FDI, Export Spillover and Firm Heterogenity: an application to the Indian manufacturing case

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Abstract

The role of Foreign Direct Investments (FDI) in the process of economic development is of particular relevance since they bring in some specific technological assets that are not immediately available in the host country. The literature related to the microeconomic impact of FDI has been mainly concentrated in explaining the final effect on productivity, caused by the fact that Multinational Enterprises (MNEs) are not completely able to protect their superior assets from spilling over. However, there is a relatively unexplored effect that has recently been at the center of some studies that is the export spillover effect. Up to now, the literature has found out only mixed results with regard to the possibility that MNEs influence both export decision and export intensity of local firms. In the present paper, we provide some empirical evidence for that specific effect examining a case of an emerging economy, namely India for the period 1994-2006 by using a firm level dataset of more than 3000 firms belonging to manufacturing industries. In particular, we introduce the theoretical argument related to the MNEs heterogeneity which has not been properly investigated especially in empirical studies trying to understand whether, by using different measures characterizing MNEs behaviour, it is possible to distinguish between different impacts that MNEs have on export performance of local firms. We estimate the model through the Heckman selection technique after having built spillover variables that take into account five types of heterogeneity: the degree of involvement in trade networks, the level of embeddedness inside the innovation system of the host country, the asset seeking vs asset exploiting motivations(technological intensity), the type and amount of inputs sourced from abroad rather than from the host country and the percentage of the foreign equity stake. The second step of the analysis we perform is that of testing the relationship between the heterogeneity of MNEs with the heterogeneity of local firms splitting the sample according to the level of R&D intensity, the level of embeddness into the innovation system and the involvement in trade activities.

Results confirm the hypothesis of different impacts caused by different MNEs behaviour especially with regard to the export intensity, while a greater impact on export decision is found when heterogeneity of local firms is accounted for.

Keywords: Exports, spillover, MNCs
JEL classification: F23, O14, O53

1. Introduction

The role of FDI as a catalyst of industrial development has been long recognized as one of the main positive influences that FDI brings in the host country. As a matter of fact, MNEs are considered to be owners of superior firm specific assets that they can not completely protect from spilling over to local firms. However, according to the wide empirical evidence available there is still some ambiguity regarding the positive benefits of FDI in the host economy, as only mixed results have been found. Various reasons need to be taken into account to explain the mixed results found out across studies: for example, the absorptive capacity of the domestic firms, the technology gap between foreign and local firms, the role of spatial proximity effects and the motivations for which MNEs invest in a specific host country (Gorg and Greenaway, 2004). Up to now, the literature has mainly focused on the effects observable on the final level of productivity. Nevertheless, there is an important aspect that has not received been properly investigation: that is, the effect on the level and the decision to enter the export market. Indeed, it is commonly accepted that the level of exports of a country represents an indicator of economic development, as, at the country level, exports and economic growth are highly and positively correlated. For these reasons, policy makers encourage the rising of exports through various incentives such as, for example, export subsidies. However, a recent microeconomic literature has tried to explain, from a theoretical and empirical point of view, what are the characteristics that distinguish exporters from non exporters. Especially, starting from the paper by Bernard and Jensen (1995), a wide range of studies found out that exporting firms usually perform better than domestic market oriented firms. With regard to this issue, the ongoing debate in the international trade literature is based on this crucial question: do successful firms export, or does exporting lead to higher firm productivity? Up to now, two different but not mutually exclusive types of answers have been found in the literature: the first most in favour of the self selection of better firms into export markets (e.g. Bernard and Jensen, 1999) and the other in favour of the learning by exporting hypothesis (e.g. Van Biesebroeck, 2005).

However, in the above mentioned type of literature, the role played by MNEs or other external sources in influencing the export performance of local firms' is rather scarce. As a matter of fact, very few papers have appeared on this topic the literature searching for the above aspect. Instead, by the most recent literature has been suggested that MNEs may act as a mean to stimulate both export decision to enter in the foreign market and export intensity of local firms. However, studies carried out following the above mentioned approach usually report mixed results both with regard to export decision and export intensity, confining mainly to the experience of developed countries.

For all these reasons, this study tries contribute to the understanding of export behaviour of firms in developing countries using a rich firm level dataset relative to Indian manufacturing industries

for the period 1994-2006 (PROWESS). We investigate whether MNEs activities are the source of rising export activity on the part of the local firms. Besides showing empirical evidence for another country, we add to the existing literature in two ways: first, by concentrating just on the channel relative to information externalities, we take into account five different types of MNEs heterogeneity building five different proxies of MNEs activities and dividing each of them into "higher" and "lower" FDI quality: the foreign equity share, the level of embeddedness in structure of production of the host country, the embeddedness in the innovation system of the host country, the level of engagement in trade activities and the most usual technological level of the subsidiaries. In this way we introduce the theoretical argument according to which different types of activities on the side of MNEs subsidiaries may have different impacts on local firms productivity (Marin and Bell, 2006), even though we investigate this aspect on the decision and level of exporting activities. Secondly, we introduce the concept of heterogeneity of local firms by splitting the sample according to specific variables, such as royalties intensities or the overall level of trade that are not usually considered. In this way we are able to test how the interaction of two types of heterogeneity interacts over time affecting export performance.

Further, India provides an interesting case study because, as it is described in Poddar (2004), India has experienced a large rising in share both of FDI inflows, and of imports and exports since 1991 when the country, started to implement a series of macroeconomic, industrial, and trade reforms. The present paper is structured as follows: in section 2 we carry out a critical review of the export spillover literature examinating it especially from the point of view of both MNEs and local firms heterogeneity; the third section is devoted to a description of the FDI and exports regime in India. Section 4 provides the description of the empirical methodology along with description of the dataset. Section 5 and 6 provide interpretation of econometric results and section 6 concludes.

2. Export spillover and firm heterogeneity: review of the literature

Despite the numerous studies on productivity spillover from FDI, only mixed results have been found with regard to empirical evidence. Some recent surveys (e.g. Görg and Greenway, 2004; Smeets, 2008) reach the conclusion that it is mainly due to two reasons: first, the differences in the empirical methodology used to carry out such studies, in particular the use of cross section or panel data (Görg and Strobl, 2001) or the way the externality term is specified (Castellani and Zanfei, 2007). Secondly, as Lipsey and Sjöholm, (2005) point out, the characteristics of the host country like the absorptive capacity of domestic firms, the technology gap between foreign and domestic firms, the role of agglomeration economies and the motivations for which MNCs invest in foreign countries play a crucial role in affecting the occurrence of the effect. Very recently, a new strand of literature emerged exploring whether productivity effect may be mediated by exports or may be a consequence of higher

export performance. The link between exports and productivity was examined until recently only at the country or industry level (e.g. Lopez, 2005). However, the investigation of this issue at microeconomic level has gained momentum since the publication of studies by Bernard and Jensen (1995, 1999). Since the appearance of these pioneering studies, two different but non-mutually exclusive positions are emerged: the first is relative to the fact that the presence of sunk costs such as the transport costs or those associated to distribution, could be the source of self-selection into the export markets. According to this view, the direction of causality runs just in one direction: that is, if a firm has a higher productivity it will be present in foreign markets. As explained in theoretical and empirical models (Melitz, 2003; Clerides et al.,1998) firms need to become more productive to enter export markets exporters. Mainly, it is due to two reasons: the first is attributable to the need of compensating for sunk cost involved in the exporting activity in order to enter in the foreign market, and (ii) second, the higher competition firms face in the foreign markets lead them to raise their productivity.

The second hypothesis is that causality may run also in the opposite direction: it means that firms become more productive after having entered in the export market, receiving a sort of learning by exporting effect. For example, Blalock and Gertler (2004) for Indonesia, Kraay for China (1999) and Bigsten et al. (2004) for Sub-Saharan Africa confirm this hypothesis. A subsequent study by Van Bisebroeck (2005) for the same region also reaches a similar conclusion. The mechanisms through which the learning by exporting effect may be generated are first of all relative to the interaction with foreign competitors and customers because more knowledge is needed with respect to the national level. In the second place, exporting allows to increase scale by having access to a larger market.

From our point of view, we think that even the presence of MNEs inside the industrial environment of a country may stimulate exports even though enterprise level studies carried out with regard to export spillover coming from FDI are rather limited especially with regard to developing countries. Before reviewing the literature is necessary to underline that these types of studies are focused just on the investigation of the causal relationship between local firm export performance as a consequence of MNEs activities. The link with productivity is not singled out clearly because both hypotheses are considered as mutually non exclusive but reinforcing: for example, Greenway et. al (2004) consider that a higher export activity is related after some time to a higher production activity. Instead, Keller and Pisu (2007) consider that first MNEs cause productivity to rise and, as a consequence of this effect, the exports may rise as well. Essentially we consider that both effects are likely to occur for local firms even though they are driven by different channels: through competition effect due to the higher presence of MNEs in the local context, they impact on the sunk costs of local firms helping them to rise productivity to the point they decide to enter export market. After they are entered in the export market the demonstration effect caused by informations MNEs convey about foreign markets spur their export intensity. Moreover, in the latter case, local firms also benefit from

better network communications MNEs have with foreign markets, such as distributions and servicing facilities as well as higher marketing capabilities. This is why we expect that the export behaviour of MNEs may act even on the export decision of firms because it lowers both production and distribution costs.

The first papers examining this issue are relative to case studies of developing countries, namely Mexico and Uruguay examined respectively by Aitken and Harrison (1997) and Kokko at al. (1997). In the first case, by using a probit model, they test whether a firm decision to export in the manufacturing Mexican industry in the period 1986-1990 is influenced by MNCs. They found positive results both with regard to proxies of sales and exports. In this case it is not recognized that different types of MNEs may be the source of different potential spillover effects. Only a sort of agglomeration effect is taken into consideration. In the second case, the authors carry out a cross section study using Uruguayan firm level data. However, the possibility that exports activities of foreign firms may act as a mean to spur higher export activities on the part of local firms is not explored. From the point of view of heterogeneity, it is taken into consideration the fact that MNEs established after 1973, that is a more outward oriented period, are the source of a greater spillover effect more than subsidiaries established in the period before 1973. It is attributed to higher potential demonstration effect caused by higher export oriented behaviour. Instead, no heterogeneity is examined on the part of local firms except for the usual R&D absorptive capacity. It should be noted that in both studies only the export decision is taken into consideration. The positive results related to the demonstration effect in the case of export confirm the fact that it may have effect to lower the sunk cost of firms, by sharing informations related to foreign markets.

With regard to the case United Kingdom, Greenway et al. (2004) use three variables to proxy spillover effect: the R&D expenditure to measure innovation spillover, the employment share of MNCs to account for higher competitive pressure and the role of exporting activities to account for information externalities (demonstration effect). By using the two step Heckman estimation procedure, they test the spillover effect both for export intensity and export decision finding positive results for all of the three variables with regard to export decision. Instead, they find a negative effect with regard to information externalities that should help firms to overcome sunk costs even though not crucial to explain export intensity. In this case, they are analyzed different channels through which it is possible to understand from where the final spillover effect is coming but it is not considered whether the behaviour of subsidiaries may influence the final effect. A specific effect that is accounted for in the empirical specification and that may actually reflect other potential sources of spillover is relative to the spillover coming from R&D of other sources that in a developed countries may be relevant unlike in the case of a developing countries. In the same way, Kneller and Pisu (2007) examine the case of United Kingdom. They add as a channel of export spillover, the backward and forward linkage effect

measurement[1]. By using a database from 1992 to 1999, they find out that they are positively related both to export intensity and export decision. Further, they consider two types of MNEs heterogeneity: the first is relative to the export orientation and the other is relative to the importance of agglomeration externalities. They find that export oriented foreign firms do not to influence the export intensity of local firms. Even in this case no other heterogeneity except for skill intensity and R&D intensity is taken into consideration.

Some papers also find evidence of negative effects on exports such as in the case of Ireland and Spain. The study of Irish firms by Ruane and Southerland (2005), who consider separately the output and export activities of foreign firms singles out positive effects coming from horizontal spillover and negative results coming from export spillover both with regard to export decision and export intensity. They motivate these results by arguing that information externalities do not occur due the particular role played by Ireland as export-platform because they do not compete with local firms failing to cause a reduction of costs on their side. Nevertheless, it is not considered that more export oriented MNEs may counterbalance this negative effect with higher information externalities (and hence demonstration) effect rather than more market oriented MNEs that, despite having more contact with local firms they may cause a lower demonstration effect. The positive results found for export decision confirm the hypothesis made by Greenway et al. (2004) while the negative effects on export intensity confirm the fact that higher export oriented MNEs may be competitors of local firms in foreign market. In this case, the heterogeneity on the part of MNEs is considered at the level of the nationality of the parent company[2]. The results found are relative to the fact that US MNEs cause a positive export spillover effect only with regard to competition effect, spurring local firms to enter into the export market. Instead, the effects of the same MNEs on the export intensity is that of a negative association confirming our hypothesis of higher competition in foreign markets.

Negative results are also found by Barrios et. al.(2003) examining the case of Spain. They find that the most important variable to account for export spillover is R&D intensity of foreign firms, while little evidence is found on the side of information externalities coming from export behaviour of foreign firms. No heterogeneity is taken into consideration with regard to different behaviour of MNEs, except for R&D intensity. In the same way as Greenway et. al. (2004), they consider that even local firms, through their technological activities may be the source of spillover effect for export performance of other local firms. The spillover effect may be also influenced by the destination country where the firm exports as it is demonstrated in their empirical application. In particular, it is shown

[1] The authors, contrary to Greenway et. al. (2004), use a measurement of spillover variable the usual ratio of foreign sales to total sales by sector.

[2] However, it reflects a more outward oriented behaviour of US MNEs with respect to non US MNEs.

how R&D spillover are particularly relevant for those firms that exports in OECD countries while they are negligible for those exporting to non OECD countries[3].

Even some recent papers carry out an empirical analysis of this effect. Nguyen (2008) considering manufacturing data about Vietnam finds out that both horizontal and forward linkages are the source of export spillover while no effect is found with regard to backward spillover; even in this case the heterogeneity is considered to be related to the fact that more export oriented foreign firms may have a higher demonstration effect finding positive results with respect to both export intensity and export decision. Results are in line with previous empirical evidence especially with regard to demonstration effect coming from information externalities. In the same way, Buck et. al. (2007) search for spillover effect in the case of China using several spillover channels as well as considering the heterogeneity of the MNEs involved before and after the Chinese's diaspora. The consideration of this type of heterogeneity is motivated by the fact that FDI coming from Chinese diaspora have located in more export oriented sectors while FDI from OECD countries are more market oriented.

The shortcomings of these studies are also relative to the scarce investigation of local firm heterogeneity: usually this aspect is searched only at the level of R&D and skills intensities but not on the overall level of technological capabilities. For example firms that are also importers of goods or even of disembodied technologies may perform better that those firms that are only exporters. Only recent empirical studies have started to investigate the link between imports and productivity: for example the papers by Bernard et. al (2007) and Muuls and Pisu(2007) find evidence of the better performance theat importers share with exporters. Theoretical studies have dealt with self-selection and learning by importing effects even though only the latter has been empirically investigated. However, it has been noticed that importing activities as well as exporting activities involve sunk costs that need to be met by local firms. Moreover, the effect may be different according to the type of import that is considered: as a matter of fact it is possible that import of goods and disembodied technological knowledge may cause a sort of technology transfer if the firm as the suitable technological capacity to absorb those technologies but the role of sunk cost is evident even in this case.

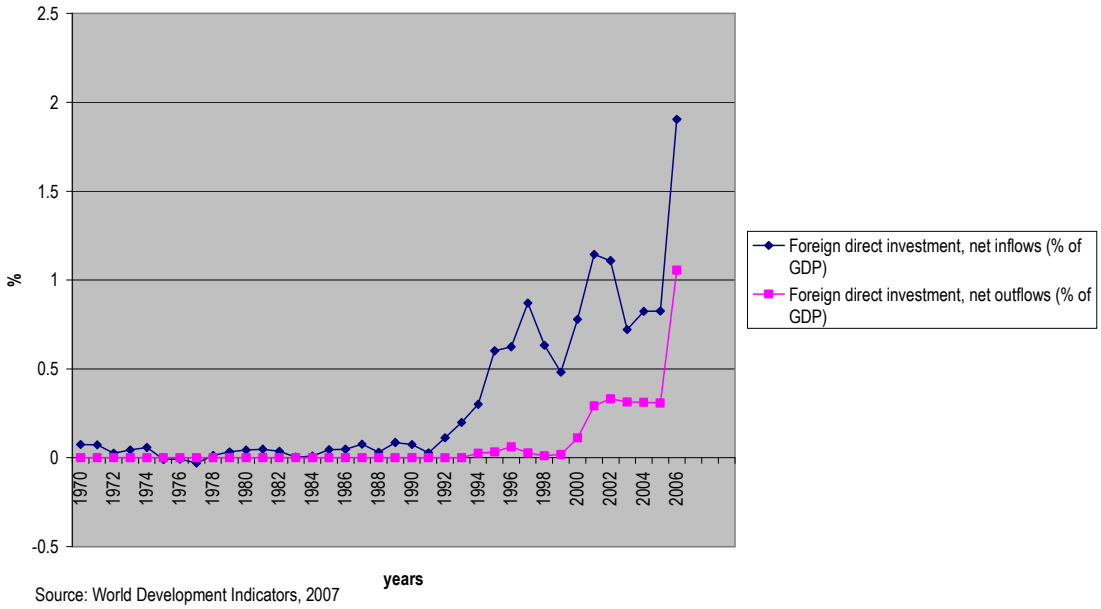
3. Foreign Direct Investment and Exports in India

Until 1990, Indian economy was characterized by severe controls and regulations on foreign capital and ownership. The adoption of controls on production of goods and services during the first three decades since independence led to the deterioration of India's competitiveness and lackluster performance in the world market. This was complemented by the adoption of policies like industrial

[3] It should be noted that their analysis, and as a consequence their econometric methodology is quite different from those of the other studies as they do not take into consideration the past export experience of firms. Indeed, their analysis is static not considering that the two aspect of export activities, namely decision and export intensity, are interrelated.

capacity licensing and regulations on capital goods imports and foreign collaborations. During the regulated regime, foreign investment was considered as a means to obtain technology previously unavailable in India. The most preferred mechanism to acquire technology during this period was through imports of capital goods and licensing agreements (Kumar 1994). However, in reality, the dirigiste regime stood as a major stumbling block in obtaining much needed modern technology. While tracing the government policies toward FDI in India, one can broadly classify the periods as pre-reform (1948-1990) and the reform period (from 1991 to present). The period from 1948 till 1990 witnessed a cautious and restrictive approach towards FDI. The pre-liberalization framework has been extensively analyzed previously by Kumar (1994). The period from the beginning of nineties witnessed the beginning of the liberal attitude towards FDI. The occurrence of the unprecedented economic crisis in 1991, forced the policy makers to transform the highly regulated regime. Accordingly, the adoption of new liberalized regime since 1991, dismantled the industrial licensing system and removed restrictions on foreign equity participation. Since its adoption, Indian economy has witnessed a large surge in FDI as it is possible to notice from Fig.1

Fig.1 India's FDI inflows and outflows (%GDP)

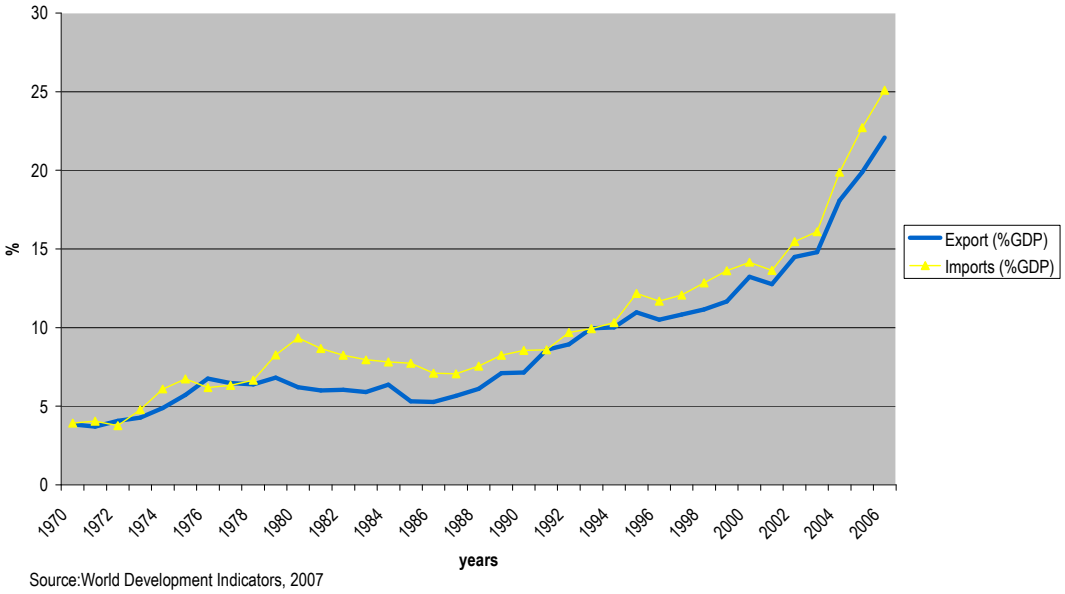


Source: World Development Indicators, 2007

In the same way, India experienced a large increase in exports and imports as well. Especially with regard to exports, it is possible to see from Fig.2 that they started rising even before the beginning of the period of great liberalization and that imports rising have been even greater across the whole span of time. It indicates that local firms drawn a lot from foreign sources both of technology and intermediate inputs. With regard to this trend, some studies have analyzed the Indian post liberalization period characterized by the grater involvement in international trade activities. Only a few papers deal with this issue: Poddar (2004) analyses the determinant of export increase by looking at the micro

foundations of export success. He finds that the increase in export intensity in Indian manufacturing is mainly due to the higher export intensity of incumbent firms rather than the entry of more export oriented firms that causes a rising of the overall export performance. In the same way Aggarwal (2002) investigates whether foreign firms or local firm perform in a different way with regard to international market. He finds that in some cases, multinational firms do not outperform local firms especially with regard to the level of technological base with which they are endowed. He concludes that India, as far as the first decade of greater economic openness, has not succeeded in attracting efficiency seeking FDI but just FDI that are more market oriented. To sum up, from these we might expect that FDI will affect more firm productivity, fostering their entrance in the export market but having less effect on the export intensity because of lower demonstration effect.

Fig.2 India's rising economic openness



Source:World Development Indicators, 2007

4. Dataset and Methodology

The empirical estimation is carried out using data coming from the PROWESS database provided by the Center for Monitoring Indian Economy (CMIE). This database contains information on more than 9000 firms registered with the Bombay Stock Exchange. However, for our study, we use data relative only to the manufacturing sector firms (Sector 15-36 in the NIC classification). At the end of the data cleaning process, we were left with a sample of 3053 firm. We built an unbalanced panel keeping only those firms with at least four consecutive observations with regard to sales, then we deleted also those sectors where the presence of foreign firms were negligible[4]. The data cover the

[2] We deleted the following sectors: 16,18,19, 20, 22,23,32,35,36

period from 1994 to 2006. For the present study, all those firms having foreign equity greater that 10%[5] of the total equity are classified as foreign firms.

The empirical model used to search for any export spillover effect draw from the empirical methodology that is recently applied to this type of studies (e.g. Greenway at al. 2004; Kneller and Pisu, 2007). As we are interested in the explanation of the export performance of firms, by using the Heckman selection model we take into account of the two stage decisional process in which firms are involved in, avoiding selectivity bias that would occur if we had considered them separately.
The two equations of the model are the following:

$$EXP_{ijt} = \alpha + ß_1K_{ijt} + ß_2Wage_{ijt} + ß_3RD_{ijt} \; ß_4Size_{ijt} + ß_5Size^2_{ijt} + ß_6Age_{ijt} + ß_7Age^2_{ijt} + ß_8Sp_{jt-1} + ß_9EXP_{ijt-1} + ß_{10}Profits_{ijt-1} + ß_{11}Sei_{jt-1} + ß_{12}Ssect_{jt-1} + \nu_i \quad \textbf{(1)}$$

$$EXPINT_{ijt} = \alpha + ß_1K_{ijt} + ß_2Wage_{ijt} + ß_3RD_{ijt} \; ß_4Size_{ijt} + ß_5Size^2_{ijt} + ß_6Age_{ijt} + ß_7Age^2_{ijt} + ß_8Sp_{jt-1} + ß_9EXP_{ijt-1} + ß_{11}Sei_{jt-1} + ß_{12}Ssect_{jt-1} + \nu_i \quad \textbf{(2)}$$

Where subscript i refers to firm, j to sectors and t to time. Moreover, $\nu_i \sim N(0,1)$ and $\upsilon_i \sim N(0,\delta)$. In the first equation the dependent variable (EXP) is a binary variable which is assigned value 1 if firms report positive exports and 0 in all the other cases. This first equation, estimated both for exporting and non exporting firms, performs the sample selection for the second model in which the depended variable that is export intensity measured as a ratio on total sales[6]. The distribution of error terms is assumed to be bivariate normal with correlation ϱ. It means that the two equations are related if $\varrho \neq 0$. It is for these reasons that estimating just the export intensity would lead to sample selection bias.

We carry out our estimation using the maximum likelihood methodology instead of the two step since it is more efficient[7].

The value of profitability ($Profits_{ijt}$) is built using profit before tax as a share in total sales by sector. This variable is a proxy of the capacity of the firm to meet the fixed cost associated with the entrance in the export market and, for this reason, discriminates between the two exports equations.

Another problem that we may need to deal with is endogeneity: in order to take into account this aspect we use the lagged depended value of the spillover variable. In this way we also account for the fact that spillovers take sometime to impact on the export status and decision of local firms.

[5] This is the standard definition adopted by IMF
[6] Sales are deflated using World Production Index at the five digit level
[7] In this last case, it is first estimated the probit of the export decision and then, after having computed the inverse Mill's ratio it is inserted inside the export ratio regression as a dependent variable.

In both models, we include two types of variables: firm's level variables and spillover variables measuring different economic activities of MNEs in the host country. In the latter case, variables are all measured at the two digit sectoral level (j) on an annual basis (t).

We also include a set of sectoral and temporal dummies to account for possible business cycle effects.

(a) *Firm level variables*

The choice of firm level variables that enter into the model are guided mainly by the consideration of the literature related to the export determinants. First, we include two proxies for age and size. The former is measured as the difference between the current year and the year of incorporation (Age_{ijt}), while the latter is built as the ratio of each firm's sales and the average sales by sector. Following the industrial organization literature, we think that older and larger plants are more likely to show higher productivity performance and thus higher exporting activity. Nevertheless, we also think that the effect produced by age and size is non-linear. In particular, advantages of size hold only to a certain extent, that is when coordination costs exceed profitability. In the same way, older firms tend to be more efficient than younger firms because of a sort of learning by doing effect, lowering distribution and production costs. However, as Power (1998) argues, age shows an inverted U shape relationship with exports as well. Accordingly, we insert a quadratic term for both variables.
The capital intensity (K_{ijt}) is added to the specification and is considered to be positively related both to decision to export and to the export intensity. It may be especially true in the case of developed countries because it embodies accumulated technological knowledge or stands for the presence of economies of scales (Wakelin, 1998). Instead, in the case of developing countries that are capital scarce the capital coefficient may turn out to be negative or insignificant. In the PROWESS database, this variable is not directly available, the capital stock is arrived at using a perpetual inventory method. We added up K_o and I_t, in which K_o is the benchmark year capital stock, which is in our case is 1994. The It value is: $It = GFA_t - GFA_{t-1}$, where GFA is gross fixed assets. In order to have the replacement cost of plant and machinery GFA of the company has been multiplied by a number which is (a) 3 if incorporation year is 1965 or earlier, (b) 2 if incorporation year is later that 1965 but earlier than 1980 and (c) 1.5 if incorporation year is later than 1980.

Moreover, as it is accounted in most of the evolutionary literature, learning is of crucial importance to the acquisition of technology. In order to effectively taking advantage of technology, firms have to hire skilled people. We use as a proxy the wage intensity ($Wage_{ijt}$) to take into account that the quality of firm workers may affect export performance (Roberts and Tybout, 1997).

In the end, we need to include a proxy for technological activities internal tot the firm. We use R&D intensity considering that the higher the technological activities the higher the export intensity

(Bleaney and Wakelin, 2002). However, it should be underlined that in the case of developing countries R&D are only a small part of the technological capability effort and for this reason it may not give the expected positive contribution to export enhancement.

(b) *Spillover variables*

As to what concern the variables related to foreign presence, we concentrate our attention in investigating the role played by the information externality. In particular we calculate the spillover variable as the ratio of MNEs exporting activities in a certain sector scaled by the relative importance of MNEs exports in total exports. However, contrary to the usual productivity spillover literature that ignores the presence of different types of FDI, we take into account MNEs heterogeneity by classifying foreign firms according to specific quality parameter that will be discussed later. In particular the approach followed is that of splitting the sample of foreign firms by considering as a cut off value the 50^{th} percentile of the sectoral distribution of the parameter that is each time used. Following this criterion, we have two measure of foreign presence SPa and SPb as given below:

$$SPa = (\sum_{\eta} Exp^{fA}_{\eta,j} / \sum Exp_{ij}) / (\sum_{\eta} Exp^{fA}_{\eta,j} + \sum_{\eta} Exp^{fb}_{\eta,j} / \sum Exp_i) \quad \textbf{(3)}$$

$$SPb = (\sum_{\eta} Exp^{fb}_{\eta,j} / \sum Exp_{ij}) / \sum_{\eta} Exp^{fA}_{\eta,j} + \sum_{\eta} Exp^{fb}_{\eta,j} / \sum Exp_i) \quad \textbf{(4)}$$

They are inserted once at a time in our baseline specifications also because considering them all together could cause some degree of collinearity as shown in the correlation matrix. In this way we estimated five different models. In each of this model, we consider two spillover variables, one of higher quality and the other of lower quality. In both equations presented above, and as it is the specification adopted in the usual spillover literature the sectoral variable that capture the foreign presence usually ignores the different quality of FDI that may be present inside the local context. The approach used to take into account of this phenomenon is that of classifying foreign firms according to a specific quality parameter and then classify firms that are above the 50^{th} percentile value considered as the cut off value. The firms that are above this cutoff value are considered of better quality.

Another issue that need to be taken into account is the fact that

We decided to focus especially on five types of heterogeneity:

1. The first is related to the technological behaviour of subsidiaries; in particular, drawing upon the literature related to FDI motivations, we divide them in two broad categories: asset exploiting vs. asset seeking FDI. In the productivity spillover literature it is not considered which may be the final effect on productivity except for the results reached by Marin and

Bell(2006) who consider that spillover effect for local firms is greater by splitting the sample into R&D intensive subsidiaries and those that do not heavily invest in R&D. In the case of export spillover, focusing only on the demonstration channel we make the hypothesis that more R&D oriented firms should provide a greater demonstration effect because they act even as a channel of R&D demonstration effect. As a matter of fact, R&D intensive subsidiaries lead to improvement of the technological efforts of local firms influencing positively both the export decision and the export intensity.

2. The second type of heterogeneity that we consider is related to the amount of royalties they pay to R&D institutions as research labs. We consider it a proxy of embeddedness inside the innovation system (IS) of the host country. In this case, the hypothesis we make is that being better interconnected inside the innovation system may lead MNEs to be more market oriented and by acquiring more local technological knowledge they provide less demonstration effect
   It is for this reason that we consider that MNEs with less level of embeddedness into the IS should have a higher potential for demonstration effect, because they are more embedded inside the technological context but they also have more technological demonstration effect.
3. The third type of heterogeneity that we analyze captures the level of embeddedness inside the production system, in particular the strength of vertical linkages. We measure this effect by considering the ratio of imported raw materials to the overall raw material expenses. In this case, it could be that a higher level of embeddedness may foster higher linkages between local and foreign firms enlarging the potential domestic market. According to this reasoning the effect of less imports of raw materials would be negative but it is counterbalance by the greater linkages between foreign and domestic firms that may foster higher demonstration effect.
4. As a fourth type of heterogeneity we consider the overall level of involvement in trade activities measure by the index: *Exports + Imports/Total Sales*. Firms that have a higher level of market orientation will have even a lower potential of influencing export performance of local firms. In particular, we consider that not only the export orientation of firms is important but also the level of imports of capital goods. In this way we take into consideration that it is the overall level of trading activities that may spur a demonstration effect to occur and that importing embodied technological knowledge may have impact even on the technological activities of local firms.
5. The last source of heterogeneity is related to the mode of entry of the subsidiaries. In particular we classify foreign firms according to the level of foreign equity share. Firms with more than 50% of foreign share equity are expected to generate a higher level of export activity because they are endowed with technology of higher quality transferred from the parent company. Moreover, they are found to have a more favourable employment impact.

As controls, we also use the lagged value of two sectoral variables: the first (Sei_{jt}) is the export share of domestic firms on total exports. It measures the importance of each sector inside the export structure of the country; by including this variable we are able to control for other variables that may affect the overall export performance and for the possibility that MNEs choose to invest in those sectors that are more export oriented. The second ($Ssect_{jt}$) is the industry size measured as the ratio of domestic sales to total sales. It accounts for possible general spillover effects that are not directly related to export activities.

5. Econometric results: MNEs heterogeneity

Tables 2 and 3 reports some descriptive statistics calculated diving the sample into foreign and local firms. At first sight we notice that MNEs do not outperform significantly domestic firms with regard to R&D confirming that MNEs choose India mainly for a market seeking motivations even though the R&D intensity has progressively risen in recent years.

Table 4 reports the estimated coefficients for export intensity or export decision. The Wald test indicates that taken jointly regressors are significant and the LR test validates the choice of the Heckman selection model.

According to our expectations, variables related to the spillover measurement are significant and have the expected signs.

The first point to be noted is that as far as the export decision is concerned, none of the spillover variables are significant even though they have the expected signs. This aspect is of particular relevance in developing countries and it is not in line with previous empirical evidence of case studies of developed countries. In the same way, both sectoral variable are insignificant, pointing to the fact that belonging to export oriented sector does not help local firms to establish their own exporting activities. Instead, the export decision depends strongly on the previous export status of the firms: it means that if a firm exports in a period it is more likely to do so in the following period. This aspect is consistent with the presence of sunk cost. The other firm level variables that increase the probability of exporting are size and age. It means that older and larger firms are more likely to export, and, moreover, the effect is non linear as expected. On the other hand, we find non significant results for the variables measuring skills intensity while a negative coefficient is shown for capital intensity: the former reflects the fact that having higher skilled workers do not affect the decision to enter the export market, while having a higher profitability appears to be decisive. The reason of the former result may be that size variable already captures this effect and especially in developing countries, capital turns out to be insignificant to meet the necessary conditions to enter into export markets. In the same way, the

role played by R&D is negligible: the reason may be that exports from Indian firms do not contain a higher level of technological level because it is the endowment of labour that affects export decision more than technology.

Passing to analyze the coefficients related of the export intensity equation, we first need to point out that firm level variables behave like in the case of export decision except for the fact that now export intensity is dependent upon skill intensity while the role played by size is not significant anymore. It is found by previous studies that in India, large firms were more market oriented while small firms had more costs to face and expanded their market abroad. This fact explain also while even the size of the domestic sector is significant, while we would expect that spillovers coming from more market oriented firms would lead to a negative sign.

Considering specifically the spillover variables, the first measures heterogeneity at the level of the asset seeking vs asset motivation choice or at the level of the technological intensity of the subsidiaries. We found that only the spillover variable built considering FDI of higher quality were positive and significant. It indicates that a greater demonstration effect comes from the asset seeking motivations: the reason is that more R&D intensive behaviour on the part of the MNEs have a positive effect not directly on exports but on the technological level of the firms leading in turn to higher level of exports.

With regard to the spillover variables related to the embeddedness inside the IS, we see that only those MNEs that have less linkages are more able to convey information externalities to local firms. This result reflects two types of arguments: the first is that they are more market oriented firms, in this way causing a lower demonstration export effect. On the other hand, it also means that they rely more on their internal technological capabilities that may exert a positive influence on the technological capabilities of domestic firms.

Considering the third type of heterogeneity, we recognize that only those MNEs having a lower import intensity of raw materials causes a positive and significant impact on export intensity of local firms: it is a proof of the fact that do not using a higher level of local raw materials enable foreign firms to the demonstration effect to occur. A higher level of involvement inside trade network turn out to positive influence export performance of local firms mainly because they are endowed with higher potential demonstration effect both on exporting and importing side. As a matter of fact, it has been found that both learning by importing and self selection hypotheses are valid, because importing implies that sunk costs are present even for the importing activities. At last, we found that those MNEs with a higher foreign equity share are more able to convey export spillover because of the higher quality of the technology transferred from parent company. Another type of explanation may lay in the fact that MNEs with higher equity shares are more export oriented and even though that may have a

negative impact on productivity (as found in the productivity spillover literature), it is counterbalanced by the higher effect reported for information externalities.

6. Econometric results: local firm heterogeneity

In all previous studies carried out on this issue, it has been accounted for the different export behaviour of exporting firms considering just the technological behaviour of firms: those that are more R&D intensive will have more chances of investing abroad. In most of the papers coming from developed countries it is found that R&D intensity is considered one of the most important determinants of export behaviour. However, we have recognized that firms with both large and small R&D intensities both in low and high tech sectors. For this reason, the division according to technology intensity of sectors is not significant in order to understand how the heterogeneity of foreign and local firms interact.

However, as suggested above, the role of other types of firm level heterogeneity are not considered. For example, it is possible that firms that do have higher linkages with the institutions of the innovation system are more able to have a solid technological base to start exporting: however, these results depend also on the fact that firms may have contacts with different institutions that are more or less effective. This aspect is of particular importance in a developing country perspective in which the role of certain institutions is not so effective as in developed countries.

In order to have a more precise picture we looked at the sectoral distribution of measures such as R&D intensity, royalties intensity and the degree of involvement in trade networks splitting the sample according to whether firms are part of the upper or lower part of the distribution.

We first discuss the results to the firms that are part of the former category. We first need to notice that in all three subgroups for the export decision equation it is found that the role of technological imports is of particular importance among the firm level variables. It reveals that even though the internal R&D capabilities are not significant to exports, technology coming from external sources may be more relevant. Instead, with regard to export intensity mainly wage or capital are significant to explain the higher export performances.

Passing to consider the single categories, we first start from R&D heterogeneity. In that case we should consider the fact that only spillover coming from R&D and foreign equity of lower quality are important in explaining spillover effect: we explain this effect by arguing that it is more likely that firms with higher R&D intensities are closer to the level of technologies of foreign firms and for this reason they grasp easier the spillover effect.

Of particular relevance is the case of firms that are more embedded inside IS. They are more able to grasp even those spillover effects coming from those MNEs that are more embedded into the production system. This reflects the fact that MNEs source their inputs abroad in this way helping firms to establish their own imports network needed in order to start exporting. We should remember

that even the ability of importing may involve sunk cost. This aspect is reinforced by the fact that export decision is triggered especially by high quality FDI related to trade activities. As a matter of fact, it should be considered that there are more positive and significant results in this case because firms are acquiring more technology from the system and for this reason they are more able to decide to start exporting rather than in the previous case.

Instead, passing to examine the case of firms belonging to the lower part of the distribution, we can find that, contrary to expectations, the most important aspect for export decision is R&D intensity instead of technological imports. It means that those firms accordingly do not possess the suitable import capacity that may improve their technological base.

Considering the significance of spillover variables, we can find that the spillover effect coming from FDI with greater linkages with the innovation system is always positive and significant: it is due to the fact that innovation system provide the necessary skills needed to enter in the export market. This is especially true for those firms that have less linkages with innovation system: in this case it is due to the fact that internal resources like R&D are more important and that it is not the connection that counts but just the fact that each MNEs have a better demonstration effect.

6. Conclusions

The literature about spillover effects coming from FDI has reached only inconclusive and mixed results. However, very few studies take into account the possibility that the effect of MNEs on local firms may be related also to exports. In particular, papers that examine developing countries are scarce almost non-existent.

In order to fill this gap, we have attempted to examine the export spillovers from MNEs based on a firm level data for the Indian manufacturing industries during the period 1994-2006 using a proper estimation methodology. India is worth exploring as a case study because of the large overall export growth since the trade reforms started in 1991 that improved the level of international economic openness.

Unlike previous empirical studies we take into consideration one important aspect that is neglected in usual analysis that is the MNEs heterogeneity combined in the second step of the analysis with the local firms heterogeneity across dimension that goes beyond the usual foreign orientation or the regional concentration.

The main significant results we get are relative to the fact that different types of MNEs have influences only on the export intensity of firms but not on the export decision. This is may be due to

the fact that we only considered heterogeneity according to the demonstration effect and that the different types of firms are so heterogeneous from the firm level variables that the final effect on export decision equation is blurred.

Some other important results need to be underlined: they are relative to the fact that when considering local firm heterogeneity MNEs affect even the export decision. In this we have given evidence that the role heterogeneity on both sides of the spillover mechanism is of particular relevance: indeed, the combination of the two heterogeneity may give rise to results that confirm that according to the sample considered MNEs may act both on export decisions and on export intensity.

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Appendix

Tab. 1. Data Overview

NIC Code	Industry Classification	All Firms	%Foreign firms
15	Food Products and Beverages	423	3,22
17	Textiles	331	1,84
21	Paper and Paper Products	108	4,85
24	Chemicals and Chemical, Products	708	6,78
25	Rubber and Plastic Products	225	7,14
26	Other Non-Metallic Mineral Products	125	8,69
27	Basic Metals	347	2,96
28	Fabricated Metal Products	106	2,91
29	Machinery and equipment	223	14,94
31	Electrical Machinery and Apparatus	121	10
32	Radio, Television and Communication Equipment	91	10,97
33	Medical, Precision and Optical Instruments, Watches and Clocks	46	17,94
34	Motor Vehicles	196	12
	Total	3053	

Source: Author's calculation on the base of PROWESS database

Tab.2 Descriptive statistics

		expint	rdint	sales	wageint
Local firms	mean	41.8644	1.035303	0.700822	14.8196
	sd	429.6299	14.47106	2.647787	62.59065
	Obs.	25353	25353	25353	25353
Foreign firms	mean	61.60259	3.03639	1.827108	19.18045
	sd	518.8091	50.95034	5.336116	82.81653
	Obs.	2281	2281	2281	2281

Tab. 3 Correlation matrix

	expspillrda	expspillrdb	expspillroa	expspillrob	expspillimpa	expspillimpb	expspilltra	expspilltrb	expspilleqa	expspilleqb
expspillrda	1									
expspillrdb	0.0293	1								
expspillroa	0.0969	0.3325	1							
expspillrob	-0.1658	0.251	-0.137	1						
expspillimpa	0.1442	0.5384	0.8738	0.09	1					
expspillimpb	-0.2133	0.0581	0.2811	0.6848	0.1364	1				
expspilltra	-0.0245	0.4147	0.8193	0.4435	0.8318	0.6577	1			
expspilltrb	0.186	0.4324	0.1839	0.1404	0.2184	0.1424	0.1679	1		
expspilleqa	-0.0815	0.2642	0.8144	0.2988	0.7403	0.6153	0.905	0.174	1	
expspilleqb	0.1673	0.3825	-0.0395	0.3142	0.1657	0.0563	0.1473	0.1472	-0.2807	1

Tab. 4 Results for MNEs heterogeneity

	(1) Export int.	(2) Export dec.	(3) Export int.	(4) Export dec.	(5) Export int.	(6) Export dec.	(7) Export int.	(8) Export decision	(9) Export int.	(10) Export dec.
kint	-0.00498	-0.00004***	-0.00497	-0.00004***	-0.00498	-0.00004***	-0.00496	-0.00004***	-0.00498	-0.00004***
	(0.23)	(3.31)	(0.23)	(3.31)	(0.23)	(3.30)	(0.23)	(3.31)	(0.23)	(3.31)
wageint	4.14405**	0.00011	4.13840**	0.00011	4.13809**	0.00011	4.13795**	0.00011	4.13857**	0.00010
	(2.44)	(0.43)	(2.44)	(0.42)	(2.44)	(0.42)	(2.44)	(0.43)	(2.44)	(0.40)
rdint	9.28170	0.00466	9.28534	0.00463	9.28375	0.00461	9.28623	0.00464	9.28570	0.00464
	(1.13)	(1.55)	(1.13)	(1.55)	(1.13)	(1.54)	(1.13)	(1.55)	(1.13)	(1.55)
age	-3.58827***	0.00466**	-3.59052***	0.00462**	-3.59368***	0.00460**	-3.58011***	0.00462**	-3.59046***	0.00466**
	(2.82)	(2.48)	(2.83)	(2.46)	(2.83)	(2.45)	(2.82)	(2.46)	(2.82)	(2.48)
agesq	0.02068**	-0.00004*	0.02068**	-0.00004*	0.02072**	-0.00004*	0.02055**	-0.00004*	0.02068**	-0.00004*
	(2.36)	(1.86)	(2.36)	(1.84)	(2.37)	(1.84)	(2.36)	(1.84)	(2.36)	(1.85)
size	-1.76122	0.23111***	-1.63033	0.23116***	-1.65152	0.23112***	-1.67383	0.23121***	-1.66529	0.23097***
	(0.84)	(9.81)	(0.77)	(9.82)	(0.78)	(9.83)	(0.79)	(9.82)	(0.79)	(9.80)
sizesq	0.03008	-0.00213***	0.02845	-0.00213***	0.02889	-0.00213***	0.02926	-0.00213***	0.02922	-0.00213***
	(1.23)	(10.02)	(1.15)	(10.03)	(1.18)	(10.05)	(1.20)	(10.03)	(1.19)	(10.02)
	(0.49)	(1.23)								
sei	568.00469**	0.18648	791.42951***	0.08782	773.68990***	0.19253	730.35554***	0.05184	723.06182***	0.17839
	(2.41)	(0.40)	(3.00)	(0.19)	(2.97)	(0.42)	(2.83)	(0.11)	(2.76)	(0.39)
sect	528.30986*	-0.04107	723.49714**	0.01481	703.67158**	0.11305	698.15580**	0.04295	710.53069**	-0.17529
	(1.76)	(0.05)	(2.13)	(0.02)	(2.14)	(0.14)	(2.09)	(0.05)	(2.13)	(0.21)
expint	0.02457		0.02440		0.02432		0.02443		0.02444	
	(1.55)		(1.54)		(1.54)		(1.54)		(1.54)	
exportdec		2.50442***		2.50421***		2.50443***		2.50417***		2.50461***
		(87.27)		(87.41)		(87.43)		(87.38)		(87.45)
profitint		0.00037***		0.00037***		0.00037***		0.00037***		0.00037***
		(4.40)		(4.40)		(4.41)		(4.40)		(4.40)
ExpEQA									53.26713**	-0.04884
									(2.22)	(0.85)
ExpEQB									22.97829	0.08580
									(0.86)	(1.03)
ExpTRA							48.34337**	-0.00907		
							(2.15)	(0.18)		
ExpTRB							-47.44527	-0.12557		
							(0.78)	(0.25)		
ExpIMPA					31.21966	-0.06817				
					(1.29)	(1.02)				
ExpIMPB					66.76367***	0.06469				
					(2.75)	(0.82)				
ExpROA			28.70085	-0.02835						
			(1.54)	(0.48)						
ExpROB			90.15800**	-0.00743						
			(2.24)	(0.09)						
EpRDA	3.59301**	-0.00086								
	(2.06)	(0.33)								
ExpRDB	11.32393	0.12253								
Obs.	21332	21332	21332	21332	21332	21332	21332	21332	21332	21332

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Tab. 5 Results for local firms' heterogeneity – R&D (lower part of distribution)

	(1) Export int.	(2) Export dec.	(3) Export int.	(4) Export dec.	(5) Export int.	(6) Export dec.	(7) Export int.	(8) Export dec.	(9) Export int.	(10) Export dec.
kint	0.00303	-0.00002*	0.00332	-0.00002*	0.00331	-0.00002*	0.00332	-0.00002*	0.00330	-0.00002*
	(0.23)	(1.77)	(0.25)	(1.75)	(0.25)	(1.76)	(0.25)	(1.77)	(0.25)	(1.77)
wageint	4.11739***	0.00020	4.09512***	0.00020	4.10297***	0.00020	4.10096***	0.00020	4.10033***	0.00021
	(4.40)	(0.66)	(4.38)	(0.66)	(4.38)	(0.68)	(4.38)	(0.68)	(4.37)	(0.71)
rdint	-31.66094	0.54777***	-32.95562	0.53859***	-32.45883	0.54665***	-32.47980	0.54681***	-32.44851	0.54699***
	(0.83)	(3.24)	(0.87)	(3.22)	(0.86)	(3.24)	(0.86)	(3.24)	(0.85)	(3.24)
techint	-14.67695**	0.00618	-14.90650**	0.00623	14.82798**	0.00629	-14.87376**	0.00625	-14.90172**	0.00628
	(2.12)	(1.26)	(2.12)	(1.27)	(2.11)	(1.28)	(2.11)	(1.27)	(2.11)	(1.27)
impint	2.57866***	-0.00008	2.60980***	-0.00008	2.60042***	-0.00008	2.61550***	-0.00008	2.61821***	-0.00008
	(2.91)	(0.42)	(2.89)	(0.46)	(2.89)	(0.45)	(2.89)	(0.44)	(2.89)	(0.45)
age	-1.78852***	0.00223	-1.71299***	0.00186	-1.65967***	0.00200	-1.50483***	0.00201	-1.53149***	0.00202
	(2.83)	(0.95)	(2.80)	(0.79)	(2.75)	(0.85)	(2.66)	(0.85)	(2.71)	(0.86)
agesq	0.00518	-0.00003	0.00365	-0.00003	0.00326	-0.00003	0.00176	-0.00003	0.00187	-0.00003
	(0.79)	(1.14)	(0.58)	(1.01)	(0.52)	(1.06)	(0.29)	(1.07)	(0.31)	(1.04)
size	-18.65976***	0.38766***	-18.20251***	0.37834***	-17.59954***	0.38332***	-16.81742***	0.38451***	-16.64904***	0.38469***
	(4.21)	(11.52)	(4.27)	(11.30)	(4.15)	(11.42)	(3.98)	(11.45)	(3.95)	(11.48)
sizesq	0.97955***	-0.01663***	0.99062***	-0.01620***	0.95833***	-0.01644***	0.91645***	-0.01650***	0.91459***	-0.01649***
	(4.13)	(9.74)	(4.22)	(9.51)	(4.13)	(9.64)	(3.99)	(9.68)	(3.99)	(9.68)
sei	368.13155***	1.45459***	345.52096***	1.54366***	348.22516***	1.45155***	319.00572***	1.41938***	294.08370***	1.43609***
	(3.78)	(5.35)	(3.30)	(5.39)	(3.22)	(5.09)	(3.20)	(4.94)	(3.04)	(5.14)
ssect	-355.41103***	-1.78381***	0.25104	-1.82826***	-95.67872	-1.93699***	-132.83531	-1.92464***	-101.11697	-1.93073***
	(2.84)	(4.05)	(0.00)	(4.02)	(0.99)	(4.27)	(1.31)	(4.15)	(1.01)	(4.27)
expint	0.11071***		0.11155***		0.11231***		0.11275***		0.11265***	
	(2.97)		(3.02)		(3.02)		(3.05)		(3.05)	
exportdec		2.47130***		2.47046***		2.47233***		2.47309***		2.47361***
		(79.93)		(79.91)		(79.98)		(80.03)		(80.03)
profitint		0.00041***		0.00040***		0.00040***		0.00040***		0.00040***
		(3.84)		(3.78)		(3.80)		(3.81)		(3.79)
ExpEQA									-10.93140	0.01871
									(1.63)	(0.63)
ExpEQB									-21.02571	0.06686
									(0.97)	(1.08)
ExpTRA							-13.14023**	0.02178		
							(1.99)	(0.73)		
ExpTRB							116.30253	0.01099		
							(1.51)	(0.03)		
ExpIMPA					16.82038	0.03726				
					(0.92)	(0.93)				
ExpIMPb					-56.57765***	-0.00301				
					(3.23)	(0.06)				
ExpROA			7.91412	0.05848*						
			(0.61)	(1.66)						
ExpROB			-61.45108***	-0.06544						
			(3.69)	(1.26)						
ExpRDA	24.35362**	-0.00364*								
	(2.15)	(1.83)								
ExpRDB2	-32.87785*	0.17551**								
	(1.69)	(2.05)								
Obs.	13624	13624	13624	13624	13624	13624	13624	13624	13624	13624

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Tab. 6 Results for local firms' heterogeneity – R&D (upper part of distribution)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Export int.	Export dec.	Export int.	Export dec.	Export int.	Export dec.	Export int.	Export dec.	Export int.	Export dec.
kint	-0.03062	-0.00011	-0.03053	-0.00011	-0.03063	-0.00011	-0.03081	-0.00011	-0.03038	-0.00011
	(0.92)	(1.11)	(0.91)	(1.11)	(0.91)	(1.11)	(0.92)	(1.10)	(0.92)	(1.12)
wageint	4.16155*	0.00053	4.15656*	0.00051	4.15738*	0.00050	4.16002*	0.00051	4.15578*	0.00052
	(1.74)	(0.25)	(1.74)	(0.24)	(1.74)	(0.24)	(1.74)	(0.24)	(1.75)	(0.25)
rdint	9.08567	0.00583	9.07421	0.00570	9.07173	0.00568	9.07630	0.00566	9.07356	0.00573
	(1.16)	(0.40)	(1.16)	(0.39)	(1.16)	(0.39)	(1.16)	(0.39)	(1.16)	(0.39)
techint	-2.59315	0.00238*	-2.57643	0.00230	-2.57793	0.00229	-2.58789	0.00229	-2.58474	0.00251*
	(0.91)	(1.70)	(0.90)	(1.60)	(0.91)	(1.60)	(0.91)	(1.59)	(0.90)	(1.76)
impint	2.41247	0.00006	2.41071	0.00007	2.41242	0.00007	2.41842	0.00007	2.41506	0.00003
	(1.17)	(0.24)	(1.17)	(0.26)	(1.17)	(0.25)	(1.17)	(0.25)	(1.17)	(0.13)
age	-4.53269	0.00406	-4.47096	0.00414	-4.50989	0.00412	-4.42035	0.00406	-4.51943	0.00379
	(1.23)	(1.00)	(1.22)	(1.00)	(1.24)	(1.00)	(1.23)	(0.98)	(1.24)	(0.91)
agesq	0.03449	-0.00004	0.03385	-0.00004	0.03411	-0.00004	0.03325	-0.00004	0.03388	-0.00004
	(1.17)	(1.06)	(1.16)	(1.09)	(1.17)	(1.10)	(1.16)	(1.07)	(1.19)	(0.90)
size	0.71058	0.11568***	0.88706	0.11519***	0.81928	0.11491***	0.75656	0.11538***	0.78055	0.11408***
	(0.16)	(4.02)	(0.20)	(4.02)	(0.19)	(4.03)	(0.17)	(4.04)	(0.18)	(3.93)
sizesq	-0.00569	-0.00104***	-0.00610	-0.00103***	-0.00532	-0.00103***	-0.00473	-0.00104***	-0.00451	-0.00103***
	(0.11)	(4.05)	(0.12)	(4.06)	(0.11)	(4.07)	(0.09)	(4.07)	(0.09)	(4.00)
sei	432.38598**	0.36231	321.42505	0.37226	349.08351	0.51794	375.94593*	0.38656	354.72152	0.49693
	(2.56)	(0.72)	(1.48)	(0.63)	(1.61)	(0.90)	(1.79)	(0.71)	(1.52)	(0.89)
ssect	-467.47646***	0.36190	-409.71649**	0.19768	-397.16347**	0.21217	-386.07359**	0.19795	-376.56089**	0.09089
	(3.19)	(0.48)	(2.36)	(0.25)	(2.33)	(0.27)	(2.24)	(0.25)	(2.05)	(0.12)
expint	0.01088		0.01077		0.01078		0.01086		0.01081	
	(1.12)		(1.11)		(1.11)		(1.13)		(1.12)	
exportdec		2.42136***		2.42495***		2.42458***		2.42600***		2.41922***
		(5.15)		(5.29)		(5.37)		(5.35)		(5.17)
profitint		0.00091		0.00090		0.00089		0.00089		0.00092
		(0.88)		(0.87)		(0.87)		(0.87)		(0.88)
ExpEQA									-13.35743	0.03365
									(0.80)	(0.66)
ExpEQB									-35.58905	0.33218***
									(0.54)	(3.55)
ExpTRA							-17.02723	0.04863		
							(0.85)	(0.92)		
ExpTRB							177.55842	-0.13776		
							(1.26)	(0.39)		
ExpIMPA					-21.32136	0.08897				
					(0.93)	(1.35)				
ExpIMPB					-1.08547	-0.03470				
					(0.05)	(0.49)				
ExpROA			-19.60623	0.03958						
			(1.06)	(0.72)						
ExpROB			6.40760	0.04819						
			(0.25)	(0.59)						
ExpRDA	22.25767	0.00154								
	(1.32)	(0.24)								
ExpRDB2	32.15389	0.27281**								
	(1.31)	(2.29)								
Obs.	7708	7708	7708	7708	7708	7708	7708	7708	7708	7708

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Tab. 7 Results for local firms' heterogeneity – Royalties (lower part of distribution)

	(1) Export int.	(2) Export dec.	(3) Export int.	(4) Export dec.	(5) Export int.	(6) Export dec.	(7) Export int.	(8) Export dec.	(9) Export int.	(10) Export dec.
kint	-0.01371	-0.00004***	-0.01314	-0.00004***	-0.01313	-0.00004***	-0.01318	-0.00004***	-0.01326	-0.00004***
	(0.55)	(3.02)	(0.53)	(3.02)	(0.53)	(3.02)	(0.53)	(3.04)	(0.53)	(3.03)
wageint	5.29959**	-0.00002	5.27972**	-0.00001	5.28181**	-0.00001	5.28282**	-0.00001	5.28122**	-0.00000
	(2.35)	(0.06)	(2.34)	(0.03)	(2.34)	(0.02)	(2.34)	(0.03)	(2.34)	(0.00)
rdint	9.56035	0.00781*	9.53759	0.00790*	9.54145	0.00778*	9.53534	0.00764*	9.53220	0.00773*
	(1.12)	(1.72)	(1.12)	(1.75)	(1.12)	(1.74)	(1.12)	(1.71)	(1.12)	(1.73)
techint	-4.49740	-0.00043	-4.48065	-0.00044	-4.48264	-0.00039	-4.49276	-0.00042	-4.47604	-0.00036
	(1.63)	(0.18)	(1.63)	(0.18)	(1.63)	(0.17)	(1.63)	(0.17)	(1.62)	(0.16)
impint	3.12289*	0.00016	3.14013*	0.00016	3.13927*	0.00016	3.14830*	0.00016	3.14285*	0.00015
	(1.73)	(1.42)	(1.72)	(1.43)	(1.73)	(1.41)	(1.73)	(1.45)	(1.73)	(1.39)
age	-4.42163***	0.00320	-4.32674***	0.00297	-4.30699***	0.00304	-4.18153***	0.00287	-4.27344***	0.00296
	(2.88)	(1.46)	(2.90)	(1.36)	(2.87)	(1.39)	(2.85)	(1.31)	(2.86)	(1.35)
agesq	0.02750**	-0.00004*	0.02585**	-0.00004	0.02570**	-0.00004	0.02459**	-0.00004	0.02549**	-0.00004
	(2.55)	(1.69)	(2.53)	(1.60)	(2.49)	(1.62)	(2.45)	(1.54)	(2.47)	(1.53)
size	-2.81121	0.27280***	-2.23689	0.27038***	-1.90092	0.27184***	-2.21263	0.27381***	-2.03973	0.27181***
	(0.94)	(11.05)	(0.72)	(11.02)	(0.60)	(11.05)	(0.72)	(11.08)	(0.65)	(11.05)
sizesq	0.03839	-0.00243***	0.03263	-0.00241***	0.02893	-0.00242***	0.03432	-0.00244***	0.03062	-0.00242***
	(1.19)	(10.75)	(0.97)	(10.72)	(0.83)	(10.75)	(1.03)	(10.79)	(0.88)	(10.75)
sei	252.35090**	1.18693***	169.04696	1.36240***	178.00774	1.26756***	197.28577	1.09164***	147.47814	1.25984***
	(2.20)	(4.56)	(1.13)	(4.95)	(1.27)	(4.66)	(1.50)	(3.98)	(1.07)	(4.74)
ssect	-353.13394***	-1.02264**	-42.43832	-1.12471***	-79.62462	-1.24789***	-165.24083	-1.03703**	-97.51941	-1.25270***
	(2.75)	(2.51)	(0.40)	(2.66)	(0.75)	(2.95)	(1.55)	(2.39)	(0.91)	(2.97)
lexpint	0.01747		0.01787		0.01798		0.01788		0.01783	
	(1.39)		(1.40)		(1.41)		(1.40)		(1.40)	
lexportdec		2.48327***		2.48196***		2.48424***		2.48529***		2.48517***
		(60.39)		(60.91)		(61.47)		(61.95)		(61.79)
profitint		0.00035***		0.00035***		0.00035***		0.00035***		0.00035***
		(3.88)		(3.80)		(3.82)		(3.84)		(3.82)
ExpEQA									-18.01734	0.03456
									(1.46)	(1.19)
ExpEQB									-9.97729	0.10383*
									(0.36)	(1.75)
ExpTRA							-20.91695	0.04809*		
							(1.61)	(1.66)		
ExpTRB							308.01117**	-0.73027**		
							(2.21)	(1.99)		
ExpIMPA					1.34767	0.05672				
					(0.08)	(1.44)				
ExpIMPB					-45.16618*	0.01293				
					(1.87)	(0.29)				
ExpROA			-9.08568	0.07572**						
			(0.61)	(2.16)						
ExpROB			-38.19424	-0.04749						
			(1.36)	(0.98)						
ExpRDA	25.27468***	-0.00397*								
	(2.71)	(1.91)								
ExpRDB	2-22.37805	0.15525*								
	(0.71)	(1.81)								
Obs.	15214	15214	15214	15214	15214	15214	15214	15214	15214	15214

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Tab. 8 Results for local firms' heterogeneity – Royalties (upper part of distribution)

	(1) Export int.	(2) Export dec.	(3) Export int.	(4) Export dec.	(5) Export int.	(6) Export dec.	(7) Export int.	(8) Export dec.	(9) Export int.	(10) Export dec.
kint	0.01875*	-0.00003*	0.01840*	-0.00003	0.01842*	-0.00003	0.01845*	-0.00003*	0.01853*	-0.00003*
	(1.75)	(1.75)	(1.73)	(1.60)	(1.73)	(1.63)	(1.73)	(1.65)	(1.73)	(1.70)
wageint	1.31230***	0.00002	1.30887***	0.00003	1.30825***	0.00003	1.30804***	0.00004	1.30930***	0.00002
	(3.24)	(0.05)	(3.22)	(0.05)	(3.22)	(0.05)	(3.22)	(0.09)	(3.22)	(0.04)
rdint	2.37316	0.00107	2.41738	0.00097	2.41997	0.00096	2.41655	0.00097	2.41211	0.00098
	(1.21)	(0.47)	(1.23)	(0.43)	(1.23)	(0.43)	(1.23)	(0.43)	(1.23)	(0.44)
techint	-1.99741*	0.01768***	-1.98447*	0.01721***	-1.98256*	0.01719***	-1.98475*	0.01738***	-1.98358*	0.01717***
	(1.74)	(3.30)	(1.73)	(3.22)	(1.73)	(3.23)	(1.73)	(3.26)	(1.73)	(3.17)
impint	0.06213	-0.00072**	0.06460	-0.00073**	0.06384	-0.00073**	0.06457	-0.00073**	0.06837	-0.00074**
	(0.30)	(2.39)	(0.31)	(2.45)	(0.31)	(2.47)	(0.31)	(2.46)	(0.33)	(2.48)
age	-1.60536***	0.00983***	-1.56217***	0.00967***	-1.54943***	0.00933***	-1.54369***	0.00966***	-1.55981***	0.00969***
	(4.53)	(2.80)	(4.38)	(2.73)	(4.34)	(2.64)	(4.30)	(2.72)	(4.34)	(2.74)
agesq	0.00965***	-0.00007*	0.00899***	-0.00007*	0.00891***	-0.00007*	0.00889***	-0.00007*	0.00908***	-0.00007*
	(2.83)	(1.95)	(2.63)	(1.87)	(2.60)	(1.79)	(2.59)	(1.84)	(2.64)	(1.85)
size	-4.34379***	0.15467***	-4.60528***	0.15710***	-4.60070***	0.15531***	-4.57531***	0.15480***	-4.47196***	0.15476***
	(5.06)	(4.52)	(5.17)	(4.60)	(5.18)	(4.62)	(5.16)	(4.60)	(5.00)	(4.51)
sizesq	0.06596***	-0.00204***	0.06968***	-0.00208***	0.06967***	-0.00206***	0.06946***	-0.00206***	0.06811***	-0.00206***
	(4.97)	(4.46)	(5.18)	(4.54)	(5.19)	(4.56)	(5.18)	(4.55)	(5.03)	(4.46)
	(0.91)	(3.58)								
sei	425.17958***	0.92566*	366.61159***	1.02523*	359.17847***	1.21989**	353.24201***	1.24356**	345.47460***	1.30296**
	(4.94)	(1.91)	(3.80)	(1.91)	(3.95)	(2.32)	(3.98)	(2.41)	(3.90)	(2.52)
ssect	-438.86562***	-0.14907	-327.57383***	-0.98474	-332.62945***	-0.89568	-336.90489***	-0.82001	-327.02268***	-0.95164
	(3.57)	(0.18)	(2.90)	(1.18)	(2.87)	(1.08)	(2.81)	(0.98)	(2.77)	(1.14)
lexpint	0.11236***		0.11070***		0.11081***		0.11085***		0.11055***	
	(5.30)		(5.28)		(5.29)		(5.29)		(5.28)	
lexportdec		2.62830***		2.62891***		2.62941***		2.62977***		2.63104***
		(52.12)		(52.19)		(52.22)		(52.22)		(52.19)
profitint		0.00040**		0.00040**		0.00040**		0.00040**		0.00039**
ExpEQA									-15.72064***	0.09842**
									(3.21)	(2.28)
ExpEQB									-30.30777***	0.34262***
									(2.78)	(3.73)
ExpTRA							-15.78054***	0.09535**		
							(3.17)	(2.15)		
ExpTRB							-22.20541	0.71715		
							(0.80)	(1.61)		
ExpIMPA					-13.40095**	0.09917*				
					(2.47)	(1.66)				
ExpIMPB					-20.26270**	0.12076				
					(2.03)	(1.42)				
ExpROA			-13.76265***	0.07704						
			(3.02)	(1.55)						
ExpROB			-22.39582**	0.20963**						
ExpRDA	20.71737*	-0.00525*								
	(1.67)	(1.70)								
ExpRDB	2-12.70219	0.37930***								
			(1.97)	(2.51)						
Obs.	6118	6118	6118	6118	6118	6118	6118	6118	6118	6118

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%