12-31-2010

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DOES A FOREIGN SUBSIDIARY'S NETWORK STATUS AFFECT ITS INNOVATION ACTIVITY? EVIDENCE FROM POST-SOCIALIST ECONOMIES*

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ABSTRACT: *Questionnaire survey among 809 foreign subsidiaries in five post-socialist economies (East Germany, Poland, Romania, Slovenia and Croatia) is used to study determinants of innovation activity of foreign subsidiaries. Findings demonstrate that foreign subsidiaries are relatively independent as far as innovation activity is concerned, while at the same time subsidiaries with better access to foreign parent companies R&D results are more likely to innovate. Important differences are found in factors that determine product and process innovation: subsidiaries that invest more in R&D exhibit higher probability for product but not for process innovation; transfer of responsibilities from headquarters to subsidiaries is conducive to process innovation; market-seeking motivation of foreign investors has a negative impact on product innovation status.*

Keywords: *Research and development, innovation, foreign subsidiaries, knowledge spillovers, post-socialist economies*

JEL Classification: F21, F23, O31, O33

1. INTRODUCTION

Internationalisation of R&D is one of the prevailing features of the globalisation processes in the last decade. R&D performed in foreign subsidiaries is the most obvious type of the internationalisation of R&D. In 1995-2003, R&D expenditures of foreign subsidiaries in the OECD area increased from USD 34 billion to USD 71 billion, i.e. an increase

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by 110%, compared to 77% increase of their turnover. In all OECD countries apart from Spain, foreign subsidiaries increased their R&D expenditures by up to four times more than domestically-controlled firms. As a result, the share of foreign subsidiaries in total business sector R&D expenditures of OECD has become quite significant. In 2004 this share was in the range between 50%-70% in Ireland, Hungary and Belgium, between 30%-50% in Czech Republic, Sweden, Australia, United Kingdom and Canada, and between 20%-30% in Netherlands, Germany, Italy, France, Portugal, Slovakia (OECD, 2008).

Still, looking at the innovation activity of foreign subsidiaries, their superiority over domestic companies is not obvious. Empirical evidence goes both ways. Falk and Falk (2006) observe that innovation intensity of foreign subsidiaries in Austria is lower than that of domestic firms. Griffith et al. (2004) find that British-owned multinational enterprises (MNEs) account for larger share of R&D activity in UK as compared to foreign-owned MNEs, Ebersberger and Lőőf (2005) claim that R&D intensity of domestically owned MNEs in Sweden is significantly higher than in any other ownership types of firms. The situation in Norway and Finland has been the same, except for Anglo-Saxon foreign-owned MNEs. Similarly, Almeida and Fernandes (2006) suggest that majority foreign-owned firms in developing countries are significantly less likely to engage in technological innovations than minority foreign owned or domestic-owned firms. On the other hand, Damijan et al. (2006) for Slovenia, Balcet and Evangelista (2005) for Italy, Gűnther (2006) for East Germany, and Girma et al. (2006) for China find that foreign subsidiaries have higher propensity to innovate than domestic companies. One cannot explain much of the difference by foreign ownership itself but rather by the fact that foreign subsidiaries are overrepresented in higher technology intensive industries, that they are larger in size (Balcet and Evangelista, 2005), more export intensive, have more modern equipment etc. Once these factors are controlled for, foreign ownership tends not to have significant impact on the propensity to innovate. Thus, according to Gűnther (2006), foreign subsidiaries play a positive role for innovation in a host country since factors, which positively influence innovation – e.g. size, R&D, export intensity, more recent technology – particularly benefit foreign subsidiaries.

The objective of this paper is to ascertain how much does foreign subsidiary's status affect its innovation activity in five post-socialist economies.[1] We build our study on a detailed questionnaire survey of innovation activity among 809 foreign subsidiaries with a particular focus on indicators reflecting foreign subsidiaries status within the MNE network. The existing literature on foreign subsidiaries' innovation activity concentrates on the comparison of innovation activity of foreign subsidiaries and domestically-controlled firms and on a foreign-parent company network as a source of knowledge which may stimulate innovation activity of a subsidiary. The literature that explicitly deals with the determinants of foreign subsidiaries' innovation activity is, however, almost non-existent. The notable exception is Kokko and Kravtsova (2008) who analyse determinants of innovative capability in MNE subsidiaries in four transition countries (Estonia, Hun-

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[1] Of which four are new EU member states (NMS: East Germany, Poland, Romania, Slovenia), while Croatia is a EU candidate country.

gary, Poland, Slovenia). Therefore, in looking for the theoretical background of foreign subsidiaries' innovation activity one has to refer to various other streams of literature, i.e. those related to determinants of firm innovation activity, knowledge transfer within MNE, subsidiary's position within its foreign parent company network, and heterogeneity of foreign investors and foreign subsidiaries.

This paper tests five propositions. The first is that innovation activity of a foreign subsidiary basically depends on the same factors as that of any other firm. Therefore, the first set of determinants of foreign subsidiaries innovation activity relates to generally identified determinants of a firm innovation activity. The second proposition is that innovation activity of a foreign subsidiary is co-determined by the extent of knowledge transfer within its foreign-parent company network. This is the first key feature, which differentiates foreign subsidiaries from domestically-controlled firms. It is expected that this knowledge transfer, in principle, improves foreign subsidiary's innovation capacity as compared to a domestically owned firm. The third proposition is that innovation activity of a foreign subsidiary is dependent on a specific position within its foreign parent company network. This is the second key feature, which differentiates foreign subsidiary from domestically-controlled firm. This position can work both ways as far as foreign subsidiary's innovation activity is concerned. The fourth proposition is that various sources of heterogeneity of foreign investors and foreign subsidiaries affect the innovation activity of foreign subsidiaries. The fifth proposition is that host-country and host-market characteristics also influence the innovation activity of foreign subsidiaries.

Our empirical strategy is as follows. Compared to related literature, we take into account a much broader set of determinants. We follow the classical approach by explicitly bringing in the empirical model the 'traditional' determinants of firm innovation activity and then gradually adding foreign-subsidiary specific determinants. Our findings confirm that, compared to average firms in the analysed countries, surveyed foreign subsidiaries are much more innovative in terms of the fraction of product and process innovators in overall number of firms. While foreign subsidiaries in the analysed countries are relatively independent in terms of innovation activity, the subsidiaries with better access to foreign parent companies R&D results are more likely to innovate. We find, however, significant differences in factors that determine product and process innovation of subsidiaries. Most notably, market-seeking motivation of foreign investors has a negative impact on product innovation status findings, while transfer of responsibilities from headquarters to subsidiaries is conducive to process innovation.

The remainder of the paper is structured as follows. Section two provides the theoretical background and existing empirical evidence on foreign subsidiaries innovation activity. Section three presents the model, section four describes the data and sample characteristics and descriptive statistics, while section five provides estimations of the model, i.e. of the importance of various sets of determinants on foreign subsidiaries' innovation activity. The last section concludes.

2. THEORETICAL BACKGROUND AND EXISTING EMPIRICAL EVIDENCE ON THE DETERMINANTS OF FOREIGN SUBSIDIARIES' INNOVATION ACTIVITY

Innovation activity of foreign subsidiaries is essentially determined by two sets of factors. The first set is traditional firm-innovation activity determinants, which are of relevance to any firm regardless of whether foreign or domestically owned. The second, which is the focus of our interest, are the determinants arising from the fact that a firm is a foreign subsidiary. The latter is in the focus of our interest. Within this context one has to refer to various streams of literature. First, to the literature on the determinants of firm innovation activity which relates to the first set. Second, to the literature on knowledge transfer within MNEs, subsidiary's position within its foreign parent company network, heterogeneity of foreign investors and foreign subsidiaries, which altogether relate to the second set of determinants.

The literature that explicitly deals with the determinants of foreign subsidiaries' innovation activity is almost non-existent. The notable exception is Kokko and Kravtsova (2008) who analyse determinants of innovative capability in MNE subsidiaries in Estonia, Hungary, Poland and Slovenia. According to them, the innovative capability of MNE subsidiaries depends on three sets of determinants: (i) the role of the subsidiary in the MNE's international production network; (ii) some other subsidiary characteristics, like size, age, and industry of origin; and (iii) host country and host industry characteristics, including the development level of the host industry and the competitive pressure exerted by local firms. The main finding of Kokko and Kravtsova (2008) is that innovative capability in product and process technology seems to be determined by a different set of variables than capability related to marketing and management knowledge. The most independent subsidiaries are also those that have the strongest innovative capability in product and process technology. At the same time subsidiaries in high technology industries recorded lower levels of innovative capability. For marketing and management capability, the pattern is almost reversed. The highest levels of innovative capability are recorded in subsidiaries that are closely tied to the parent company, with high foreign ownership shares and substantial exports back to the parent company.

2.1 Determinants of firm innovation activity

Proposition one: *Innovation activity of a foreign subsidiary depends on the same factors as that of any other firm. Therefore, the first set of determinants of foreign subsidiaries innovation activity comprises of generally identified determinants of firm innovation activity. The issues/factors which are in the centre of attention here are own R&D, external sourcing of knowledge, absorption capacity plus a number of other firm innovation activity determinants.*

Own R&D and other standard explanatory variables. Own R&D is the crucial determinant of firm's innovation capacity and of firm's capacity to absorb external knowledge (Cohen

and Levinthal, 1989; Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992, 1998 etc.). Other most often tested explanatory variables of firm's innovation activity are firm size, industry characteristics, market concentration, technology characteristics, product diversification and market position (export orientation) (Veugelers and Cassiman, 1999; Cohen and Levinthal, 1989). The relationship between innovativeness and size is positive, but not necessarily linear, and it depends on industry characteristics. Industry characteristics are the determinant of firm's innovation activity in the sense that higher-tech industries exhibit higher innovation activity. Industry variable captures several dimensions, i.e. scope for future demand, opportunities for technological innovations and cumulativeness of knowledge, indicating to which extent current innovation build further on previous R&D (Veugelers and Cassiman, 1999: 65). The model of Veugelers and Cassiman (1999: 70-75) for Belgian manufacturing firms confirms that large and more export oriented firms in high tech industries are more likely to innovate, while results of Mairesse and Mohnen (2006) for French manufacturing firms do not fully support these findings. Their main finding is that R&D is positively correlated with all measures of innovation output, and, all other things equal, more correlated than size to innovation. Innovation is generally more sensitive to R&D in low-tech sectors than in the high-tech sectors.

In our approach, own R&D and other standard explanatory variables of firms' innovation activity will be analysed through: (i) share of R&D expenditures in total sales, (ii) type of product with respect to its technological intensity, as a proxy for industry characteristics, (iii) number of employees as a proxy for size.

External sourcing of knowledge. The second set of factors which co-determine firm's innovation activity is external sourcing of knowledge in its various forms, i.e. licensing agreements, contracting out of R&D, buying of equipment (imports), innovation cooperation, knowledge spillovers from other firms and learning-by-exporting. The issue of external sourcing of knowledge is usually considered within the transfer of technology issue, but rarely within the context of innovation-activity determinants. The examples of the latter are Veugelers (1997), Veugelers and Cassiman (1999), Frenz and Ietto-Gilles (2007), and Damijan et al. (2006). They all recognise that own R&D is the most important for innovation activity, but external sources are also relevant. One of the main conclusions here is that external sourcing does stimulate firm's own R&D but only if a firm possesses adequate absorptive capacity (Veugelers, 1997). This points to the complementarity between in-house R&D and external know-how (Allen, 1986; Cohen and Levinthal, 1990); it is difficult to be a good ‚buyer' when one is not also a ‚maker' (Radnor, 1991). That is why Veugelers and Cassiman (1999) find it is more appropriate to talk about 'make and buy' and not 'make or buy' innovation strategy of firms.

The following possible sources of external knowledge will be analysed: (i) acquisition of external knowledge (via licensing agreements and by contracting out R&D activities), (ii) acquisition of external knowledge by importing, (iii) learning by exporting.

Licensing agreements are one of the basic channels of international technology transfer (Eaton and Kortum, 1996), but nowadays provide a less important source, as the latest

and most valuable technologies are not available on license (UNCTAD, 2000). As far as contracting out of R&D activities is concerned, Veugelers (1997) claims that it does significantly stimulate own R&D but only when absorptive capacity is present. Imports of intermediate products and capital equipment may also work as a channel of technology transfer (Feenstra et al., 1992). Empirical research suggests that imports are an important source of technology, in that much knowledge and R&D is embodied in goods that are imported, especially capital goods and machinery (Hoekman and Smarzynska Javorcik, 2006; Keller and Yeaple, 2003; Keller, 2004; Eaton and Kortum, 2001; Coe and Helpman, 1995; Coe et al., 1997; Xu and Wang, 1999; Keller, 2000; Lumenga-Neso et al., 2001; Keller, 2002; Kraay et al., 2001).

The concept of learning-by-exporting says that more intensive competition on export markets stimulate exporters to strengthen their growth and performance (Van Biese-broeck, 2003). Via their international contacts, exporters acquire knowledge on new production methods, inputs and so forth (Aw et al., 1998). The literature is not unanimous about the existence of learning-by-exporting effects; they have been found in the case study literature, whereas authors of econometric studies take a much more sceptical view (Keller, 2004). Where only a small minority of authors find support for the learning-by-exporting hypothesis, the vast majority of studies fail to find any evidence of firms' productivity benefiting from exporting activities (see Greenaway and Kneller, 2007 for a survey)

External sourcing of knowledge tends to stimulate firm's own R&D and innovation if a firm possesses adequate absorptive capacity (Veugelers, 1997). Most of the literature on absorption capacity relates to FDI spillovers. The predominant conclusion is that technology spillovers from MNEs tend to occur more frequently when the technological and social capabilities of the host country and the absorptive capacity of firms in the economy are high enough (Blomström, 1986; Kokko, 1994; Kokko et al., 1996; Cameron, 1996; Imbriani and Reganati, 1997; Borensztein, De Gregorio and Lee, 1998; Cameron et al., 1998; Kinoshita, 2000; Keller and Yeaple, 2003; Damijan et al., 2003a; Glass and Saggi, 1998; Girma et al., 2001; Girma and Gőrg, 2002; Griffith et al., 2004; Lim, 2001; Halpern and Murakozy, 2006; Abraham et al., 2006).[2] Far the most frequently quoted determinant of absorption capacity is human capital (Borensztein, De Gregorio and Lee, 1998; Hoppe, 2005; Kneller and Stevens, 2006; Gorodnichenko et al., 2006). *In our exercise, absorption capacity will be proxied by the extent of own R&D.*

2.2 Knowledge transfer within MNE

<u>Proposition two:</u> *Innovation activity of a foreign subsidiary relies upon the extent of knowledge transfer within its foreign parent company network. This is the first key feature, which differentiates foreign subsidiary from a domestically-controlled firm. It is expected*

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[2] In contrast, a handful of authors claim that bigger technological gap offers more room for technological spillovers (Findlay, 1978; Haskel et al., 2001; Castellani and Zanfei, 2003).

that this knowledge transfer, in principle, improves foreign subsidiary's innovation capacity as compared to domestic firms.

The issue of technology and technology transfer from parent companies to their foreign subsidiary, as well as organization of technology, is at the heart of the theories of international production and MNEs (see, for instance, Dunning, 1993; Bartlett, 1986; Bartlett and Ghoshal, 1989; Perez, 1998). In the transaction cost (internalisation) approach (Coase, 1937; Williamson, 1975, 1981, 1985; Buckley and Casson, 1976), one of the main reasons for the existence of international production is the presence of market failures in technological transactions (Williamson, 1981). Technology also has the central position also in the macroeconomic development approach to international production, i.e in the product life cycle hypothesis (Vernon, 1966) and in the flying geese model (Kojima, 1978; Kojima and Ozawa, 1985).

In looking at the theoretical foundations of knowledge transfer within MNEs it seems appropriate to apply resource based, as well as organizational and institutional perspectives. Such an eclectic approach encompasses the whole complexity of the relationship between foreign parent and its subsidiary. The resource-based theoretical perspective focuses on idiosyncratic resources and capabilities of firms as drivers of their performance. Several studies point that FDI in transition economies often requires a massive resource transfer (managerial, financial, knowledge etc) from the foreign parent to the local subsidiary. A major stream of literature researches how foreign investors can facilitate organisational learning (Steensma and Lyles, 2000; Lane et al., 2001) and how this, in turn, influences firm performance (Lyles and Salk, 1996; Dhanaraj et al., 2004). Organisational and institutional theory is the second way to approach knowledge transfer within MNEs. The underlying assumption of the knowledge complementarity concept (Buckley and Carter, 2004) and the dynamic capabilities approach (Teece et al., 1997) is that a subsidiary cannot develop idiosyncratic resources nor dynamic capabilities independent from the MNE headquarter or other parts of the MNE. Gupta and Govindarajan (1994) suggest that within the same MNE, strategic roles can be expected to differ in terms of the extent and directionality of knowledge flows between foreign subsidiary and the rest of the corporation (more on that in section 2.3).

Although it is far from guaranteed that all activity carried out by MNEs in host countries will lead to technology transfer, empirical evidence on technology transfer from MNEs to foreign subsidiaries in terms of higher productivity levels and growth is ample.[3] On the other hand, empirical evidence on the impact of FDI on foreign subsidiaries' innovation activity is more scarce. According to Cantwell and Molero (2003: 5-7), there is little evidence of any great difference in the innovation behaviour of foreign-owned compared to domestically-owned firms. The difference between the two groups is more a result of structural differences, such as a larger average size of foreign subsidiaries and their great-

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[3] Empirical studies, using firm-level panel data, include Haddad and Harrison, 1993; Blomström and Wolff, 1994; Blomström and Sjöholm, 1999; Aitken and Harrison, 1999; Blalock, 2001; Girma et al., 2001; Alverez et al., 2002; Barry et al., 2002; Girma and Görg, 2002; Damijan, Knell, Majcen, Rojec, 2003b; Arnold and Smarzynska Javorcik, 2005.

er presence in high-tech sectors (Molero and Heys, 2002). However, innovation strategies require increasingly more global sourcing and parent MNEs more often tend to integrate their subsidiaries in their innovation strategies. More innovation active foreign subsidiaries will tend to source more know-how from local sources and, at the same time, will become more interesting vehicles for technology diffusion to the local economy. But this may also lead to the situation when valuable know-how leaves the country, while the subsidiary R&D remains too dependent on the assimilation of know-how developed elsewhere in the parent company (Sanna-Randaccio and Veugelers, 2003: 17-18).

In our empirical approach, knowledge transfer within MNEs will be proxied by the subsidiaries' own judgement of the importance of headquarters R&D for subsidiary's R&D and innovation.

2.3. Subsidiary's position within its foreign parent company network

Proposition three: *Innovation activity of a foreign subsidiary is co-determined by its specific position within the parent company network. This is the second key feature, which differentiates foreign subsidiaries from a domestically-controlled firm.*

Transfer of technology from foreign parent to its subsidiary and innovation activity of a subsidiary *inter alia* depend on subsidiary's position in parent company's network. The literature on subsidiary's strategy focuses on the process through which foreign subsidiaries enhance their resources and capabilities, and in so doing increasingly add value to the MNE network as a whole (White and Poynter, 1984; Bartlett and Ghoshal, 1989; Young et al., 1988; Birkinshaw and Hood, 1998). One of the most widely used subsidiary typologies within this stream of literature is the one by White and Poynter (1984). They distinguish between the following types of subsidiaries: marketing satellite, miniature replica, rationalised manufacturer, specialised producer and strategic independent. The strategic roles of a subsidiary in White and Poynter's typology change according to its technological capacity (Couto et al., 2003), where moving to more advanced forms of subsidiaries typically involves their higher autonomy and innovative capability (Kokko and Kravtsova, 2008).

Gupta and Govindarajan (1994) suggest that within the same MNE, strategic roles can be expected to differ in terms of the extent and directionality of knowledge flows between foreign subsidiary and the rest of the corporation. They find that innovation by foreign subsidiaries is more typically the results of autonomous initiative rather than strategic directives issued from the corporate headquarter. For example, if a subsidiary operates as a centre of excellence or has been assigned a world product mandate, it is likely to have the autonomy to develop, manufacture, and market a product-line worldwide. Birkinshaw et al., (1998) contrast such 'high contributory role subsidiaries' with the implementer and rationalised subsidiary types, which lack autonomy, authority, and capabilities to generate independent competencies (Young and Tavares, 2004). However, the relation between technological capabilities and autonomy in the foreign subsidiary is

not clear-cut (Young and Tavares, 2004). On one hand, subsidiaries with greater R&D capabilities may be less technologically dependent on their headquarters and hence display higher levels of autonomy (Birkinshaw and Morrisson, 1995; Pearce, 1999; Taggart and Hood, 1999). On the other hand, strategic sensitiveness of knowledge-related activities can lead to tighter control by headquarters (Bartlett and Ghoshal, 1989; Martinez and Jarillo, 1991). Moreover, strong headquarter assignments may not only facilitate control but also efficiency of the MNE's internal market (Mudambi, 1999; Egelhoff et al., 1998).

In our exercise, the position of subsidiaries in their foreign parent companies networks will be analysed via: (i) integration of subsidiary into foreign parent company network via customer-supplier relations of subsidiary with other parts of its MNE group (share of susbsidiary's exports/imports to foreign parent company network in total exports/imports), (ii) transfer of responsibilities from foreign investor to its subsidiary, (iii) the division of control between subsidiaries and their foreign parent companies in various business functions.

2.4. Heterogeneity of foreign investors and foreign subsidiaries

<u>Proposition four</u>: *Various other sources of heterogeneity of foreign investors and foreign subsidiaries impact the innovation activity of foreign subsidiaries.*

Heterogeneity of foreign investors and foreign subsidiaries may also influence the innovation activity of foreign subsidiaries. Likely the most important source of this heterogeneity are different positions of subsidiaries within their foreign parent companies networks. Still, there are other sources of heterogeneity. To the best of our knowledge there is no literature that would directly tackle the impact of foreign investors and foreign subsidiaries heterogeneity on the latters' innovation activity. However, the issue is broadly covered in the literature on FDI spillovers, which can be usefully applied for our purpose.

The most important sources of foreign subsidiaries heterogeneity relates to domestic versus export market orientation of a subsidiary (Smarzynska, 2003: 6; UNCTAD, 2001; Altenburg, 2000; Belderbos et al., 2001; Sgard, 2001; Tytell and Yudaeva, 2005; Moran, 2005), acquisition versus greenfield type of FDI (UNCTAD, 2001; Belderbos et al., 2001; UNCTAD, 2000; Toth and Semjen, 1999) and joint venture (local equity participation) versus wholly foreign owned subsidiaries (Smeets and de Vaal, 2006; Smarzynska Javorcik and Spatareanu, 2006; Abraham et al., 2006; Almeida and Fernandes, 2006; Gorodnichenko et al., 2006). Studies on sources of heterogeneity of foreign investors which influence the intensity of FDI spillovers as a rule concentrates on the home country of foreign investors (Abraham et al., 2006; Perez, 1998; Graham and Krugman, 1989; Levy and Dunning, 1993). Time dimension is another source of heterogeneity in FDI spillovers literature (Kosova, 2006; Cantwell, 1989).

In our exercise, the following sources of firm heterogeneity will be taken into account: (i) subsidiaries' heterogeneity: motivation of foreign investor, share in equity held by foreign

investor, (ii) foreign investors' heterogeneity: type of foreign owner, (iii) time dimension: year of entry of foreign investor.

2.5. Host country characteristics

<u>Proposition five</u>: *Host country characteristics also influence the innovation activity of foreign subsidiaries.*

It is widely accepted that host country characteristics have an impact on the type of FDI and foreign subsidiaries. The most obvious way to proxy host country's absorption capacity is to look at its overall level of development (Blomström et al., 1994; Xu, 2000; Kokko and Kravtsova, 2008). Economists often conceive absorptive capacity as a certain level of human capital and education capacity (Borenzstein, De Gregorio and Lee, 1998; Kokko and Kravtsova, 2008); the higher the level of human capital the better are chances for technology transfer via FDI and innovation activity of subsidiaries. Another possible determinant of host country's absorption capacity is investment and business climate. Liberal investment and business climate is more likely to attract more dynamic FDI with more technology transfer etc. (Moran, 1998; Lim, 2001: 4-9; Kokko and Blomström, 1995; Balasubramayam et al., 1996, 1999; Ernst, 1998). Also, Kinoshita and Lu (2006) show that technology spillovers via FDI in developing countries take place only when the host country has the sufficient level of infrastructure. Kokko and Kravstova (2008) quote Rugman and Douglas (1986), Egelhoff et al. (1998), and Walsh et al. (2002) as those who claim that market structure, infrastructure and education are likely to encourage upgrading of affiliates.

In our exercise, a host country dummy will be used to take account of host country characteristics.

3. MODEL

Based on the above propositions, we estimate the following empirical model

(1) $P(Inov_{it} = 1) = \alpha + \beta_1(Inov.det_{it-1}) + \beta_2(know.transf.exter_{it-1}) + \beta_3(know.transf.inter_{it-1}) + \beta_4(sub.position_{it-1}) + \beta_5(heterog)_{it-1} + \beta_6(host.country)_{it} + \varepsilon_{it}$

where $Inov_{it}$ stands for innovatory activity at time *t*. We employ three different variables to account for innovatory activity, namely dummies for product and process innovation as well as information on the share of new or significantly improved products in firm's total sales. Firms' innovatory activity is explained by six sets of explanatory variables:

a/ Innovation determinants ($Inov.det_{it-1}$) represent classical determinants of innovation, where we use the share of R&D expenditure in total sales and firm size, as measured

by total employment. We expect both variables to have a positive impact on subsidiaries' innovatory activity.

b/ External sources of knowledge are included under *know.transf.exter$_{t-1}$*. In order to control for possible sources of knowledge outside the firm and the MNE network, we employ the share of imports in total supplies, the share of exports in total sales (learning-by-exporting) as well as subsidiaries' own opinion on the importance of acquisition and purchase of external knowledge for their innovatory activity. We expect all three variables to have a positive impact on subsidiaries' innovatory activity.

c/ Importance of knowledge transfer within the MNE network (*know.transf.inter$_{it}$*) is estimated with the inclusion of the observed importance of R&D activities performed at the MNE headquarters for subsidiaries' innovatory activity. We expect headquarters R&D to have a positive impact on subsidiaries' innovatory activity.

d/ *sub.position$_{t-1}$* serves as a measure of the role of subsidiary's position within the MNE network on subsidiary's innovatory activity. Subsidiary's position within the MNE network is, firstly, measured by the share of subsidiary's exports to other parts of the network in its overall exports and the share of imports from network in overall imports. This helps indicate the reliance of a subsidiary on selling/buying from the network and, consequently, on its integration in the network. Secondly, we introduce subsidiaries' perception of the degree of transfer of new responsibilities (related to new geographical markets, products and business functions) from headquarters to a subsidiary. Thirdly, subsidiaries' perception of the degree of control they have over operational, marketing and strategic business functions is included. We expect the higher the subsidiaries' responsibilities and control over business functions the higher their innovatory activity.

e/ Heterogeneity of subsidiaries and foreign investors is captured under *heterog$_{it}$* and proxied by: (i) strategic motivation of foreign investors, which is divided into market-seeking, efficiency-seeking and strategic-asset-seeking, (ii) foreign share in total equity as a proxy for foreign control, (iii) year of entry of foreign investor to control for length of foreign presence, and (iv) different types of foreign investors, i.e. multinational (MNE) groups (present in several countries and having above 250 employees or EUR 50 million in turnover), small and medium-sized foreign firm, and foreign financial investors. We expect efficiency and strategic-asset seeking FDI to have a positive impact on innovatory capacity and the opposite for market-seeking FDI. We also expect MNEs as foreign parents to have a positive impact on innovatory capacity.

f/ *host country$_{ti}$* is a host country dummy, used to take account of host country characteristics.

All regressors are lagged one period to mitigate the issues of endogeneity. Dependent variables therefore represent values for year 2006, while our independent variables in the preferred regression represent the 2005 values. In the Appendix we present results with a longer lag for the regressor variables as they taken on values from 2002 instead. The results do not differ significantly from results with one period lags, therefore only focus on the former.

4. DATA, SAMPLE CHARACTERISTICS AND DESCRIPTIVE STATISTICS

To evaluate the impact of different groups of determinants of innovation on both in-novation status and innovation intensity of firms we use data from the IWH FDI Micro Database. The Database encompasses 809 manufacturing (NACE Rev 1.1, industries 15 to 37) foreign subsidiaries (firms with 10 per cent or higher foreign equity share) with about 214,000 employees from five countries, i.e. Croatia, East Germany, Poland, Ro-mania and Slovenia, which were surveyed by a comprehensive questionnaire in 2007. The selection of countries tries to balance country size, geographic location and level of economic development. The data relate to 2005, for some variables the data for 2002 and 2005 were collected, and for some for 'at entry' and 'today'. The survey questionnaire was centrally designed and followed the same pattern in all five countries. Altogether a population of 6,833 firms were approached, of which 11.84 per cent responded. In terms of employment, the response rate was 19.05%.

In terms of the number of firms the three largest sectors in the total population are food products and beverages, wearing apparel and dressing, and fabricated metal. In terms of employment the three largest sectors are again food and wearing apparel, and this time manufacturing of motor vehicles, trailers & semi-trailers. The deviations of the indus-try shares in the sample compared with the relevant population equivalents are up to 3 percentage points, if we consider the share of an industry in the total number of firms, and up to 5 percentage points if we take into account the shares of employment by indus-try.[4] In terms of distribution of firms across size classes, the sample is underrepresented for micro (1-9) and small enterprise (10-49), and consequently over-represents medium seized (50 - 249) and large (above 250) firms.

Table 1 below presents the shares of foreign subsidiaries questioned undertaking product and process innovations. About two thirds of the firms surveyed claimed they have made product innovations in the past three years. Similarly, about two thirds of firms claimed to have introduced process innovations. Country wise, the share of product innovators firms is the highest in Poland, followed by East Germany – West Germany (EG-WG) MNEs, East Germany and Slovenia. Croatia and Romania lag somewhat behind. As far as process innovations is concerned, Slovenia is in the lead, followed by EG-WG MNEs, Poland and East Germany. Again, Croatia and Romania lag behind.[5] There is a considerable difference of sample foreign subsidiaries' innovatory activity according to the type of their foreign parent companies. 60.7% of subsidiaries with MNEs as foreign parent companies claimed that they were innovatory active in the last three years, while the corresponding shares for small or mediums sized firms is 27.1% and for financial investors only 4.3%.

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[4] Share of sector 18 (clothing) in the total number of firms is 9.21% in the population of firms and 5.93% in our sample, with the deviation of 3.27 percentage points representing the highest deviation of all sectors. On the other hand, sector 34 (Manufacture of motor vehicles, trailers and semi-trailers) has the highest deviation in terms of the share of employment at 5.25 percentage points (with the sample employment share understating the population share).

[5] Foreign subsidiaries from the sample seem to be much more innovatory active than enterprises in the ana-lysed countries on average. According to Eurostat (2008: 103), the share of innovatory enterprises in all enter-prises is 24.8% in Poland, 26.9% in Slovenia, 19.5% in Romania.

TABLE 1: *Share of innovatory firms among surveyed foreign subsidiaries*

Country	No. of firms	Share of product innovators[a]	Share of process innovators[b]
East Germany	222	68.9%	68.9%
EG-WG MNEs	73	76.7%	74.0%
Croatia	144	59.0%	60.4%
Poland	110	79.1%	70.9%
Romania	220	57.7%	57.3%
Slovenia	40	65.0%	75.0%
Total	809	67.1%	66.3%

Source: IWH FDI Micro Database and own calculations.
[a] Product innovators are firms that succeeded in introducing new or significantly improved products or services in the past three years. Product must be new to the surveyed firm, not necessarily to the market.
[b] Process innovations are new or improved production or delivery methods including e.g. changes in techniques, equipment and/or software.

The numeric variables, most of which appear as regressors in (1) are described in Table 2. The only variable in Table 2 that serves as a regressant is the approximate share of new and significantly improved products in total firm sales (in %), where the mean and median values are relatively low, but display a very high standard deviation. Still, if one faces high share of product innovators among the surveyed firms (67.1%) with much lower average share of new products in the surveyed firms sales (14.3%, with median value of only 5.0%), it is obvious that new or significantly new products only rather gradually gain importance for subsidiaries overall activity.

In addition to firm size, as measured by the average number of employees in 2005, we also use the share of R&D expenditures in total sales as standard determinants of innovation. On average, surveyed firms spend 4.8% of their sales for R&D, with the median value of only 0.8%. Importance of acquisition of external knowledge is an ordinal variable, whereby the respondents were asked to rank its importance for the firm from 1-not important to 5-extremely important. Both the average and median values for this variable are close to 2.5, which is in the middle between 2-little important and 3-important. On average, the surveyed subsidiearies are highly export and import oriented, with 50.6% share of exports (median value is 50%) and 45.8% share of imports (median value is 40%) in sales. The importance of R&D undertaken by the MNE headquarters was, again, assessed on an ordinal scale ranging from 1-not important to 5-important. Here the average values (as measured by the mean and median) are near to 3-important, i.e. somewhat higher than was the case with acquiring external knowledge.

TABLE 2: *Descriptive statistics of numeric variables*

Variable	N	Mean	Median	Std. Dev.	Min	Max
Share of new products in total firm sales (in %)	633	14.250	5.0	37.251	0	100
Standard determinants of innovation						
R&D expenditure share in total sales (in %)	662	4.830	0.8	11.23392	0	80
Total employment (No. of employees)	803	266.781	101	532.9778	1	6505
External sources of knowledge						
Importance of acquisition of external knowledge (from 1=not important to 5=extremely important)	446	2.482	2.5	1.180227	1	5
Share of imports in total supplies (in %)	772	45.767	40	35.75004	0	100
Share of exports in total sales (in %)	780	50.591	50	38.53494	0	100
Knowledge transfer within MNE						
Importance of head quarters R&D (from 1=not important to 5=extremely important)	717	2.796	3	1.462888	1	5
Subsidiary's position within MNE network						
Share of exports to network in total exports (in %)	780	7.935	1.7	12.15206	0	100
Share of imports from network in total imports (in %)	660	39.711	28.6	40.15911	0	100
Transfer of responsibilities from headquarters (from 1=no transfer to 4=full transfer)	722	1.871	1.7	0.884919	1	4
Operational control (from 1=fully controlled by subsidiary to 4=fully controlled by foreign investor)	786	1.570	1	0.83143	1	4
Marketing control (from 1=fully controlled by subsidiary to 4=fully controlled by foreign investor)	771	2.314	2	1.11311	1	4
Strategic control (from 1=fully controlled by subsidiary to 4=fully controlled by foreign investor)	720	2.326	2.4	0.881323	1	4
Heterogeneity						
Market-seeking strategy (from 1=not important to 5=extremely important)	758	2.815	3	1.095932	1	5
Efficiency-seeking strategy (from 1=not important to 5=extremely important)	767	3.020	3	1.313073	1	5
Strategic-asset seeking strategy (from 1=not important to 5=extremely important)	751	2.521	2.5	1.027249	1	5
Share of foreign equity (in %)	797	87.885	100	22.19562	0	100
Year of foreign investor entry	787	1997.546	1998	4.738325	1970	2006

As far as subsidiary's position within MNE network is concerned, may be the most out-standing feature is a low share of subsidiaries' exports to other affiliates within the MNE network relative to overall exports, which is dwarfed by much higher share of imports from the network in total imports (the respective mean values are approximately 8% and 40%). Obviously, subsidiaries are much more integrated in their foreign parent compa-nies' network on the supplies than on the sales side. In other words, subsidiaries do not

seem to produce intermediate products for other parts of their network, but products for arms length buyers. Thus, within their foreign parents' networks, subsidiaries are responsible for certain markets and/or for certain products. These responsibilities seem to be related to subsidiaries right at the entry of foreign investor, as since then only quite limited transfer of responsibilities has happened. The extent to which responsibilities have been transferred to subsidiaries since the entry of foreign investor, was measured on an ordinal scale ranging from 1-no transfer to 4-full transfer. The interviewees assess the extent of transfer as being on average under the range of 'limited transfer'.

Yet another indicator of subsidiaries position within foreign parent companies' networks is division of control over individual operational, marketing and strategic business functions.[6] This indicator was also measured on an ordinal scale ranging from 1=fully controlled by subsidiary to 4=fully controlled by foreign investor. As expected, foreign investors are more eager to control strategic and marketing business functions than the operational ones.

Within the 'heterogeneity' variables we look into motivation of foreign investors, foreign share in total equity and age. Wholly foreign owned subsidiaries dominate, while the average foreign share in the equity is 87.9%. Foreign investors' motives have been grouped into market-seeking, efficiency seeking and strategic-asset seeking ones. The importance of these is evaluated by the subsidiaries on an ordinal scale from 1-not important to 5-extremely important. Efficiency-seeking motivation seems to be the most frequent, closely followed by market-seeking and the least frequent being strategic-asset-seeking motivation. Average value of strategic-asset-seeking motive, which serves as a proxy for being motivated by an acquisition of subsidiary's knowledge, is in the range between 2-little important and 3-important.

5. RESULTS

We estimate (1) by using a simple probit in cases where the dependent variables are either the probability to product innovate (columns 1 and 4) or the probability to process innovate (columns 3 and 6), while we employ standard OLS for the case when the dependent variable is share of new or significantly different products in total sales (columns 2 and 5). Results are presented in Table 3. Columns 1 to 3 present estimates without industry dummies, while columns 4-5 include industry dummies

Results presented in Table 3 reveal several key findings. Within all the analyzed sets of determinants (standard determinants of innovation, external sources of knowledge, knowledge transfer within MNE, subsidiary's position within MNE network and het-

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[6] Operational control is proxied by the interviewees' perception of the division of control between subsidiary and foreign parent company as far as production and operational management is concerned. Marketing control is proxied by control over market research and marketing, while strategic control is proxied by control of a combination of business functions, i.e. basic and applied research, product development, process engineering, strategic management and planning, investment project and finance.

erogeneity) there are individual determinants which significantly impact the innovatory activity of foreign subsidiaries:

a/ *Standard determinants of innovation.* One of the key determinants of innovation is expectedly the share of R&D expenditure in sales indicating that firms that spend more on R&D are more likely to product innovate and will be able to base a larger share of their sales on newly developed products. This, however, is not the case for process innovation, where firm size exhibits statistically significant impact (albeit with a very low value of the ratio) on the likelihood of innovation. This is likely related to the fact that larger scale producers tend to benefit more from process innovation than smaller firms. Compared with low tech industries, more advanced industries do not seem to be more likely to innovate, on the contrary, when industry dummies are included, high-tech firms are even significantly less likely to process innovate than low-tech firms.

TABLE 3: *Impact of affiliate characteristics on innovation activity*

	Product innovation status	Share of new products	Process innovation status	Product innovation status	Share of new products	Process innovation status
	1	2	3	4	5	6
Standard determinants of innovation						
R&D expenditure share in total sales	**0.031*** [0.017]	**0.033*** [0.012]	0.006 [0.012]	**0.029*** [0.016]	**0.033*** [0.013]	0.004 [0.013]
Total employment	0.0001 [0.0001]	0.0001 [0.0001]	**0.0004*** [0.0002]	0.0001 [0.0001]	0.0000 [0.0001]	**0.0005*** [0.0002]
High-tech industry dummy	0.474 [0.485]	0.409 [0.489]	0.217 [0.528]	0.02 [0.716]	0.178 [0.786]	**-1.278*** [0.734]
Medium-tech industry dummy	0.108 [0.214]	**0.416*** [0.212]	-0.061 [0.212]	-0.284 [0.513]	0.713 [0.733]	-1.09 [0.843]
External sources of knowledge						
Importance of acquisition of external knowledge	0.108 [0.108]	0.177 [0.115]	**0.202*** [0.108]	0.151 [0.116]	0.213* [0.120]	0.174 [0.119]
Share of imports in total supplies	**-0.006*** [0.003]	**-0.006**** [0.003]	-0.005 [0.003]	-0.005 [0.004]	-0.005 [0.004]	**-0.006*** [0.004]
Share of exports in total sales	-0.001 [0.004]	-0.002 [0.004]	-0.001 [0.004]	-0.001 [0.004]	-0.002 [0.004]	0.001 [0.004]
Knowledge transfer within MNE						
Importance of headquarters R&D	**0.209**** [0.082]	0.082 [0.085]	**0.135*** [0.080]	**0.236**** [0.084]	0.095 [0.088]	**0.163*** [0.085]
Subsidiary's position within MNE network						
Share of exports to network in total exports	0.001 [0.011]	-0.003 [0.012]	-0.009 [0.012]	0.002 [0.012]	-0.004 [0.012]	-0.006 [0.012]
Share of imports from network in total imports	-0.001 [0.003]	0.000 [0.003]	-0.003 [0.003]	-0.002 [0.003]	0.094 [0.297]	-0.003 [0.003]
Transfer of responsibilities from headquarters	0.091 [0.109]	0.006 [0.113]	**0.275**** [0.109]	0.108 [0.113]	0.001 [0.121]	**0.322***** [0.112]
Operational control	0.192 [0.134]	0.146 [0.141]	0.053 [0.131]	0.211 [0.139]	0.178 [0.152]	0.054 [0.135]

Marketing control	-0.053	0.094	0.206	-0.046	0.095	0.193
	[0.142]	[0.149]	[0.142]	[0.147]	[0.153]	[0.145]
Strategic control	-0.252	-0.263	-0.21	-0.28	-0.272	-0.12
	[0.189]	[0.206]	[0.184]	[0.195]	[0.214]	[0.192]
Heterogeneity						
Market-seeking strategy	-0.142	0.127	-0.046	**-0.177***	0.094	0.011
	[0.089]	[0.094]	[0.088]	**[0.099]**	[0.100]	[0.095]
Efficiency-seeking strategy	0.060	0.019	0.121	0.072	0.031	0.091
	[0.077]	[0.079]	[0.081]	[0.081]	[0.087]	[0.079]
Strategic-asset seeking strat.	0.134	0.027	0.030	0.138	0.017	0.018
	[0.098]	[0.098]	[0.099]	[0.104]	[0.108]	[0.104]
Share of foreign equity	-0.003	0.006	-0.001	-0.003	0.007	-0.002
	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Owner foreign MNE	-0.144	0.096	**0.523****	-0.096	0.070	**0.545****
	[0.245]	[0.259]	**[0.239]**	[0.257]	[0.277]	**[0.258]**
Owner small or medium sized enterprise	-0.154	0.390	0.185	-0.171	0.330	0.261
	[0.250]	[0.259]	[0.242]	[0.260]	[0.276]	[0.250]
Owner financial investor	0.151	0.607	0.137	0.242	0.711	0.370
	[0.489]	[0.521]	[0.480]	[0.475]	[0.519]	[0.490]
Year of foreign-investor entry	-0.024	**-0.048****	-0.035	**-0.037***	**-0.059****	**-0.047****
	[0.020]	**[0.021]**	[0.022]	**[0.022]**	**[0.023]**	**[0.023]**
Host-country dummies	YES	YES	YES	YES	YES	YES
Industry dummies	NO	NO	NO	YES	YES	YES
Observations	256	239	256	250	237	254
Pseudo R-squared#	0.13	0.17	0.17	0.16	0.20	0.23

Note: Dependent variable in columns 1 and 4 is an indicator variable of product innovation, dependent variable in columns 2 and 5 is the share of sales attributed to a new product, while in columns 3 and 6 it is a process innovation indicator variable.
Robust standard errors in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.
# except columns 2 and 5, where we report the adjusted R-squared.

b/ *External sources of knowledge.* Although the importance of acquiring external knowledge has a positive impact on the probability of innovation and its measurable impact, the coefficient is only significant for process innovation when industry dummies are excluded and for the share of new products with industry dummies. On the contrary, there is some evidence that firms with a higher share of imports in total supplies will be less likely to innovate and will also benefit less from innovation in terms of the share of new products in total sales.

c/ *Knowledge transfer within MNE.* R&D activities of the foreign parent company headquarters seem to be quite important for subsidiaries' likelihood to innovate. Headquarters' R&D activities have positive and significant impact on subsiadiries' innovation activity with the ratio of 0.163 for process and 0.236 for product innovations, if industry dummies are included.

d/ *Subsidiary's position within MNE network* does not really seem to have a very important impact on subsidiary's innovation activity. Of all the variables tested within this set of determinants, it is only the transfer of responsibilities from headquarters to subsidiaries, which is conducive to process innovation. Division of control between

headquarters and subsidiaries, or subsidiaries trade with the network do not prove to have any impact on subsidiaries' innovatory activity. All these, as well as low share of subsidiaries' exports going to parent network, seem to indicate that foreign subsidiaries in new EU member states function as fairly independent entities as far as innovatory activity is concerned. Their innovatory activity is motivated by the increase of their own competitiveness and not by some broader parent company goals.

e/ *Heterogeneity.* Market-seeking motivation of foreign investors has a negative impact on product innovation status. In other words, FDI looking for the local market are not conducive to product innovation activity of the subsidiaries. Still, there is no indication that efficiency or strategic asset-seeking FDI would have a positive impact on subsidiaries innovation activity. On the other hand, it is important who is a foreign investor, since it is only MNEs, and not small or medium sized enterprises or financial investors, who have significant and positive impact on process innovation status of subsidiaries. Also, the length of foreign presence in a subsidiary has a positive impact on innovation and also the share of new products in total sales. It therefore seems that a foreign investor needs some time to initiate innovation activities in a subsidiary. Foreign share in equity, as a measure of foreign control, does not impact subsidiary's innovation activity. This is in line with the lack of impact of division of control of business functions on the innovation activity (see above).

6. CONCLUSIONS

From a host country point of view, increased R&D and innovation activity of foreign subsidiaries means more opportunities for knowledge transfer in the host economy; firstly directly to the subsidiaries under foreign ownership and control and, secondly, indirectly to other firms in the host economy through spillovers. Therefore, identification of the determinants of foreign subsidiaries' innovation activity is of direct relevance for host country policy makers. In other words, apart from FDI spillovers, attracting of R&D intensive FDI with high innovation capabilities is definitely the most legitimate reason for a government to promote inward FDI. According to the latest CREST report (European Union, 2008: 12), FDI in R&D is high on the political agenda of most EU member states, although the R&D part is usually included in more general FDI polices. Although only a limited number of countries have specific policy instruments in place to stimulate spillovers from FDI in R&D there is a rising awareness to innovate policy measures in order: (i) to take advantage of inward FDI in R&D by means of embedding (former) high-tech enclaves with little knowledge diffusion in the local environment and to generate spillovers without hollowing out the local research base; (ii) to capture the scientific benefits of outward FDI in R&D (back) to domestic R&D environments; (iii) to adapt policy measures to the rationale of knowledge competition rather than cost competition.

Our findings confirm that FDI tend to have a positive impact on a host country's innovation activities. Compared to average firms in the analysed countries, surveyed foreign subsidiaries are much more innovative in terms of the fraction of product and process innovators in overall number of firms. Roughly two thirds of the surveyed subsidiar-

ies undertook product and process innovations in the last three years, Still, new or significantly new products only rather gradually gain importance for subsidiaries overall activity, as their share in total sales is only 14.3% in terms of mean and 5.0% in terms of median value. Taking account of a wide array of information on standard determinants of innovation, external sources of knowledge, knowledge transfer within MNE, subsidiary's position within MNE network and heterogeneity, we come to several interesting findings.

First, subsidiary's position within MNE network does not really seem to have a very important impact on subsidiary's innovation activity. Only, transfer of responsibilities from headquarters to subsidiaries is conducive to process innovation, while division of control between headquarters and subsidiaries, or subsidiaries trade with the network do not prove to have any impact on subsidiaries' innovatory activity. Foreign subsidiaries in new EU member states seem to be relatively independent ventures as far as innovatory activity is concerned.

Second, there are differences in factors that determine product and process innovation. Subsidiaries with higher R&D expenditures and more transfer of R&D results from headquarters do more product innovations; company size and acquisition of external knowledge do not impact product innovation activity. Situation with process innovations is different. While R&D activities of the headquarters remain to have positive and significant impact on subsidiaries' innovatory activity, the size of own R&D expenditures does not. However acquisition of external knowledge and company size have significant and positive impact on process innovation, while subsidiaries in high-tech industries exhibit significantly lower probability to process innovate than low-tech firms.

Third, market-seeking motivation of foreign investors has a negative impact on product innovation status, but there is no indication that efficiency or strategic asset-seeking FDI would have a positive one. The fact that foreign investor is a MNE, and not a small or medium sized enterprise or a financial investor, is positive for subsidiary's process innovation. The same goes for the age of subsidiary, i.e. a foreign investor needs some time to initiate innovation activities in a subsidiary.

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APPENDIX: Impact of affiliate characteristics on innovation activity with longer lags on the control variables

	Product innovation status	Share of new products	Process innovation status	Product innovation status	Share of new products	Process innovation status
	1	2	3	4	5	6
Standarad determinants of innovation						
R&D expenditure share in total sales	0.027 [0.018]	**0.04** **[0.018]****	0.004 [0.014]	0.021 [0.018]	**0.044** **[0.020]****	0.003 [0.015]
Total employment	0.000 [0.000]	0.000 [0.000]	**0.001** **[0.000]***	0.000 [0.000]	0.000 [0.000]	**0.001** **[0.000]****
High-tech industry dummy	0.173 [0.495]	0.1 [0.483]	0.093 [0.499]	-0.244 [0.751]	0.175 [0.781]	-0.861 [0.833]
Medium-tech industry dummy	-0.149 [0.223]	**0.383** **[0.232]***	-0.272 [0.227]	-0.457 [0.596]	-0.09 [0.883]	**-1.983** **[0.975]****
External sources of knowledge						
Importance of acquisition of external knowledge	0.123 [0.122]	**0.263** **[0.132]****	0.193 [0.128]	0.146 [0.131]	**0.34** **[0.151]****	0.166 [0.136]
Share of imports in total supplies	**-0.64** **[0.350]***	**-0.625** **[0.354]***	-0.01 [0.357]	-0.449 [0.397]	-0.542 [0.424]	-0.335 [0.411]
Share of exports in total sales	0.068 [0.401]	0.029 [0.405]	-0.402 [0.413]	0.024 [0.470]	-0.081 [0.456]	-0.071 [0.481]
Knowledge transfer within MNE						
Importance of headquarters R&D	**0.197** **[0.091]****	0.046 [0.089]	0.100 [0.089]	**0.208** **[0.097]****	0.026 [0.092]	0.12 [0.100]
Subsidiary's position within MNE network						
Share of exports to network in total exports	-0.008 [0.012]	-0.009 [0.013]	-0.002 [0.013]	-0.01 [0.013]	-0.015 [0.013]	0.002 [0.013]
Share of imports from network in total imports	0.206 [0.290]	0.218 [0.318]	-0.327 [0.306]	0.096 [0.300]	0.355 [0.351]	-0.348 [0.326]
Transfer of responsibilities from headquarters	0.119 [0.120]	-0.114 [0.120]	**0.281** **[0.122]****	0.132 [0.127]	-0.153 [0.133]	**0.371** **[0.132]*****
Operational control	0.049 [0.146]	0.19 [0.152]	-0.182 [0.145]	0.046 [0.150]	0.25 [0.162]	-0.223 [0.149]
Marketing control	0.077 [0.159]	0.051 [0.161]	0.117 [0.158]	0.109 [0.162]	0.076 [0.167]	0.08 [0.159]
Strategic control	-0.227 [0.216]	-0.264 [0.221]	0.113 [0.213]	-0.25 [0.224]	-0.284 [0.230]	0.284 [0.226]
Heterogeneity						
Market-seeking strategy	-0.157 [0.105]	0.032 [0.101]	-0.134 [0.104]	**-0.207** **[0.119]***	-0.004 [0.107]	-0.102 [0.110]
Efficiency-seeking strategy	0.049 [0.086]	0.012 [0.084]	**0.164** **[0.094]***	0.081 [0.093]	0.008 [0.095]	0.121 [0.092]
Strategic-asset seeking strat.	0.158 [0.103]	0.03 [0.100]	0.076 [0.107]	0.169 [0.110]	0.009 [0.115]	0.083 [0.114]
Share of foreign equity	-0.003 [0.005]	0.004 [0.005]	-0.009 [0.005]	-0.003 [0.005]	0.005 [0.006]	**-0.01** **[0.006]***

Owner foreign MNE	-0.05	0.373	**0.487**	0.029	0.398	0.462
	[0.271]	[0.257]	**[0.265]***	[0.297]	[0.290]	[0.294]
Owner small or medium sized enterprise	-0.242	**0.469**	0.005	-0.199	**0.498**	0.075
	[0.279]	**[0.268]***	[0.273]	[0.295]	**[0.297]***	[0.293]
Owner financial investor	-0.546	0.332	-0.264	-0.405	0.336	-0.331
	[0.620]	[0.627]	[0.605]	[0.652]	[0.563]	[0.640]
Year of foreign-investor entry	-0.035	-0.014	-0.033	**-0.053**	-0.026	-0.044
	[0.025]	[0.026]	[0.027]	**[0.027]***	[0.027]	[0.030]
Host-country dummies	YES	YES	YES	YES	YES	YES
Industry dummies	NO	NO	NO	YES	YES	YES
Observations	214	209	214	208	207	212
Pseudo R-squared#	0.13	0.14	0.19	0.15	0.21	0.26

Note: Dependent variable in columns 1 and 4 is an indicator variable of product innovation, dependent variable in columns 2 and 5 is the share of sales attributed to a new product, while in columns 3 and 6 it is a process innovation indicator variable.

Robust standard errors in brackets.

* significant at 10%; ** significant at 5%; *** significant at 1%.

except columns 2 and 5, where we report the adjusted R-squared.