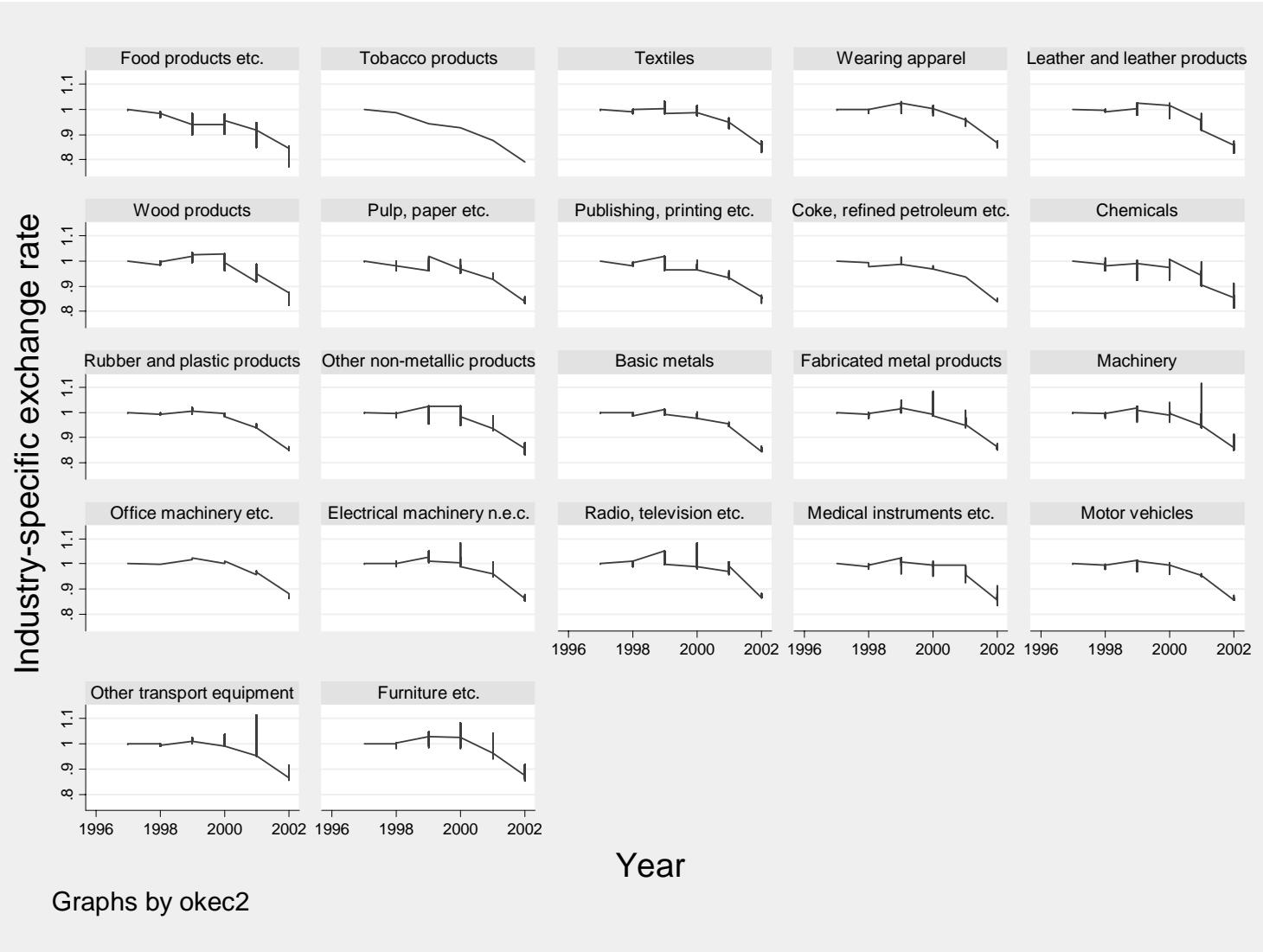


Figure 2: Evolution of industry-specific exchange rate (plots based on 2-digit NACE aggregation)



Graphs by okec2

Table 3: *Characteristics of firms entering and exiting export market*

	Ownership					Average Employment <sup>a</sup>
	Domestic Private	Domestic State	Domestic Mixed	Foreign	International	
Entering Firms	66%	2%	8%	12%	11%	206
Exiting Firms	66%	3%	10%	10%	12%	126
All Firms	56%	3%	12%	13%	16%	374

Notes:

<sup>a</sup> Recomputed on an eight hour day basis

Table 4: *The decision to export (dependent variable: export status)*

	OLS	Fixed Effects	Probit	GMM (1st differences)
Lagged export status	0.71355 *** (.01504)	0.16023 *** (.03209)	0.65481 *** (.01996)	0.43476 *** (.05489)
Industry Specific Exchange Rate	0.37799 ** (.16044)	0.29460 (.20444)	0.37622 ** (.15656)	0.26352 (.22621)
Employment	6.6E-06 *** (1.7E-06)	3.9E-05 ** (1.6E-05)	5.5E-05 *** (1.1E-05)	9.4E-06 (2.4E-05)
Wages	0.03704 *** (.01155)	0.00264 (.03812)	0.02948 *** (.01055)	0.00319 (.05205)
Investments	0.32980 (.2858)	0.32601 (.26555)	0.14556 (.2947)	0.48724 (.48407)
Ownership: Foreign	0.01926 *** (.00708)	0.03620 (.02883)	0.02336 *** (.0068)	0.02326 (.03016)
Ownership: International	0.01711 ** (.00683)	0.01577 * (1.73)	0.00701 (.00724)	0.03463 * (.01814)
Ownership: Domestic Mixed	0.01826 *** (.00696)	0.01728 (.01654)	0.00848 (.00763)	0.02979 (.02353)
Year Dummies	Included	Included	Included	Included
Industry Dummies	Included		Included	
R <sup>2</sup> /Pseudo R <sup>2</sup>	0.55	0.40	0.51	--
Number of observations	8044	8044	8016	6302

Notes:

Employment is in logs, all firm characteristics lagged one year.

Robust standard errors in parentheses.

Marginal effects reported for probit estimation.

\* Significant at 10% level

\*\* Significant at 5% level

\*\*\* Significant at 1% level

Table 5: Responsiveness to Changes in Exchange Rates Levels and Volatility  
 (dependent variable: export status)

	(1)	(2)	(3)	(4)
Lagged export status	0.71307 *** (.01506)	0.71403 *** (.01499)	0.71327 *** (.01504)	0.71280 *** (.01505)
Industry Specific Exchange Rate (ISER)	0.42534 *** (.16416)		0.25713 (.21658)	0.31328 * (.18583)
ISER: Foreign	-0.21922 ** (.09755)			
ISER: International	-0.11870 (.11675)			
ISER: Domestic Mixed	-0.02103 (.13591)			
Lagged ISER		0.12467 (.16442)		
Lagged ISER: Foreign		-0.00665 (.02391)		
Lagged ISER: International		-0.03537 *** (.01513)		
Lagged ISER: Domestic Mixed		-0.01920 (.02018)		
ISER Volatility			27.02213 (19.77038)	
ISER Volatility: Foreign			-36.64331 *** (13.74467)	
ISER Volatility: International			-35.77365 *** (13.51732)	
ISER Volatility: Domestic Mixed			-18.31022 (12.89934)	
Lagged ISER Volatility				17.42683 (15.93879)
Lagged ISER Volatility: Foreign				-15.82695 ** (7.76907)
Lagged ISER Volatility: International				-19.05318 *** (5.94487)
Lagged ISER Volatility: Domestic Mixed				-9.11293 (6.31267)
Employment	6.4E-06 (1.6E-06)	7.0E-06 *** (1.7E-06)	6.5E-06 *** (1.6E-06)	6.5E-06 *** (1.6E-06)
Wages	0.03609 *** (.01155)	0.03684 *** (.01156)	0.03490 *** (.01156)	0.03736 *** (.01161)
Investments	0.32506 (.28681)	0.34573 (.28545)	0.31449 (.28633)	0.31855 (.28668)
Ownership: Foreign	0.22886 ** (.09398)	0.02751 (.02353)	0.08894 *** (.02695)	0.05128 *** (.01671)
Ownership: International	0.13105 (.11286)	0.04795 *** (.01497)	0.08466 *** (.02569)	0.05153 *** (.01273)
Ownership: Domestic Mixed	0.03855 (.13332)	0.03447 * (.02097)	0.05335 ** (.0269)	0.03706 ** (.01584)
Year Dummies	Included	Included	Included	Included
Industry Dummies	Included	Included	Included	Included
R <sup>2</sup> /Pseudo R <sup>2</sup>	0.55	0.55	0.55	0.55
Number of observations	8044	8046	8044	7991

Notes:

Employment is in logs, all firm characteristics lagged one year  
 OLS estimation, robust standard errors in parentheses

\* Significant at 10% level

\*\* Significant at 5% level

\*\*\* Significant at 1% level

**Table 6: Spillovers from the presence of exporters on exporting status of domestic firms within a group, no lag** (coefficients at the concentration measures, each coefficient from a separate regression)

Group	Concentration measure	
	<u>Number of exporters</u>	<u>Export of all</u>
		<u>Number of all</u>
County	-1.4459 ***	0.2550 *
Region	-1.2050 ***	-0.1574
Industry (2 digits)	-0.4647 ***	-0.0349
Industry (3 digits)	-0.3607 ***	-0.0003
County&Industry (2 digits)	-0.0196	-0.0182
Region&Industry (2 digits)	-0.0609	0.0584 *
County&Industry (3 digits)	-0.0317	-0.0095
Region&Industry (3 digits)	-0.0613 **	0.0017

Notes: OLS estimations with export status as a dependent variable. Explanatory variables include concentration measure, lagged export status, industry-specific exchange rate, lagged number of employees, lagged average wage, lagged intangible investments, dummies for years, ownership, county or region and industry (2- or 3-digits).

\* Significant at 10% level

\*\* Significant at 5% level

\*\*\* Significant at 1% level

**Table 7: Spillovers from the presence of exporters on exporting status of domestic firms within a group, 1 year lag** (coefficients at the concentration measures, each coefficient from a separate regression)

Group	Concentration measure	
	<u>Number of exporters</u>	<u>Export of all</u>
		Number of all
County	-0.5680 ***	0.0118
Region	-0.2599	0.1131
Industry (2 digits)	-0.3884 ***	0.0091
Industry (3 digits)	-0.2530 ***	-0.0068
County&Industry (2 digits)	0.0074	0.0081
Region&Industry (2 digits)	-0.0533	0.0252
County&Industry (3 digits)	0.0148	0.0185
Region&Industry (3 digits)	-0.0550 **	0.0143

Notes: OLS estimations with export status as a dependent variable. Explanatory variables include lagged concentration measure, lagged export status, industry-specific exchange rate, lagged number of employees, lagged average wage, lagged intangible investments, dummies for years, ownership, county or region and industry (2- or 3-digits).

\* Significant at 10% level

\*\* Significant at 5% level

\*\*\* Significant at 1% level

**Table 8: Spillovers from the presence of multinationals on the exporting status of domestic firms  
within a group, no lag** (coefficients at the concentration measures, each coefficient from a separate  
regression)

Group	Concentration measure			
	<u>Number of foreign</u>	Number of foreign	<u>Revenue of foreign</u>	<u>Revenue of foreign</u>
		Number of all	and international	Revenue of all
County	0.2004	0.1382	0.1354	0.0750
Region	0.2553	-0.3553	0.0948	-0.1276 *
Industry (2 digits)	-0.7101 ***	0.0772	-0.0787 *	0.0332
Industry (3 digits)	-0.1292	0.0265	-0.0540 **	-0.0254
County&Industry (2 digits)	-0.0063	0.0016	-0.0223	-0.0262
Region&Industry (2 digits)	-0.0136	0.0096	0.0112	0.0117
County&Industry (3 digits)	-0.0491	-0.0097	-0.0601 *	-0.0269
Region&Industry (3 digits)	-0.0334	-0.0132	-0.0075	-0.0020

Notes: OLS estimations with export status as a dependent variable. Explanatory variables include concentration measure, lagged export status, industry-specific exchange rate, lagged number of employees, lagged average wage, lagged intangible investments, dummies for years, ownership, county or region and industry (2- or 3-digits).

Table 9: **Spillovers from the presence of multinationals on the exporting status of domestic firms within a group, one year lag** (coefficients at the concentration measures, each coefficient from a separate regression)

Group	Concentration measure			
	<u>Number of foreign</u>	Number of foreign	<u>Revenue of foreign</u>	<u>Revenue of foreign</u>
		Number of all	and international	and international
County	-0.0465	-0.0529	-0.0656	-0.0577
Region	0.1541	-0.2955	0.1672	-0.0147
Industry (2 digits)	-0.7570 ***	-0.0041	-0.0184	-0.0011
Industry (3 digits)	0.0449	0.0760	-0.0007	0.0078
County&Industry (2 digits)	0.0271	0.0017	0.0258	0.0035
Region&Industry (2 digits)	-0.0172	0.0115	0.0033	-0.0058
County&Industry (3 digits)	0.0420	0.0585 *	-0.0058	0.0285
Region&Industry (3 digits)	-0.0234	-0.0233	0.0009	-0.0041

Notes: OLS estimations with export status as a dependent variable. Explanatory variables include lagged concentration measure, lagged export status, industry-specific exchange rate, lagged number of employees, lagged average wage, lagged intangible investments, dummies for years, ownership, county or region and industry (2- or 3-digits).