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Tough Love:
Do Czech Suppliers Learn from their Relationships with Multinationals?

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TOUGH LOVE:
DO CZECH SUPPLIERS LEARN FROM THEIR RELATIONSHIPS WITH MULTINATIONALS?

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Abstract: Many countries strive to attract foreign direct investment (FDI) hoping that knowledge brought by multinationals will spill over to domestic industries and increase their productivity. While the empirical studies have cast doubt on the existence of horizontal spillovers from FDI in developing countries, several recent papers have confirmed the presence of vertical spillovers, which take place through contacts between foreign affiliates and their local suppliers. However, the existing studies rely on industry-level proxies for vertical spillovers rather than information on actual relationships between local companies and multinationals. This study goes one step further by employing a unique dataset from the Czech Republic, which allows us to identify local firms supplying multinationals operating in the country. The data suggest that suppliers are different from other firms. They are larger, have a higher capital-labor ratio, pay higher wages and exhibit a higher productivity level. The evidence is suggestive of both high productivity firms having a higher probability of supplying multinationals as well as suppliers learning from their relationships with multinationals.

Keywords: *foreign direct investment, technological spillovers, suppliers*

JEL classification: F21, F23

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I. Introduction

Policy makers in developed and developing countries place attracting foreign direct investment (FDI) high on their agenda, expecting FDI inflows to bring new technologies, know-how and thus contribute to increasing the productivity and the competitiveness of domestic industries. Many economies go beyond the national treatment of multinationals (MNCs) by offering foreign companies, through subsidies and tax holidays, more favorable conditions than those granted to domestic firms.[1] As the economic rationale for this special treatment, they often cite positive externalities generated by FDI through productivity spillovers to domestic firms.

Despite this issue being hugely important to public policy choices, there is little conclusive evidence indicating that domestic firms in developing countries benefit from foreign presence in their sector (see Haddad and Harrison (1993) study on Morocco, Aitken and Harrison (1999) on Venezuela and Djankov and Hoekman (2000) on the Czech Republic). The picture is more optimistic in the case of vertical spillovers, namely those taking place through contacts between multinationals and their local suppliers of intermediate inputs, as several existing studies demonstrate that the productivity of domestic firms is positively correlated with the presence of multinationals in downstream industries. The evidence on vertical spillovers emerges from a review of the case study literature (Moran 2001) and from firm-level econometric analyses performed by Javorcik (2004) using Lithuanian data, Javorcik and Spatareanu (2008) focusing on Romania, and Blalock and Gertler (2004) employing Indonesian data.[2] However, the existing studies of vertical spillovers rely on industry level proxies for linkages between industries and thus are unable to pinpoint the exact mechanism through which such spillovers take place.

To the best of our knowledge, this is the first study testing *directly* whether firms supplying multinational corporations are more productive than non-suppliers. Moreover, this is the only study that makes a distinction between the *self-selection* issue (i.e., the

[1] For instance, 59 of 108 countries surveyed by the World Bank reported offering some type of FDI incentives in 2004 (Harding and Javorcik 2007).
[2] For a survey of the literature see Görg and Greenaway (2004).

possibility that more productive firms become MNC suppliers) and the *learning* effect (i.e., the productivity benefits accruing to suppliers from their interactions with MNCs).[3]

Understanding how firms become MNC suppliers and whether or not they benefit from their relationship with multinationals has important policy implications. If local suppliers indeed learn from their interactions with foreign affiliates then using policy instruments to attract FDI or establishing supplier development programs may be justified. If, on the other hand, what matters is having prospects for more lucrative contracts than those available from local customers then a similar outcome could be achieved by, for instance, facilitating access to foreign markets through multilateral or preferential trade agreements and/or facilitating the flow of information about foreign markets and business opportunities available there.

Examining the question asked by this study poses big data challenges. Information on the type of customers supplied by firms (and hence their MNC supplying status) is typically not collected by statistical agencies, tax authorities or commercial databases. While time-varying information on relationships with MNC customers can be obtained through firm-level surveys, such surveys cannot be used to collect long spans of historical data on firm balance sheets and profit and loss statements. Therefore, in order to conduct our study we combined enterprise survey covering 391 domestic firms operating in the Czech Republic in 2003 with historical company account data from a commercial database *Amadeus*. The survey allows us to identify companies making sales to multinationals operating in the Czech Republic along with the information about the duration of these relationships and details regarding firm management. *Amadeus* gives us historical panel data on firms' balance sheets and profit and loss statements for the period 1993-2000. We are thus able to construct an unbalanced panel data of domestic firms that encompasses a plethora of time varying information on firms' balance sheet variables as well as their supplier relationships.

[3] A notable exception is a paper by Chung, Mitchell and Yeung (2003) who examined this question in the context of U.S. automotive component industry in the 1980s. They found that Japanese FDI into automotive assembly was associated with overall productivity improvements in the U.S. auto component industry. However, their results also indicated that Japanese assemblers tended to purchase components from *less productive* U.S. suppliers and that the productivity growth of U.S. suppliers affiliated with Japanese assemblers was not greater than that of other non-affiliated U.S. suppliers.

The Czech Republic is suitable place to study this question for several reasons. After starting its transition from central planning to a free market economy, it has received large inflows of foreign direct investment. Between 1993 and 2000, total FDI inflows it had received reached 21.8 billion dollars or 2,124 dollars per capita. Survey evidence suggests that MNCs are actively engaged in local sourcing in the Czech Republic. They purchase about half of intermediate inputs (in terms of value) from Czech suppliers. The virtual absence of FDI before the beginning of transition also means that supplying relationships between MNCs and Czech firms are of a relatively new vintage.

The empirical results indicate that Czech firms supplying multinationals exhibit different characteristics from other firms. They tend to have higher sales, be more capital-intensive, pay higher wages and exhibit higher productivity. While there is evidence of more productive firms self-selecting into supplying relationships with multinationals, the analysis employing the instrumental variable approach is suggestive of learning from the relationships with MNCs.

This study is structured as follows. The next section introduces the data sources, presents the arguments why we would expect suppliers to perform differently than other firms and discusses the summary statistics. Section 3 describes the empirical specification and presents the results. Section 4 concludes.

II. Are MNC Suppliers Special?

Data sources

The analysis, presented in this study, is based on the results of an enterprise survey commissioned by the Foreign Investment Advisory Services (FIAS), a joint facility of the World Bank and the International Finance Corporation, in the Czech Republic during the second half of 2003. The survey was conducted by a professional polling company by means of face-to-face interviews taking place at respondents' workplaces. All respondents were guaranteed full anonymity. Three hundred ninety-one Czech and 119 foreign companies were interviewed. The focus of the survey was on manufacturing firms, i.e. those operating in sectors 15-36 according to the NACE classification. About one-fifth of respondents were located in the capital city of Prague while the rest was distributed across all regions of the country. As we are interested in the

implications of FDI for indigenous producers, our econometric analysis is based only on data for the Czech firms. However, we will also present summary statistics on the qualitative questions answered by foreign affiliates.

The results of the firm survey were supplemented with financial information on interviewed firms, which was taken from the *Amadeus* database compiled by Bureau van Dijk.[4] This additional financial information is available for about a third of firms in the sample. The balance sheet and profit and loss information covers the period 1993-2000. After discarding outliers, we are left with 486 observations for the Czech firms.[5] This unbalanced panel encompasses 108 domestic companies, 40 of which are suppliers to MNCs operating in the Czech Republic.

As part of our dataset is based on information from a survey, one may be concerned about the response bias. This, however, does not appear to be serious concern as the mean values of firm total assets, fixed assets, value added and sales do not appear to be significantly different between the respondent group and firms which declined to be interviewed. The two groups differ only with respect to employment–survey respondents appear to be larger (see Table 1).

Companies are classified as MNC suppliers if they report in the survey that they make sales to at least one multinational and are able to indicate the year they started doing business with MNCs operating in the Czech Republic. The definition of a supplier pertains only to firms making sales to foreign affiliates active in the Czech Republic. The supplier dummy is set to 1 starting in the first year the company supplied an MNC and ending in 2000, which is the last year of our sample. The supplier dummy is equal to zero in all other cases. As no detailed information on the supplier status is available for individual years in between, we assume that companies have been supplying MNCs throughout this period. This is a reasonable assumption as the survey results indicate that MNCs are interested in long term relationships with their suppliers. For instance, when

[4] The database includes all firms that either had total assets of more than 20 million Czech Crowns (CZK) or a turnover of more than 40 million CZK.
[5] We removed companies with missing employment figures, negative value added and wages and observations containing obvious typographical errors.

asked about the shortest and the longest contract accepted, local companies reported on average 14 and 31 months, respectively.[6]

The distribution of suppliers and non-suppliers across sectors is presented in Table 2.

FDI inflows and local sourcing in the Czech Republic

As illustrated in Chart 1, FDI started to flow to the Czech Republic in the early 1990s with the flows increasing substantially since the mid-1990s. Thus it comes as no surprise that the supplying relationships between Czech firms and foreign MNCs located in the country began quite early in the transition process. About half of the suppliers in the sample reported making their first sale to an MNC before 1996. Starting in 1999, however, the growing volume of FDI inflows does not seem to have been accompanied by an increase in the number of firms becoming MNC suppliers. This pattern may be due to the following factors. First, the chart depicts only the number of firms receiving their *first* contract ever from an MNC customer and thus it does not capture the likely situation of firms increasing the number of foreign customers by obtaining contracts from MNCs newly entering the country. Second, FDI inflows in the late 1990s and the early 2000s were dominated by non-manufacturing sectors (mainly transport, communications, financial intermediation, etc.) which tend to source fewer intermediate inputs. For instance, while during 1993-2002 sixty-nine percent of all FDI inflows went into non-manufacturing, this proportion was equal to 82 percent in 2002.

While our analysis focuses mainly on local firms, the survey also collected views of MNCs active in the Czech Republic, which allows us to shed some light on the extent and factors driving their sourcing decisions.[7] The survey results suggest that multinationals are actively engaged in local sourcing in the Czech Republic. Ninety

[6] This assumption is also supported by the findings of Chung et al. (2003) who showed that once U.S. suppliers established a relationship with a Japanese auto maker, they typically provided the components for the entire model run of four years or more.

[7] The interviewed firms were majority-owned foreign investment enterprises and represented almost all manufacturing industries, namely, fabricated metals (19 MNCs); publishing and printing (14); rubber (11); machinery (10); apparel (9); electrical machinery (9); food products (8); textiles (7); non-metallic mineral products (7); furniture (6); pulp and paper (4); wood products (3); chemicals (3); radio, TV and communications equipment (3); leather (2); basic metals (1); medical equipment (1); motor vehicles (1) and other transport equipment (1).

percent of interviewed MNCs reported purchasing inputs from at least one Czech company.[8] The median MNC in the sample had a sourcing relationship with 10 Czech suppliers while an MNC in the top quartile with at least 30. Czech companies were the most important supplier group, followed by other European suppliers (located in the European Union or Eastern Europe) and other MNCs operating in the Czech Republic. There also appeared to be a limited amount of sourcing from North America. Less than eight percent of MNCs made their purchases in Russia or the Commonwealth of Independent States (see Table 3).

When asked about the share of inputs purchased from each type of suppliers (in terms of value), MNCs indicated sourcing *on average* 48.3 percent of inputs from Czech enterprises, as compared to 33.3 and 12.6 percent from firms in the European Union/Eastern Europe and MNCs located in the Czech Republic, respectively (see Chart 2). The share of inputs coming from the other regions appears to be negligible. Since average figures do not always give an accurate impression, it is worthwhile to report some more statistics. Fifty-five out of the 114 MNCs, which answered this question, reported buying at least half of their inputs from Czech suppliers. More than a tenth of respondents acquired all of their inputs from Czech enterprises. Around forty percent of MNCs expected to purchase more inputs from Czech suppliers in the future. However, the anticipated increase was unlikely to be large and was expected to come from MNCs with limited local sourcing at present.[9]

As for the composition of inputs sourced by MNCs, almost half of all inputs purchased were parts and components or final products (on average 32.4 and 15.6 percent, respectively). Raw materials constituted 36 percent and packaging 14 percent.

The MNC decision to choose one type of supplier over another was driven by several factors. For example, the top reasons reported for cooperating with Czech suppliers included: low prices (71%), geographic proximity which allowed for a better relationship with a supplier (64%), savings on transport costs (56%) and savings on

[8] Note that the question specifically asked respondents to exclude suppliers of services, such as catering or cleaning.

[9] Note that these figures are similar to those collected in other surveys. For instance, the Opinion Window survey commissioned by CzechInvest in 2002 found that MNCs in the Czech Republic sourced on average 32.2 percent of their inputs locally in 2000 and 34.7 percent in 2001. This share was expected to increase to 35.8 percent in 2002. Similarly, CzechInvest reported that 57 percent of MNCs indicated their ability to increase local content (CzechInvest Factsheet No. 3, January 2002).

import duties (44%). On the other hand, sourcing from foreign firms located in the Czech Republic was primarily driven by the fact that these firms were global suppliers of the MNCs (45%), offered more competitive prices (45%), higher quality products (29%) or products not available from Czech firms (29%). As before, savings on transport costs (34%) and benefits of proximity (30%) mattered as well. Finally, importing inputs from abroad was primarily driven by: using company's global suppliers (46%), implementing the decision of the parent company (37%), unavailability of particular products from Czech firms (36%) or desire to purchase higher quality inputs (30%).

Should being an MNC supplier matter?

There are several reasons why we would expect that MNC suppliers are different from other firms. On the one hand, we might expect that as a result of their contacts with MNCs local suppliers improve their performance. By doing business with multinationals local firms expose themselves to greater competition as they compete not only with other local firms but also with potential suppliers from abroad and are under pressure to improve their performance in order to retain their supplier status. Further, as case studies suggest (Moran 2001), they may also benefit from direct assistance and knowledge transfer from their multinational customers. Such knowledge transfer would be consistent with the results of the empirical studies on inter-industry spillovers (Javorcik 2004; Javorcik and Spatareanu 2008; Blalock and Gertler 2008).

On the other hand, it is plausible that good firms self-select into being MNC suppliers. This hypothesis has been tested empirically and confirmed in the context of exporters (Bernard and Jensen, 1999; Clerides, Lach and Tybout, 1998). In a general equilibrium model with productivity heterogeneity across firms, Melitz (2003) demonstrated that if there are sunk costs associated with export market entry, firms with higher *ex ante* productivity self-select into exporting, whilst those with lower productivity produce only for the domestic market. Given the fact that MNC customers tend to have higher requirements in terms of quality, technological sophistication and on-time delivery of the product, especially when compared to domestic buyers in developing and transition

economies, becoming an MNC supplier is likely to be associated with some fixed cost on the part of local firms.[10]

Self-selection or learning?

Before we examine this question in a formal manner, it may be interesting to present some tabulations from the survey which suggest that both possibilities are plausible. First, we focus on the arguments in favor of good firms self-selecting into becoming MNC suppliers.

The key factor that allows Czech companies to make sales to MNCs is having a product of a suitable quality. This view is supported by the fact that eighty percent of survey respondents sell the same product to both MNC and local customers, and only five percent of respondents sell an improved version of the product to MNCs and its basic version to local customers. Only twenty-one percent of firms reported developing the product specifically for the MNC customer and in only 5.5 percent of cases the foreign customer helped in the development process. For a quarter of all firms the product was developed in house, and only in four percent of companies it is based on technology licensed from abroad.

While Czech suppliers appear to be engaged in product upgrading, a vast majority of such activities is based on their own efforts. More than a quarter of MNCs reported that the complexity and/or quality of products bought from Czech suppliers increased during the previous two years. In more than half of the cases, this change was due to suppliers making improvements independently of the MNCs. In the remaining cases, the improvement was a result of the foreign customer introducing higher requirements. Only in a handful of cases (15%), the MNC respondents indicated that the change was a direct result of the assistance provided to the supplier.

Having a suitable product is a necessary but not a sufficient condition for becoming an MNC supplier. Many multinationals go through thorough technical audits and/or require their prospective suppliers to obtain quality certification, such as for

[10] The anecdotal evidence collected by the author during conversations with managers of local firms in the Czech Republic suggests that this is indeed the case. Before becoming MNC suppliers many firms had to go through lengthy technical audits performed by their potential customers and were often required to obtain quality certifications, such as ISO 9000.

instance ISO 9000. As a further evidence of self-selection may serve the fact that 17 percent of Czech companies surveyed reported obtaining ISO certification *in order to become MNC suppliers*. These firms constituted 40 percent of all companies reporting having an ISO certification.

The survey results also suggest that Czech companies may be learning from their contacts with MNCs. For instance, 25 out of 171 Czech suppliers interviewed reported receiving various forms of assistance from their multinational customers. Given the fact that credit constraints faced by Czech companies were mentioned by MNCs as one of the factors preventing them from sourcing more inputs locally, it is not surprising that advance payment and financing topped the list of assistance received (see Table 4). It was closely followed by leasing of machinery and employee training. Further, Czech suppliers reported receiving assistance with quality control, business strategy, purchasing inputs and production technology. While there is some evidence of technology transfer taking place (through leasing of machinery, direct assistance with production technology or technology licensing), the picture is consistent with the earlier observation that most Czech companies acquire their production technology on their own. Thus the knowledge transfer is more likely to pertain to general business practices rather than specific technologies. It takes the form of employee training, help with quality control, organization of production lines or inventory management.[11] Providing employee training seems to take place quite frequently, as one-fifth of suppliers stated that their staff was invited for training to the premises of the multinational customer. While fees are charged for some forms of support, the majority of it is free (see Table 4).

The high requirements imposed on suppliers by MNCs and fiercer competition such firms face while doing business with multinationals constitute another reason why we would expect local suppliers to perform better than other Czech firms. For instance, about a third of suppliers reported that MNC customers required the share of defective products delivered to decline over time. Similarly, in 39 percent of cases, price cuts were

[11] For instance, after a Czech producer of aluminum alloy castings for the automotive industry signed its first contract with an MNC, the MNC staff visited the Czech firm's premises for two days each month over an extended period to assist with improving the quality control system. Subsequently, the Czech firm applied these improvements to its other production lines (not serving this particular customer) and reduced the proportion of defective items produced (Javorcik 2004).

mandated to take place over time. Moreover, as indicated above, in order to retain their supplier status some companies needed to upgrade their products.

In summary, the evidence collected through the survey suggests that better performing firms become MNC suppliers and that some knowledge transfer is taking place from MNCs to their local suppliers.

Are MNC suppliers different?

What do the hard figures tell us about characteristics of suppliers relative to other firms? In Table 5, we present summary statistics for the two groups of firms separately. We find that suppliers tend to have on average higher sales, fixed assets, investment and total factor productivity (TFP) than non-suppliers. However, the differences between the two groups do not appear to be very large, especially with respect to the last variable. Suppliers are more likely to have an ISO certification or a manager with foreign work experience.

Since these statistics may be influenced by the sectoral composition of firms within the two groups, we follow Bernard and Jensen and calculate supplier premium by regressing each of these variables on industry and year fixed effects. We also repeat the exercise controlling for firm size measured by employment. The results presented in Table 6 indicate that MNC suppliers tend to be 13 percent larger in terms of employment and 18 percent in terms of sales value but they do not experience a faster sales growth. Further, they tend to have higher TFP levels (14 percent premium) and value added per worker (23 percent premium). They also appear to be more capital-intensive (17 percent) and pay higher wages (12 percent). Controlling for firm size does not change these conclusions.

III. Econometric analysis

Predicting the supplier status

Having established the case for self-selection and learning, we now turn to the econometric analysis. We begin by examining the determinants of the supplying status using a probit model. Let $Supplier_{it}$ be a dummy variable that takes the value of one if firm i supplies one or more MNCs at time t, and zero otherwise. More specifically, this

variable equals one for all years after (and including) the year in which a firm started making sales to multinationals. We assume that a firm supplies MNCs if and only if a latent variable, $Supplier_{it}$* is positive. The latent variable depends on a number of firm characteristics and its industry affiliation.

$Supplier_{it} = 1$ if $Supplier_{it}^* > 0$

$Supplier_{it} = 0$ otherwise

where

$$Supplier_{it}^* = \alpha + \beta_1 \ln TFP_{it-1} + \beta_2 \ln Size_{it-1} + \beta_3 \text{Cash ratio}_{it-1} + \beta_4 \text{Exporter}_{it-1} + v_t + v_j + u_{it}$$

As the first determinant of the supplying status, we consider a firm's TFP lagged one period, as it is likely that only the best performing firms are able to meet the expectations of multinational buyers. The TFP is estimated using the semi-parametric estimation procedure suggested by Olley and Pakes (1996), which allows us to take into account the possibility that a firm's private knowledge of its productivity (unobserved by the econometrician) may affect the input decisions. This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time and thus addresses the simultaneity bias between productivity shocks and input choices. The insight of the method is that the observable characteristics of the firm, such as investment, can be modeled as a monotonic function of the productivity of the firm.

To obtain TFP we estimate production functions whether output is measured by firm's turnover and production inputs include capital, labor and materials. Turnover is expressed in constant units of the local currency deflated using the PPI index for the three-digit NACE sectors (defined according to the Classification of Economic Activities in the European Community), obtained from the Czech Statistical Office. The capital stock is proxied by the value of fixed assets expressed in constant units of the local currency. The value of fixed assets has been deflated using the GDP deflator from the IMF's *International Financial Statistics*. Labor input is measured using the wage bill deflated using the consumer price index from IMF's *International Financial Statistics*. Material inputs are deflated using the weighted average of PPI index for the three-digit

NACE supplying sectors. Investment was calculated as difference in fixed assets plus depreciation. Negative values were set to zero. The Olley-Pakes procedure is performed separately for each 2-digit NACE sector using information on all domestic firms listed in *Amadeus* rather than just those covered by the survey.[12]

As the second determinant of the supplier status, we include the firm's size lagged one period. It is possible that foreign affiliates prefer doing business with large and well-established firms or that only large suppliers are able to provide the required volume of output. We measure the firm's size in terms of total assets, deflated using the GDP deflator. Both the TFP and the firm size enter in the log form.

As the survey evidence suggests that MNC suppliers may need to undertake costly changes in preparation for doing business with MNCs, firms with more cash at hand may be better positioned to do so. To take this possibility in to account we control for the ratio of firm's cash to its current liabilities, which measures the firm's ability to meet its cash obligations and is often used in the short-term liquidity analysis.[13]

The information on all three determinants (or their components) comes from the *Amadeus* database.

Further, thanks to their experience of dealing with foreign buyers and the ability to adjust to international standards, exporters may find it easier than other firms to do business with foreign affiliates. To account for the possibility, we control for the exporting status of the firm. The information on the exporting status comes from the survey. The exporter dummy ($Exporter_{it}$) takes on the value of one if firm i was an exporter at the time of the survey. The value of one is assigned to all years starting with the year reported in the survey as the time of the first-time entry into foreign markets until the last year of our panel. The dummy takes on the value of zero in all other cases.

Additionally the model includes industry fixed effects defined at the two-digit NACE level as well as year fixed effects. The unbalanced sample used in the regression

[12] In order to be able to express unobserved productivity as a function of investment and capital, the Olley and Pakes procedure relies on the observations with nonzero investment. However, as shown by Pavcnik (2002), including observations with zero investment does not seem to be problematic in practice. Hence, to avoid a reduction in the sample size, we do not discard cases of zero investment.

[13] Javorcik and Spatareanu (2009) find that, unlike other Czech firms, MNC suppliers are not credit constrained. They attribute this finding to self-selection of non-constrained firms into becoming MNC suppliers.

covers the period 1993-2000, though 1993 drops out as all the right hand side variables enter lagged one period.

The probit results, reported in the top panel of Table 7, suggest that the MNC supplier status is positively correlated with the lagged productivity, firm size, cash ratio and the exporting status. All of these variables are statistically significant both when entered together or in various combinations.

A shortcoming of the above model is that we cannot control for the lagged supplier status.[14] Therefore, in the middle panel of Table 7 we present the estimation results of a linear probability model. As before, we find that the lagged productivity is a strong predictor of the firm being an MNC supplier. The coefficient on this variable is positive and statistically significant at the 5 percent level in all specifications. In contrast to the earlier findings, once we control for the lagged supplying status (which itself is positive and statistically significant) the other explanatory variables are no longer significant.[15,16]

In the bottom panel of Table 7, we present the results from a linear probability model explaining the decision to *start supplying* MNCs (rather than *being* an MNC supplier in given time period, as in the other two panels). This means that we drop from the sample suppliers observed in their second (or later) year of supplying MNCs. The coefficient on the TFP is positive and statistically significant at the 5 percent level in all specifications, suggesting that better performers are more likely to become MNC suppliers.

In sum, the results emerging from all three types of estimation point into the same direction: more productive firms are more likely to supply MNCs. This means that if we are interested in searching for the evidence of learning from the supplying relationships

[14] Given how the $Supplier_{it}$ variable is defined, its lag is a perfect predictor of the current supplying status and hence it cannot be included in the estimation.

[15] The estimation of linear probability models is based on a slightly higher number of observations than probit as, due to the inclusion of industry fixed effects, industries with no suppliers drop out from the probit estimation.

[16] We also experimented with a specification including firm fixed effects (instead of industry fixed effects). The short span of our data set (on average we have 4.5 observations per firm) meant that the coefficients of interest were not precisely estimated. The coefficient on the lagged productivity was slightly smaller (0.02) and statistically significant at the 12-13 percent level.

with MNCs, we need to control for the selection issue. This is the task to which we turn next.

Examining learning from supplying relationships with MNCs

The results we have discussed so far suggest that suppliers are different from non-suppliers. But were suppliers more productive to begin with, or did they improve their performance once they started supplying MNCs? To shed some light on this issue we employ the instrumental variable approach. In the first stage, we regress the supplier status on a set of instruments and year fixed effects. In the second stage, we regress the firm's TFP on the lagged (instrumented) supplier status and year fixed effects.

The first set of instruments is industry-year specific. As it is likely that proximity to MNCs facilitates business relationships, our set of instruments includes proxies for the presence of multinationals in the same industry as well as in downstream industries. The proxy for the presence of MNCs in the same sector is defined as the share of the sector output produced by foreign firms. More specifically, it is calculated by weighting the output of each firm *f* in sector *j* (Y_{ft}) by the share of the firm *f*''s equity owned by foreigners (*Foreign Share*$_{ft}$) and then dividing it by the total output of sector *j:*

$$\text{MNCs in the same sector}_{\text{jt}} = \frac{\sum_{\text{f for all f} \in j} \text{Foreign Share}_{ft} * Y_{ft}}{\sum_{\text{f for all f} \in \text{j}} Y_{ft}}$$

The proxy for the presence of multinationals in downstream sectors (i.e., sectors supplied by firm i operating in sector j) is defined following Javorcik (2004) as

$$\text{Potential MNC customers}_{\text{jt}} = \sum_{\text{k if k} \neq j} \alpha_{jk} * \frac{\sum_{\text{f for all f} \in k} \text{Foreign Share}_{ft} * Y_{ft}}{\sum_{\text{f for all f} \in k} Y_{ft}}$$

That is we use the proportion of sector *j*'s output supplied to a downstream sector *k* calculated based on the 1999 input-output matrix of the Czech Republic (α_{jk}) to weight the MNC presence in each downstream sector *k*. As the formula indicates, inputs supplied within the sector are not included. Thus the greater the foreign presence in sectors supplied by industry *j* and the larger the share of output supplied to industries with a

multinational presence, the higher the value of the variable.[17] The above calculations are based on all firms included in the *Amadeus* database rather than just firms included in our sample.

The next two instruments reflect the Czech Republic's trade policy. It is plausible that if imports in a given sector are subject to tariffs, foreign affiliates may be more inclined to source inputs locally.[18] Thus tariff applied on sector *j*'s imports from the European Union will be used as an instrument. As tariff level may also affect the level of competition in the sector and hence firm productivity (though Arnold et al. (2007) report that this is not the case in the Czech Republic), we will use tariffs lagged two periods.

Further, local producers may not be able to supply high quality intermediates unless they have access to imported raw materials (or may not be able to supply competitively priced intermediates if raw materials they use are subject to high tariffs). To take this possibility into account we will calculate the average tariff on inputs, where

$$\text{Tariff on inputs}_{\text{jt}} = \sum_{\text{k if k}\neq j} \alpha_{jk} Tariff_{jt}$$

Javorcik and Spatareanu (2009) found that absence of liquidity constraints was an important determinant of which Czech firms were able to supply multinationals. Therefore, our next instrument takes into account: (i) progress in banking sector reform in the Czech Republic as captured by an index compiled by the European Bank for Reconstruction and Development and reported in their annual publication *Transition Report*; (ii) reliance of sector *j* on the financial sector, as reflected in the Czech input-output matrix; and (iii) the firm's liquidity ratio defined as (current assets - current liabilities) / total assets. Our instrument is an interaction of the three components. The intuition behind it is the following: the reform of the banking sectors is likely to have an impact on firms' access to credit with firms in sectors relying more heavily on external financing being more affected. Similarly, the extent to which firms are affected may depend on their liquidity. All the components of the instrument are lagged two periods.

[17] To illustrate the meaning of the variable, suppose that the sugar industry sells half of its output to jam producers and half to chocolate producers. If no multinationals are producing jam but half of all chocolate production comes from foreign affiliates, *Potential MNC customers*$_{jt}$ will be calculated as follows: ½*0 + ½*½ = ¼.

[18] Recall that 44 percent of multinationals cited import duties as a reason for why they choose to purchase inputs in the Czech Republic.

Our second set of instruments is firm specific and time varying. To address the issue of credit constraints just mentioned, we use a firm's liquidity ratio, leverage ratio and cash ratio. The leverage ratio is defined as the ratio of current liabilities to current assets. Both components come from the *Amadeus* database. The cash ratio is defined, as discussed before, as cash to current liabilities.

Several other instruments are based on the survey information. They include a dummy for the firm manager having foreign work experience and dummy for the firm having an ISO certification. It is likely that firms whose managers have foreign work experience are better positioned to obtain contracts from multinationals. Similarly, as indicated by the survey evidence discussed earlier, an ISO certification seems to play an important role in the multinationals' decision to choose a local supplier. Finally, our set of instruments also includes the second lag of a supplier status and the second lag of the exporting dummy. The instruments are used in various interactions.

The results of the estimation are presented in Table 8. The number of observations in the IV regressions (based, as before, on an unbalanced panel) is smaller than in the previous specifications. This is for two reasons. First, two years of data are lost because the instruments are based on second lags. Second, information on some of the variables used as instruments is not available for all firms and years.

While these results should be treated with caution because of the small number of observations, they are nevertheless informative. The Hansen test for overidentification restrictions shows that the null hypothesis cannot be rejected at conventional significance levels and thus the test does not cast doubt on the validity of our instruments. The F-tests and Shea R^2 suggest that our instruments are good predictors of the supplying status.

We start our discussion of the IV results with the first stage. We find that firms with a higher leverage ratio are less likely to supply MNCs. The same is true of firms operating in sectors facing high input tariffs. The likelihood of supplying MNCs is also lower in sectors with a large foreign presence, possibly because foreign affiliates may be able to buy intermediates from other multinationals. The second lag of the exporting status, as well as the second lag of the supplying status interacted with other variables, also appear to be statistically significant.

In all specifications, the supplier indicator is positive and statistically significant, which is suggestive of Czech suppliers learning from their relationships with multinational customers. The magnitude of the coefficient is meaningful: 6 of 8 specifications suggest that MNC suppliers are 12-15 percent more productive than other firms. This is in line with the 14 percent premium produced by the OLS estimates reported in Table 6.

In summary, the results suggest that suppliers are different from non-suppliers in terms of productivity levels even after taking into account the self-selection of better performers into supplying MNCs. This observation is suggestive of suppliers learning form their interactions with multinational customers. It is consistent with the anecdotal evidence, observations emerging from the survey data discussed earlier and the econometric studies studying spillovers through vertical relationships using proxies built using information from input-output matrices.

IV. Conclusions

Building on the existing evidence demonstrating a positive correlation between the presence of multinationals in downstream industries and the productivity of domestic firms in the supplying (upstream) sectors, this study aims to shed more light on the mechanisms through which vertical spillovers from FDI may be taking place.

We employ a unique data set which allows us to identify local firms supplying multinationals operating in the Czech Republic to ask whether best firms self-select into becoming suppliers or whether suppliers learn from their interactions with MNCs. The results can be summarized as follows. First, we demonstrate that MNC suppliers different from other firms in terms of various characteristics (productivity, size, capital-intensity, wages). Second, we find that better performing firms are more likely to become MNC suppliers. Third, taking into account the selection issue, we find evidence suggestive of Czech suppliers learning from their relationships with multinationals.

As our analysis is based on a relatively small sample, further work is needed to understand the mechanisms through which FDI affects domestic firms.

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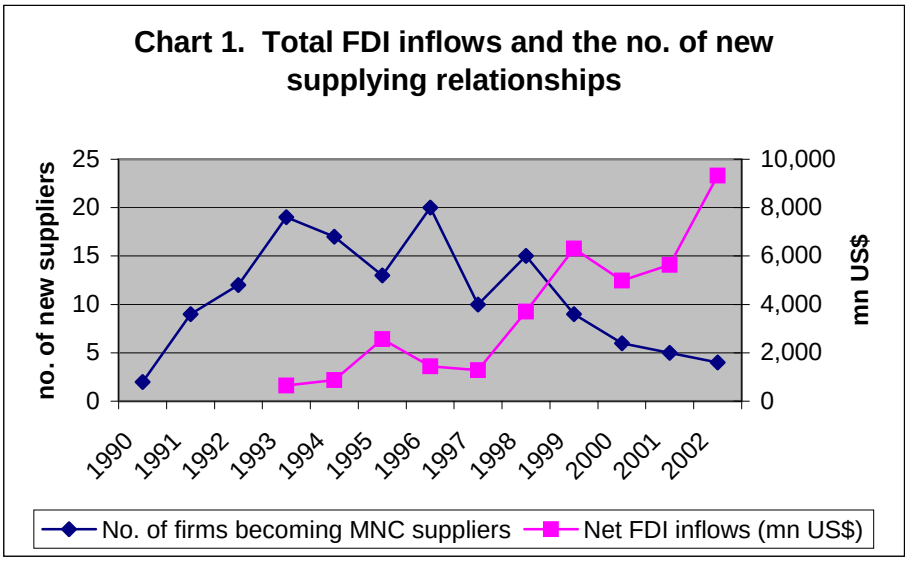

Source: FIAS survey for the number of suppliers, IMF *International Financial Statistics* for FDI inflows.
Notes: Figures on FDI inflows are not available for 1990-92 as during this period the Czech Republic was part of Czechoslovakia.

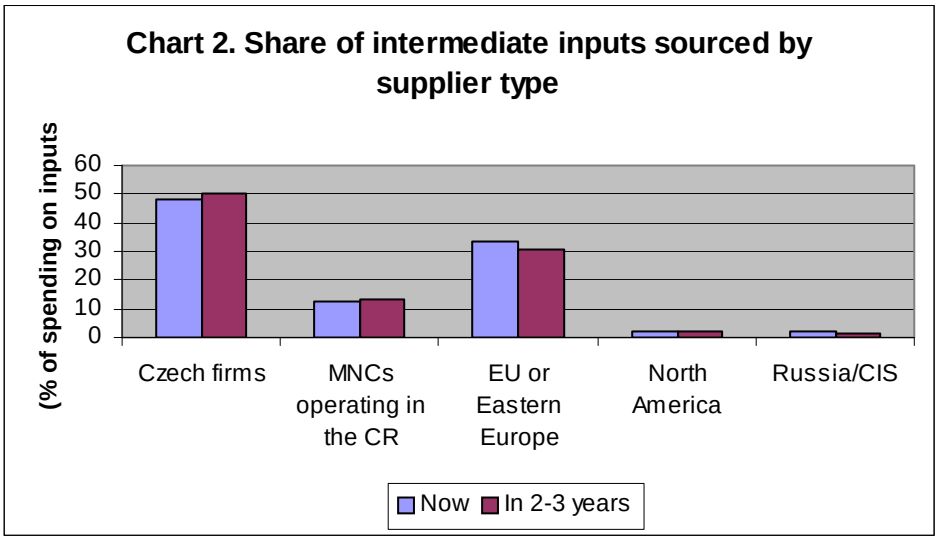

Table 1. Survey Respondents vs. Firms which Declined to Be Interviewed

Variable	Mean Respondent	Mean Non-Respondent	t-stat	p-value
Total Assets (th)	265000	278000	0.231	0.817
Fixed Assets (th)	142000	126000	0.453	0.651
Value Added (th)	71800	55600	1.490	0.137
Sales (th)	263000	264000	0.022	0.982
Employment	242	196	2.003	0.045

Table 2. Distribution of Suppliers and Non-Suppliers across Sectors

NACE	No. of firms		
	Non-suppliers	Suppliers	Total
Manufacture of fabricated metal products except machinery	15	8	23
Manufacture of food products and beverages	7	7	14
Publishing, printing and reproduction of recorded media	4	3	7
Manufacture of basic metals	5	3	8
Manufacture of textiles	2	2	4
Manufacture of wood and of products of wood except furniture	8	2	10
Manufacture of chemicals and chemical products	3	4	7
Manufacture of rubber and plastic products	4	4	8
Manufacture of other non-metallic mineral products	2	2	4
Other mining and quarrying	0	1	1
Tanning and dressing of leather; manuf. of luggage and footwear	0	1	1
Manufacture of machinery and equipment	9	2	11
Manufacture of medical, precision and optical instruments	3	1	4
Manufacture of wearing apparel; dressing and dyeing for fur	2	0	2
Manufacture of electrical machinery and apparatus	2	0	2
Manufacture of furniture; manufacturing n.e.c.	2	0	2
Total	**68**	**40**	**108**

n.e.c. denotes ‘not elsewhere classified’.

Table 3. Distribution of MNC Suppliers

	No. of suppliers which are				
	Czech	EU or Eastern Europe	MNCs operating in the CR	North America	Russia/CIS
No of MNCs reporting each type of suppliers	107	85	56	18	9
MNC in the 25th percentile	5	2	2	1	1
median MNC (50th percentile)	10	5	4	1	2
MNC in the 75th percentile	30	10	10	4	2

CIS stands for the Commonwealth of Independent States.

Table 4. Assistance Received from MNC Customers

	No. of firms reporting receiving assistance (out of 25 companies reporting assistance)	of which assistance for a fee
advance payment and financing	14	2
leasing/lending of machinery	7	2
employee training	7	1
quality control	5	1
business strategy	5	0
supplying inputs	2	1
production technology	3	1
organization of production lines	3	1
finding export markets	3	1
obtaining license for a new technology	2	1
financial planning	2	0
maintenance of machinery	2	1
inventory management	1	0

Table 5. Summary Statistics

	Obs	Mean	Std. Dev.
Non-Suppliers			
ln TFP	326	11.403	0.391
Value added (th)	326	35600	24800
Sales (th)	326	126000	131000
Fixed Assets (th)	326	48100	57500
No. of employees	326	178	125
Investment (th)	326	753	14900
Exporter	326	0.736	0.441
ISO	293	0.601	0.491
Manager with foreign experience	293	0.078	0.269
Leverage ratio	293	0.970	4.414
Liquidity ratio	293	0.167	0.221
Cash ratio	326	0.336	0.537
Suppliers			
ln TFP	160	11.531	0.338
Value added (th)	160	41700	29400
Sales (th)	160	156000	194000
Fixed Assets (th)	160	60200	89500
No. of employees	160	172	94
Investment (th)	160	5364	24800
Exporter	160	0.850	0.358
ISO	152	0.605	0.490
Manager with foreign experience	152	0.191	0.394
Leverage ratio	152	0.728	0.616
Liquidity ratio	152	0.181	0.259
Cash ratio	160	0.529	1.135
IVs			
Potential MNC customers	100	11.390	5.780
MNCs in the same sector	100	18.960	14.310
Tariff on inputs	100	2.830	3.180
Banking reform * IO * liquidity ratio	91	0.699	0.734

Table 6. Supplier Premium

	(a) (%)	(b) with controls for firm size
Total employment	**12.8**	-
Sales	**17.7**	**11.1**
Sales growth	n.s.	n.s.
Capital per worker	**16.6**	**18.6**
TFP	**14.1**	**11.6**
Value added per worker	**23.2**	**12.2**
Wages per worker	**11.7**	**14.4**

(a) The premia are based on coefficients of the Supplier dummy in the following regressions:
$ln\ X_{it} = \alpha + \beta\ Supplier_{it} + \mu_j + \mu_t + \varepsilon_{it}$
where μ_j stands for two-digit industry and μ_t for year fixed effects.
(b) The premia are based on the following regression:
$ln\ X_{it} = \alpha + \beta\ Supplier_{it} + \delta\ ln\ Employment_{it} + \mu_j + \mu_t + \varepsilon_{it}$
n.s. denotes a coefficient not statistically significant at the conventional significance levels.

Table 7. Predicting Supplier Status

Probit model: Predicting supplier status				
TFP (lag)	0.521***	0.454**	0.421**	0.407**
	[0.194]	[0.194]	[0.196]	[0.195]
Firm size (lag)		0.157*	0.158**	0.142*
		[0.081]	[0.080]	[0.080]
Cash/current liabilities (lag)			0.242***	0.227***
			[0.074]	[0.071]
Exporter (lag)				0.541***
				[0.191]
Intercept	-0.093	-2.138	-1.794	-1.897
	[0.000]	[0.000]	[0.000]	[0.000]
No. of obs.	449	449	449	449
Pseudo R^2	0.1	0.11	0.12	0.14
Linear probability model: Predicting supplier status				
TFP (lag)	0.033**	0.034**	0.034**	0.035**
	[0.015]	[0.014]	[0.014]	[0.014]
Firm size (lag)		-0.001	-0.001	-0.001
		[0.008]	[0.008]	[0.008]
Cash/current liabilities (lag)			-0.001	0
			[0.006]	[0.006]
Exporter (lag)				-0.022
				[0.025]
Supplier (lag)	0.960***	0.961***	0.961***	0.964***
	[0.012]	[0.012]	[0.012]	[0.013]
Intercept	-0.319**	-0.306	-0.306	-0.306
	[0.161]	[0.231]	[0.234]	[0.236]
No. of obs.	486	486	486	486
R^2	0.9	0.9	0.9	0.9
Linear probability model: Predicting the *decision* to become a supplier				
TFP (lag)	0.044**	0.043**	0.042**	0.044**
	[0.022]	[0.020]	[0.021]	[0.021]
Firm size (lag)		0.003	0.005	0.005
		[0.013]	[0.013]	[0.013]
Cash/current liabilities (lag)			0.014	0.015
			[0.030]	[0.030]
Exporter (lag)				-0.031
				[0.033]
Intercept	-0.492*	-0.534	-0.559	-0.58
	[0.252]	[0.369]	[0.364]	[0.365]
No. of obs.	338	338	338	338
R2	0.06	0.06	0.06	0.06

All specifications include industry and year fixed effects. Robust standard errors in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable in the top and the middle panel equals one if firm i *is* an MNC supplier at time t and zero otherwise. The dependent variable in the bottom panel equals one if firm i *becomes* an MNC supplier at time t and equals zero if firm i does not supply MNCs at time t. The sample used in the bottom panel excludes suppliers observed in their second (or later) year of supplying MNCs.

Table 8. Instrumental Variable Approach

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IV							
	SECOND STAGE							
Supplier (lag)	**0.125***	**0.125***	**0.262***	**0.210***	**0.137***	**0.144****	**0.124***	**0.154***
	[0.073]	**[0.073]**	**[0.155]**	**[0.110]**	**[0.081]**	**[0.073]**	**[0.066]**	**[0.092]**
Intercept	13.600***	13.600***	13.529***	13.552***	13.596***	13.593***	13.607***	13.577***
	[0.071]	[0.071]	[0.096]	[0.080]	[0.070]	[0.067]	[0.064]	[0.077]
	FIRST STAGE							
Leverage ratio (lag 2)	-0.001***							
	[0.000]							
Liquidity ratio (lag 2)		0.007						
		[0.065]						
Banking reform * IO * liquidity ratio (lag 2)			**-0.070****					
			[0.031]					
Tariff on inputs			-0.024***					
			[0.006]					
Potential MNC customers (lag 2)				-0.001	0.001			-0.002
				[0.005]	[0.004]			[0.003]
MNCs in the same sector (lag 2)				-0.003	-0.001			-0.003**
				[0.002]	[0.001]			[0.001]
MNCs in the same sector (lag 2) * Supplier (lag 2)						0.020***		
						[0.003]		
Manager with foreign experience * Supplier (lag 2)			0.645***	0.729***				0.344***
			[0.041]	[0.030]				[0.083]
Tariff (lag 2)* Supplier (lag 2)							0.043***	
							[0.003]	
Potential MNC customers (lag 2) * Supplier (lag 2)	0.055***	0.055***					0.059***	
	[0.004]	[0.004]					[0.003]	
ISO * Supplier (lag 2)	0.253***	0.253***			0.799***	0.506***	0.115**	0.736***
	[0.053]	[0.055]			[0.022]	[0.047]	[0.049]	[0.033]
Cash ratio (lag 2) * Supplier (lag 2)				0.201***	0.178***	0.130***		
				[0.033]	[0.019]	[0.023]		
Exporter (lag 2)			0.146***					0.082**
			[0.049]					[0.040]
Intercept	0.096***	0.093***	0.296***	0.311***	0.145***	0.116***	0.069***	0.192***
	[0.016]	[0.019]	[0.050]	[0.065]	[0.053]	[0.016]	[0.013]	[0.060]
No. of obs.	314	314	318	322	374	374	371	322
F-test	67.5	63.2	54.5	46.9	130.3	57.5	232.0	70.7
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shea partial R2	0.72	0.72	0.17	0.27	0.53	0.63	0.78	0.48
Hansen J statistic	1.33	0.30	3.26	3.09	4.21	0.77	0.28	3.01
p-value	0.52	0.86	0.35	0.38	0.24	0.68	0.87	0.56

All specifications include year fixed effects. Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.