FDI and Spillovers in Switzerland: Interaction Effects between Spillover Mechanisms and Domestic Technological Characteristics

Lamia Ben Hamida and Philippe Gugler*

Faculty of Economics and Social Sciences of the University of Fribourg

and World Trade Institute Berne , Switzerland

lamia.benhamida@unifr.ch; philippe.gugler@unifr.ch

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Abstract

This paper examines intra-industry spillovers from foreign direct investment (FDI) in Swiss manufacturing firms. It suggests that (a) the assessment of spillover benefits calls upon a detailed analysis of those effects according to their ways of occurrence (viz. the increase of competition, demonstration effects, and worker mobility). (b) The size and the extent of spillovers depend upon the interaction between the channels by which they occur and the existing technological capacities of domestic firms. And (c) only domestic firms which largely invest in absorbing foreign technology are likely to benefit from spillovers. Regression results are affirmative in that domestic firms with high technological capacity appear to gain benefit from spillovers from FDI heightening competition, while mid technology firms benefit a lot from demonstration effects. Yet, low technology firms which are not able to benefit from foreign affiliates via demonstration effects alone, manage to reap the spillover benefits via the recruitment of MNCs labor that can help them to successfully imitate foreign knowledge. The results also demonstrate that only domestic firms which largely invest in the absorptive capacity benefit from FDI spillovers, which mainly result from the technology transfer.

Keywords: FDI; Inra-industry spillovers; Demonstration effects; Competition effects; Worker mobility; Absorptive capacity

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1. Introduction

Foreign direct investment is increasingly considered to be the main conduit of new technologies between countries – the creation, diffusion, and commercialization of technological innovations is one of the main characteristics of MNCs (Dunning and Gugler, 1994). It is argued that inward FDI is the principle source of positive spillovers for host economies (Dunning 1992 and Buckley et al. 2003). Many governments around the globe have liberalized their FDI regulations since the early 1980's and are now actively providing generous investment incentives to attract inward FDI (UNCTAD, 2003). While the expected potential benefits include among others, employment creation, capital formation, export promotion, etc., the main motivation for these policies often stems from the expectation of FDI spillovers resulting in productivity enhancement of domestic firms. In fact, MNCs are assumed to possess a countervailing advantage over the domestic firms in host countries (Hymer, 1960, 1968) since they use advanced technology in production, marketing, management, etc. which makes them more efficient than domestic firms (Dunning and Rugman, 1985). Such advanced technology may spill over to domestic firms allowing them to improve their performance.

Generally, spillovers are said to take place when the entry and the presence of MNC affiliates lead to efficiency benefits in the host country's local firms and the MNCs are not able to internalize the full value of these benefits (Blomström and Kokko, 1998). Spillovers are assumed to occur through four channels, viz. demonstration effects, competition effects, worker mobility, and backward-forward linkages. Although the effects via the last channel are also of a great importance and worthy to be explored, we focus in this paper on studying the intra-industry spillovers.

The number of empirical studies assessing the incidence of intra-industry spillovers to local firms is fast growing. Nonetheless, despite the policy relevance spillover effects of FDI on host economies are not well understood. So far, results have been mixed for both developed and developing countries and evidence on spillovers has not been conclusive yet.[1] One of the reasons is that the share of foreign to total sectorial activity (e.g. foreign employment/sales share) that has been by and large used by scholars to measure spillover benefits does not seem

[1] A meta-analysis of spillover studies is presented in Meyer and Sinani (2005).

appropriate to capture much of competition (Kokko, 1996) and worker mobility (Ben Hamida, 2006a), it can only hold the whole information about spillovers through demonstration effects. Thereby, the assessment of spillover benefits needs to disentangle the effect of competition effects and worker mobility from that of demonstration effects by employing different control variables. Doing so, the precise process of spilling-over will be correctly described in a more satisfactory model and then the impact of this process will be exactly identified.

Other reason for the apparently contradictory findings from the country studies is that domestic absorptive capacity may influence the incidence of spillovers (Wang and Blomström, 1992 and Perez, 1998), in which only firms with high level of absorptive capacity are likely to benefit from FDI spillovers whereas insufficient absorptive capacity may hinder critical learning processes at the firm which in turn could not exploit the technological opportunities arising from foreign presence (Cohen and Levinthal, 1989). The firm's level of absorptive capacity depends upon its existing level of technological competence as well as its learning and investment efforts undertaken to be able to use productively foreign knowledge. This theoretical argument has been broadly taken into account by most empirical studies so as to be able to determine significant spillover effects. Nevertheless, those studies except Narula and Marin (2003) and Ben Hamida and Gugler (2006) disregard the importance of learning and investment efforts in determining the absorptive capacity of domestic firm and retain in most cases its existing level of technological capacity or its technological gap vis-à-vis the foreign firm as proxies.

Further possible explanation of these negative or insignificant spillover results is that the size and the extent of spillovers depend largely upon the interaction between the mechanisms by which they occur and the existing technological levels of domestic firms. Thereby, relatively high technology firms are highly likely to benefit from spillovers through demonstration and/or competition effects, while small technology firms which are not in position to compete with foreign firms, gain a lot from other forms of spillovers such as worker mobility, since this channel provides some personnel assistance which can help domestic firms to better understand and implement the foreign technology (Mody, 1989).

This paper attempts to analyze empirically the intra-industry spillover effects from FDI using firm-level data from Swiss manufacturing industries. Switzerland is a particularly interest-

ing example for this study given that it experiences increasing flows of inward FDI over time. It is regarded to have achieved competitive technological levels in many industries; MNCs tend to concentrate their activities in more dynamic and competitive industries. And Swiss government authorities (mostly at the cantonal level) are more and more active in attracting foreign MNCs.

Our paper differs from existing empirical literature with respect to three main points: first, it offers a more comprehensive picture of FDI intra-industry spillovers by distinguishing these effects according to their diverse channels. The share of total sales in the industry accounted for by foreign firms is used to capture the demonstration-imitation productivity effects while other control variables are used to assess the competition- and worker mobility-related spillovers. Second, it makes use of a thorough measure of domestic absorptive capacity in which the learning and investment efforts of domestic firms come with their existing technological capacities. Relatedly, it is argued that only domestic firms which largely invest in absorbing foreign technology benefit from spillovers. And third it suggests that the size and the extent of spillovers depend largely upon the interaction between the mechanisms by which they occur and the existing technological capacities of domestic firms.

The regression results demonstrate that domestic firms with high technological capacity appear to benefit from spillovers which are basically from the increase of competition. Mid technology firms benefit a lot from demonstration effects, while low technology firms which are not able to benefit from foreign affiliates via demonstration effects alone, manage to reap the spillover benefits via the recruitment of MNCs labor that can help them to successfully imitate foreign knowledge. In addition, only firms which largely invest in the absorptive capacity benefit from spillovers which mainly result from technology transfer.

The structure of the paper is as follows. Following this introduction, section 2 analyzes the framework underlying the empirical results, section 3 presents the model, section 4 discusses the Swiss data and some descriptive statistics, section 5 presents the regression results, and section 6 concludes the paper.

2. Inward FDI and spillovers: The framework

As previously noted, positive spillovers represent one of the main elements justifying the effort made by government to attract foreign investors. FDI intra-industry spillovers benefits are assumed to occur through three channels, viz. demonstration effects, competition effects, and worker mobility. Domestic firms may improve their productivity when the foreign firms after entering the market demonstrate their advanced technologies; they may afterwards adapt and imitate them. When the increase in competition that occurs as a result of foreign entry forces domestic firms to introduce new technology and/or work harder. And when domestic workers trained by or worked in MNCs affiliates may decide to leave and join an existing or open up a new domestic firm, taking with them some or all of the firm-specific knowledge of the MNC.

A large literature has developed over the last two decades the concept of intra-industry spillovers. Too often, scholars in theoretical analysis offer a partial description of such spillovers, since each of them analyzes merely one kind of these effects. In Kopecky and Koizumi (1977), Findlay (1978), and Das (1987) spillovers are determined by the degree of foreign presence alone – contagion-type spillovers, measured for example in Findlay's studies by the ratio of the capital stock of foreign-owned firms in the backward economy to the capital stock of the domestically owned firms. While, in Wang and Blomström (1992), Perez (1998), and Nakamura (2002), spillovers are rather endogenously generated by the technological competition between foreign affiliates and domestic firms – competition-related spillovers. And in Kaufmann (1997), Fosfuri et al. (2001), and Glass and Saggi (2002) spillovers are the outcome of the movement of domestic labors who have been previously trained or worked at MNCs affiliates.

Just as spillovers have not been analyzed at the theoretical level in a complete picture with respect to their diverse channels, so empirical studies are also focused on given partial analyses of these effects. In fact, spillover effects have been by and large measured by the share of foreign presence in the corresponding industry. This variable seems to be inappropriate to capture much of the competition- (Kokko 1996) and worker mobility-related spillovers (Ben Hamida 2006a). Even if the share of foreign to total sectorial activity seems to be an appropriate measure for spillover effects through demonstration, it cannot hold the whole information about compe-

tition and worker mobility effects. This is one of the reasons why there are evidence contrasts in the scant empirical evidence available. Yudayeva et al. (2000), Castellani and Zanfei (2001), Haskel et al. (2002), and Karpaty and Lundberg (2004) for example find positive evidence for the existence of spillover benefits from FDI for respectively, Russia, Italy, UK, and Sweden. While, using the same measure of spillovers, Aitken and Harrison (1999), Djankov and Hoekman (2000), and Castellani and Zanfei (2002) report negative and insignificant spillovers for Venezuela, Czech Republic, and Italy, respectively.

If the share of foreign presence is not appropriate to assess the spillover effects from the increase of competition and the worker mobility, it seems clear that studies using this measure may yield misleading results. Thus, assessing the overall spillover effects needs to disentangle the effect of competition and worker mobility from that of demonstration by employing different control variables for each spillover mechanism. Given that, this paper makes use of foreign sales share to assess the spillover effects form demonstration effects and employs other variables for competition effects and worker mobility-related spillovers.[2]

Other possible reason for those mixed results is that spillovers largely depend on the level of the absorptive capacity of domestic firms (Cantwell, 1989), in which only domestic firms possessing sufficient levels of absorptive capacity are likely to efficiently exploit spillovers. The diffusion of knowledge across borders may be limited because of the low absorptive capacity of potential recipients located abroad (Rugman and Verbeke, 2001). The concept of absorptive capacity encompasses the firm's ability to recognize valuable new knowledge, integrate it into the firm and use it productively. Thereby, the firm's level of absorptive capacity depends upon its existing level of technological competence as well as its learning and investment efforts undertaken to be able to use productively foreign knowledge. As suggested by Narula and Marin (2003), "absorption is not purely about imitation", in that technologies have a certain firm-specific aspect to them and then need to be decoded so as to be efficiently used by domestic firms raising their productivity. Thus it is expected that only domestic firms which largely invest in absorbing foreign technologies benefit from FDI spillovers.

Absorptive capacity has been broadly undertaken by most empirical studies so as to be able

[2]Spillover variables will be exactly defined in the next section.

to determine significant spillover effects. Nevertheless, those studies disregard the importance of learning and investment efforts in determining the absorptive capacity of domestic firm and retain in most cases its existing level of technological capacity or its technological gap vis-à-vis the foreign firm as proxies. Among others, Konings (1999), Girma et al. (1999), and Liu et al. (2000) used R&D intensity, technological gaps, and intangible assets per worker as proxies for domestic absorptive capacity. Using panel data on domestic firms of Bulgaria, Romania and Poland, panel data on UK manufacturing firms, and panel data on UK manufacturing industries respectively, Konings, Girma et al., and Liu et al., respectively, reported evidence of positive spillovers for R&D intensive firms in Bulgaria and Poland, for all UK firms with low technology gaps, and in UK industries with high technological capacities in terms of intangible assets. Early exceptions are Narula and Marin (2003) and Ben Hamida and Gugler (2006) who assert, respectively, that only Argentinean manufacturing firms and Swiss manufacturing firms that have invested more in absorptive capacities (in respect of investments in new equipment for product/process innovation and training activities) receive positive spillovers from FDI. Conversely, Narula and Marin conclude that the distinction of sectors according to different levels of technology gap does not provide any significant spillovers.

Further reason for the negative or insignificant spillover results is that the size and the extent of spillovers depend largely upon the interaction between the mechanisms by which they occur and the existing technological levels of domestic firms. As stated by Mody (1989), relatively high technology firms are highly likely to benefit from spillovers through demonstration and/or competition effects, while small technology firms which are not in position to compete with foreign firms, gain a lot from other forms of spillovers such as worker mobility, since this channel provides a (technical, managerial, etc.) assistance which can help domestic firms to better understand and implement the foreign technology. This shows that even low technology firms may experience some spillover benefits from FDI and that only firms with very low technological competence to a point that they are not capable of reaping profits via any of the spillover channels enter into a process of cumulative decline and eventually leave the market.

Recently, Ben Hamida (2006a) has analyzed in a theoretical paper FDI spillovers according to their diverse channels and found that the firm, which is not far behind the technological

frontier of the industry, manages to exploit fully the technological opportunities using merely demonstration effects, while the firm of low technological development group is not able to benefit from foreign affiliates via demonstration effects alone, rather, it gains a lot from worker mobility. To test these theoretical findings, Ben Hamida (2006b) has used a qualitative method based on interviews with managers of foreign and domestic firms from Swiss manufacturing and service/construction. Doing so, the interviews analysis suggests that the theoretical findings remain pertinent for Switzerland. However, as qualitative analysis does not allow for the measurement of the size and the extent of spillover effects, we believe that further quantitative analysis would be promising. In this context, testing whether the increase in domestic productivity are function of the interaction effects between spillover channels and the technological capacities of domestic firms is the focal point of our empirical analysis discussed in this paper.

3. Variables and econometric specification

We model the effects of FDI intra-industry spillovers within the context of a production function,[3] in which the change in the natural log added value of the i-th domestic firm is determined as follows:

$$\begin{aligned} \Delta LnY_{i,j} &= \alpha_0 + \alpha_1 \Delta LnK_{i,j} + \alpha_2 \Delta LnL_{i,j} + \alpha_3 FP_j + \alpha_4 HC_{i,j} \\ &\quad + \alpha_5 FP_j * HC_{i,j} + \alpha_6 \Delta Comp_{i,j} + \alpha_7 \mathrm{Si}\, ze_{i,j} \\ &\quad + \alpha_9 Industry_j + \varepsilon_{i,j,} \end{aligned} \tag{1}$$

where the subscripts i and j denote firm and industry, Δ represents changes in the variables between 2001 and 2004, and α_0, α_1, α_2, α_3, α_4, α_5, α_7, α_8 and α_9 the parameters to be estimated. Table 1 describes the variables and their measurements.

Y denotes added value at firm level, K its physical capital, L its employment, and HC the level of its human capital. The coefficients of those variables are expected to be positive and significant. Si ze, defined by the sales of firm i, is expected to increase productivity as larger sized

[3] The derivation of this model is explained in the annex.

firms may be more efficient (Dimelis and Louri, 2002). The inclusion of industry dummies,[4] $Industry$, in equation (1) and the use of changes over the time control for the industry-specific productivity differences; they correct for the omission of unobservable variables that might undermine the relationship between spillover variables and productivity growth of domestic firms (Aitken and Harrison, 1999 and Narula and Marin, 2003).

To assess the overall spillover effects of foreign firms on domestic competitors, we employ three different control variables with respect to the three possible intra-industry spillover mechanisms: first, the main effect[5] of the share of foreign presence at four-digit industry level,[6] FP, reflects spillovers from demonstration effects, resulting from the technology transfer that occurs from the direct contact between local agents and foreign affiliates operating at different levels of technology (Ben Hamida and Gugler, 2006).

Second, the interaction term $FP * HC$ between foreign presence and human capital is assumed to determine the effect of worker mobility related to the presence of foreign firms in the domestic market. In fact, this interaction assesses the combined effect of those variables on productivity of domestic firms; that is the influence of foreign firms would be co-determined by the level of human capital of the domestic firms. It is argued that human capital increases the ability of domestic firms to benefit from positive spillovers (Borensztein et al., 1998 and Meyer and Sinani, 2001) – the sign of the interaction effect is then expected to be positive. Moreover, the technique of upgrading the level of the firm's human capital depends on its existing technological level. On the one hand, relatively high technology firms attempt to benefit from spillovers through demonstration and/or competition effects (Mody, 1989). Thereby, the ability of such firms to either absorb foreign technology or pursue independent lines of technological development, associated with the quality level of human capital, would be largely determined by the amount those firms spend in training their existing employees and/or the new ones so as to acquire the specific technique required either for the implementation of foreign knowledge or for the development of the existing one. On the other hand, small technology firms are not

[4]There are 32 industry dummies accounted for manufacturing.

[5]It is also called the average effect (Aiken and West, 1991) since it denotes the effects of the FP on domestic productivity at the mean of HC as those variables used for interaction are centered (more details are given in footnotes of table (7))

[6]we take use of the maximum available disaggregation industry level to be able to effectively assess the intra-industry spillover benefits.

able to benefit from foreign affiliates via demonstration effects alone as they do not possess a sufficient level of human capital that allow them to exploit efficiently the foreign technological opportunities, rather they gain a lot from worker mobility, since this channel provides a (technical, managerial, etc.) assistance which can help them to better understand and implement the foreign technology. For that, to upgrade their level of human capital and then be able to use properly foreign best technology, those firms tend to invest in recruiting domestic employees already trained by or worked in foreign firms by given them higher salary than foreign firms do[7] – it is assumed that when leaving the MNCs those employees will take with them some or all of the firm specific knowledge (Blomström and Kokko, 2002).

Third, regarding competition-related spillovers, we use price markup or the so-called Lerner index as a measure of competition – the difference between firm's price (p) and its marginal cost (mc) over its total price. Lerner Index measures the degree to which firms can markup price above marginal cost; the larger the Lerner Index and the greater the power of the monopolist. The Lerner index is also known as the Market Power index (Baye, 2006) as it describes the power a firm has within a market; e.g. a monopoly has the power to set high differences (p - mc) and so will have a high Lerner Index, while, in a highly competitive market, each firm will have tight value of (p - mc) and low Lerner index.

Unfortunately the data set available do no allow for firm's price and marginal cost informations. So, following Narula and Marin (2003) and Chung (2001) we use the difference between firm's sales and its costs over its total sales as a measure of the firm's price markup. When markup is high, a value near 1, competition is low. While, when markup is low, a value near 0, competition is high.[8] As competition-related spillovers are associated with the increase in the level of competition that occurs as a result of foreign entry and presence, it seems more appropriate to take the change in markup to measure the change in the level of competition. A negative coefficient estimate attracted by the change in markup is consistent with the expectation that decreased markup (increased competition) is followed by productivity increase.

To test the hypotheses, in which the size and the extent of spillover effects may vary ac-

[7]Foreign affiliates are unlikely to be mute spectators as their employees move to domestic competitors taking with them their secrets.

[8]It is to note that in some cases a higher markup may be due to industry specificities as for example in luxury industry (Narula and Marin, 2003).

cording to the diverse levels of technological capacity of domestic firms and their absorptive capacity with respect to learning and investment efforts, we proceed to make various tests using equation (1). As a first step, we divide the full sample of domestic firms into three sub-samples characterized by the size of their existing technological capacities and estimate equation (1) separately for domestic firms with high, mid, and small technological capabilities. The existing technological capacities of domestic firms are measured by their technological gaps, GAP, compared to their foreign rivals. GAP is defined as the ratio of the average labour productivity of foreign-owned firms in the relevant four-digit industry to domestic firm's own labor productivity, calculated for 2001. Hence, GAP is equal to one if the domestic firm operates at the same labour productivity as the average of its foreign rivals. Values that are smaller than or equal to one – the technological frontier of the industry – are interpreted as signs of small productivity gaps. Values which are higher than one but not far behind the technological frontier of the industry are interpreted as signs of mid productivity gaps, and those which are far behind the technological frontier characterize high productivity gaps. we expect to find stronger signs of competition-related spillovers in the sub-sample with small technological gap, whereas demonstration- and worker mobility-related benefits tend to take place in sub-samples of mid and high technological gap, respectively.

As a second step, we divide the full sample into two sub-samples according to the investment level of domestic firms, $INVEST$, in the absorptive capacity. $INVEST$ is measured by the level of investment expenditures in new equipment and training activities for product/process innovation, within the period 2002-2004. we expect that only domestic firms which largely invest in absorptive capacities benefit from FDI spillovers.

we test for the equality of coefficients across sub-samples using Chow-tests. All results refer to OLS estimations of equation (1).

4. Data and descriptive statistics

Data for this paper are derived from innovation activity surveys (2002 and 2005) of manufacturing firms, with at least 5 employees, conducted at the Swiss institute for business cycle

Table 1: Variable definitions

Variables	Definitions
$\Delta LnY_{i,j}$	The log change in added value at the firm level.
$\Delta LnK_{i,j}$	The log change in physical capital, measured by gross capital income – firm level.
$\Delta LnL_{i,j}$	The log change in total number of employees in a firm.
FP_j	The share of total sales in an industry j accounted for by foreign firms.
$HC_{i,j}$	The average labor cost of the firm (in 100'000 CHF) constructed as the ratio of the firm's labor costs to the number of employees.
$\Delta Comp_{i,j}$	The change in price markup at firm level measured by the difference between firm's total sales and costs over total sales.
Si ze_{ij}	The log total sales of the firm.
$GAP_{i,j}$	The ratio of the average labour productivity of foreign-owned firms to domestic firm's own labor productivity, calculated for 2001.
$INVEST_{i,j}$	The level of investment expenditures in new equipment and training activities for product/process innovation, within the period 2002-2004.

research "KOF".[9] Individual information covers the technological behavior and productivity performance of 1201 firms – 185 majority-owned foreign affiliates – in 2001 and 1134 firms – 182 majority-owned foreign affiliates – in 2004.[10]

Tables 2, 3, 4, 5, and 6 present a summary of the samples and descriptive statistics of the relative position of foreign versus domestic firms. All these calculations are based on weighted data sets so as to give a representative picture of Swiss economy.[11] As shown in table 2, the share of foreign investment in manufacturing total employment accounted for 2001 is about 19 (21.6 in total sales). This share hides significant differences across sectors as shown in table 3, in that 84 percent (94.7 in sales) of computer and office equipments is foreign owned compared to only 2.5 percent (8.8 in sales) for printing and publishing. The foreign presence is also preeminent in among others paper, machinery, electrical machinery, and transport equipments. In spite of the slight decrease of the foreign employment and sales shares at the aggregate level from 2001 to 2004, there is a significant increase in foreign share across sectors. That is 6 of these sectors recognize a substantial increase in foreign employment share (8 in foreign sales

[9] Questionnaires can be downloaded from www.kof.ethz.ch (Industrieökonomik).

[10] Unfortunately, data of 2004 are the more recent ones.

[11] The weights are used to correct for the selection bias resulting from "unit" non-response and for the deviations of the sample structure from that of the underlying population.

share). Nonetheless, in other sectors foreign share falls by as much as 50 percent (such as food, watches, wood products, and computer and office equipments).

Table 4 compares the relative performance of foreign and domestic firms across sectors in 2004, measured by total sales, total employment, and export as a percentage of total sales, using the ratio of foreign to domestic means. In general, the differences in the aggregate indicate that foreign manufacturing firms in Switzerland are larger than domestic firms, mainly in sales and export (about twice) – These differences are strongly significant with regard to export. This stems from the significant dominance of foreign firms, in terms of sales, mainly in sectors as computer and office equipments, transport equipments, beverage and metalworking; in terms of export in wood products, watches, and other manufacturing; and in plastics regarding both sales and exports. Labor differences also favor foreign firms in some sectors as communication equipments, and also computer and office equipments and transport equipments.[12]

In what concerns the relative technological position of foreign versus domestic firms, table 5 reports the results of this comparison, in 2001 and 2004, for the share of innovative products in sales, the share of R&D labor, and the labor productivity expressed as value added per employee. In 2001, the data for the aggregate suggest that on average foreign firms hire R&D employees and innovate more than domestic firms; their share of R&D labor is about once and half more than domestic firms, which is significant at the 10% level. In spite of the slight change of these differences from 2001 to 2004, the result change considerably across sectors. That is some sectors recognize a substantial increase in favor of foreign firms mainly in beverage, pharmaceutical, and communication equipments in terms of R&D labor; and in paper and plastics in terms of innovative products. While in other sectors those differences markedly decrease highlighting domestic firms, such as in food, medical instruments, and watches in terms of R&D labor and innovative products.[13]

The difference in terms of productivity denotes the industrial technological gap between domestic and foreign firms, which is in favor of foreign firms and significant at the 1% level for 2001 at the aggregate level. This shows that on average the gap is relatively high – marks the

[12]There exist sectors wherein domestic firms dominate foreign affiliates -with the ratio of foreign to domestic means is less than, but these differences are not significant.

[13]It is to note that there exist sectors wherein domestic firm perform better than foreign ones in both periods but these differences are not significant, except for chemical regarding R&D labor.

relative productivity performance of foreign firms over their domestic rivals – and appears not be associated with a catching-up process by domestic firms between 2001 and 2004. Nevertheless, when the sectors are considered individually these results change considerably and show that in some sectors the gap is small while in others is very high. In food and printing and publishing for example foreign firms perform better than domestic ones while in chemicals domestic firms are found to be at the same technological level as foreign affiliates. Moreover, beverage experiences a large gap in 2001 associated with a process of falling behind in 2004, whereas food, wood products, and watches succeed in catching-up with and even in forging ahead of foreign firms. This catching-up process may result from the investment effort of domestic firms in learning activity as, for example, in wood product, machinery, and watches sectors the decrease in the technological gap appear jointly related to the increase of the share of innovative products. Whether at least some of the increases in productivity are due to spillover benefits arising from the learning process of foreign technologies is the focal point of our empirical analysis discussed in the next section.[14]

Finally, table 6 analyzes the relative contribution of foreign firms to domestic human capital development versus domestic counterparts, in 2004. Variables used are the share of professionals – engineers, mangers, and all other professionals in production and R&D activities – in total employees, the labor quality index expressed in terms of the ratio of professional to non professionals, and the share of labor cost in sales (including salary, training expenditures, etc.). The data for the aggregate suggest that foreign firms hire more professionals which for the most part consist on R&D employees (table 5), the quality of their labor force is significantly higher, and they invest more in labor costs. The high level of labor cost perceived in foreign affiliates relative to similar domestic firms may result from the large amount they spend in training.[15] This way, MNC affiliates may be particularly valuable sources of new technology and hence more opportunities for spillover benefits are expected. As suggested by Blomström and Kokko (2002), the labor market is one of the main ways in which new technological knowledge is expected to disseminate to the domestic economy, workers already trained by or worked

[14]The regression analysis make use of a sample of only 370 manufacturing firms because of missing data for some variables when matching the two data sets of 2002 and 2005 surveys.

[15]Chen (1983) and Gershenberg (1987) found evidence that foreign firms spend more in training than domestic firms in Kenya and Hong Kong, respectively.

in foreign affiliates may be potentially available to work in domestic firms or start their own firms in the same industry. In this respect, we find that many relatively small technology firms in 2001, which spend as much as or even more than foreign firms in labor cost, experience in 2004 an increasing level of their technological development.[16] This could be explained by the fact the those firms succeeded in attracting skilled domestic employees worked in foreign firms, qualified as appropriate to their productivity enhancement. Across sectors, the results in table 6 show that foreign firms hire more professionals and possess a more skilled labour force in sectors as chemicals; and invest more in labor costs in plastics, transport equipments, and electrical machinery.

5. Results

Regression estimates, column 1 in tables 7 shows the results of the spillover tests of the full sample of 370 Swiss manufacturing firms. The value added of the firms in Switzerland for the full samples increases with changes in the employment and the human capital of domestic firms. However, as expected, the estimated coefficient of the variable FP is negative and insignificant showing that foreign presence does not have any effect on productivity growth of domestic firms; so on average there is no evidence of technological spillovers from demonstration effects. The interaction term between FP and HC is also insignificant, indicating that the full sample data have not demonstrated the change in response with FP depends on the level of human capital. Alike, the increase in competition seems to impede the productivity growth of domestic firms as the $\Delta Comp$ estimate is positive and highly significant. And the physical capital and Si ze do not affect significantly the productivity change of domestic firms.

In column 2, 3, and 4 of tables 7, we have proceeded to divide the sample of manufacturing into three sub-samples characterized by the values for the variable GAP. The results suggest that the estimated coefficients of FP and $FP * HC$ are only positive and significant in the sub-samples of firms with mid and large technological gaps – when GAP is greater than one. Both kinds of firms manage to exploit fully the technological opportunities arising from their direct contact with foreign firms – demonstration-related spillovers. The size of such benefits is 0.009

[16] Domestic firms of industries such as watches succeeded in catching-up with foreign rivals.

for mid technology firms while 0.005 for low technology ones, implying that an increase in the share of foreign investment from 0 to 10 percent leads to as much as 0.05 percent-point increase in domestic productivity of low-level group and about twice larger for mid-level group.[17] Mid and low technology firms also gain benefits from FDI by investing in human capital; the amount those firms spend in training their existing employees and/or the new ones appears to be of great importance for the successful implementation of foreign knowledge. The positive and significant interaction effects of FP with HC indicate that the effect of foreign firms is broadly co-determined by the level of human capital of the domestic firms – this finding confirms the strong association between FDI effects and the level of domestic human capital. Moreover, as we have mentioned in previous section, domestic firms and especially low technology ones tend to upgrade their level of human capital by recruiting domestic employees already trained by or worked in foreign firms. Doing so, low technology firms may get hold of some personnel assistance, essential to be able to decode and use effectively foreign best technology. In this respect, the positive and highly significant interaction effect of FP with HC – column 4 of table 7 – could be a sign of worker mobility-related spillovers. This result seems consistent with Ben Hamida (2006a)'s theoretical analysis.

The estimated coefficient of $\Delta Comp$ is negative and significant only for the sub-sample of domestic firms with small technology gap, suggesting that heightened competition (decreased markup) is followed by productivity increase – mid and low technology firms do not benefit from the competition-related spillovers. The estimated coefficients of FP and $FP * HC$ are insignificant for the high technology manufacturing firms. This is not surprising given that high technology firms do not need to learn from foreign technologies to increase their productivity since they perform as much as or even better than foreign rivals in the industry. Instead, those firms gain benefit from FDI via competition effects; the competitive pressure generated by the presence of foreign firms induces it to use more efficiently its existing technology by learning within its existing line of technological development.

The estimated coefficients of HC are positive and significant for all sub-samples with larger

[17] Comparing with Ben Hamida and Gugler (2006)'s regression results of demonstration-related spillovers for manufacturing, the effect of FP in 2001 on the productivity change of mid technological firms between 2001 and 2004 is smaller than that of 1998 on the change between 1998 and 2001.

effects in mid and low technology firms. This can be explained by the fact that those kinds of firms substantially invest in upgrading their human capital to fully exploit the technological opportunities arising from foreign presence; in turn this investment effort has a great impact on their productivity growth.

Columns 5 and 6 of tables 7 report the results of spillovers according to the level of the absorptive capacity in terms of learning and investment efforts for manufacturing firms. Estimated coefficients of both FP and $FP*HC$ are positive and significant only for high-$INVEST$ sub-samples, indicating that only domestic firms which highly invest in the absorption of foreign knowledge have more efficiently internalize FDI spillovers from technology transfer.[18] The estimated coefficient of $\Delta Comp$ for high-$INVEST$ sub-sample is significantly positive, suggesting that there is no evidence for competition-related spillovers. Moreover, domestic firms which little invest in the absorptive capacity are not capable of reaping profits via any of the spillover channels. This findings confirm the importance of the investment and training efforts of domestic firms in productively absorbing foreign knowledge occurring from demonstration effects and worker mobility since both channels require further investment once introducing the foreign best technology in their existing technological process.

The chow tests soundly support the divisions of manufacturing sample with respect to GAP and $INVEST$.

6. Summary and conclusions

This paper suggests that firstly, the assessment of the effects of spillovers from foreign direct investment on the productivity development of domestic firms calls upon a detailed analysis of those effects according to their ways of occurrence; and secondly, spillover benefits are determined by the interaction between the channels by which they occur and the technological characteristics of the recipient host firms. In this respect, we focus on testing the effects of the diverse intra-industry spillover channels according to the level of the absorptive capability of domestic firms.

Based on samples of Swiss manufacturing, we show that is important to take account of the

[18] This result seems consistent with Narula and Marin (2003)'s analysis.

level of technological capacity of the domestic firms as well as their investment effort in the absorptive capability when evaluating productivity spillovers generated from FDI. That is, taking all the firms together the results do not report on average significant evidence for spillovers, neither from the increase of competition nor from the technology transfer. However, looking separately at three sub-samples of firms characterized by the size of the technological gap between domestic and foreign firms, yields differences in results. Domestic firms with high technological capacity appear to benefit from spillovers which are basically from the FDI heightening competition. Mid technology firms benefit a lot from demonstration effects, while low technology firms which are not able to benefit from foreign affiliates via demonstration effects alone, manage to reap the spillover benefits via the recruitment of MNCs' labor that can help them to successfully imitate foreign knowledge.

Furthermore, when taking into account the investment level of domestic firms in the absorptive capacity, we find evidence for positive spillovers only in the sub-sample of firms with relatively high investment level. Those benefits result from the FDI technology transfer. Spillovers, however, affect negatively the productivity of domestic firms which do not actively engage in investment and learning to be able to absorb foreign knowledge.

On the policy front, suggestions with respect to attracting FDI following such findings must take into account that benefits from FDI in terms of spillovers require sufficient level of human capital, especially for mid and low gap firms, to be able to use efficiently foreign knowledge. In this respect, actions to motivate subsidization of foreign investment as well as to support learning and investment in domestic firms seem to be necessary ingredients in a policy package to maximize the technological spillovers from foreign direct investment.

Future research aiming at analyzing foreign characteristics (such as the degree of foreign ownership, the nationality of foreign investors, the complexity level of MNC technology, the motivations for FDI, etc.) as determinants of spillover effects could be also of a great importance to policy-makers in leveraging the potential benefits of inward FDI spillovers. Also, exploring other kind of spillovers such as inter-industry and market access spillovers could be promising.

References

Aiken, L. and West, S. (1991). *Multiple regression: Testing and interpreting interactions*, Sage Publications, Newbury Park, London.

Aitken, B. J. and Harrison, A. E. (1999). Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela, *American Economic Review*, 89, 605-618.

Baye, Michael R. (2006). *Managerial Economics and Business Strategy*, 5th Edition. McGraw-Hill.

Ben Hamida, L. and Gugler, P. (2006). Are There Demonstration-Related Spillovers From FDI? Evidence From Switzerland", In Proceedings of EIBA Conference, Regional and National Divers of Business Location and Competitiveness, December 7-9, Fribourg.

Ben Hamida, L. (2006a). Multinational firms, Spillovers, and Productivity Growth: An Evolutionary Model, In Proceeding of EcoMod International Conference, Regional and Urban Modeling, June 1-3, Brussels.

Ben Hamida, L. (2006b). Intra-Industry Spillovers from Inward FDI: An Evolutionary Model, In Proceedings of EIBA Conference, Regional and National Divers of Business Location and Competitiveness, December 7-9, Fribourg.

Blomström, M. and Kokko, A. (1998). Multinational Corporations and Spillovers, *Journal of Economic Surveys*, 12/3, 247-277.

Blomström, M. and Kokko, A. (2002). FDI and Human Capital: A Research Agenda, OECD Working Paper, No. 195.

Borensztein, E., De Gregorio, J. and J-W. Lee. (1998). How does foreign direct investment affect economic growth? *Journal of International Economics*, 45, 115-135.

Buckley, P. J., Clegg, J. and Wang, C. (2003). Is the Relationship between Inward FDI and Spillover Effects Linear? An Empirical Examination of the Case of China, Presented at the 29th Annual Conference of European Academy of International Business, Copenhagen.

Cantwell, J. (1989). *Technological Innovation and Multinational Corporations*, Oxford: Basil Blackwell.

Castellani, D. and Zanfei, A. (2001). Technology Gaps, Absorptive Capacity and the Impact of Inward Investment on Productivity of European Firms, Mimeo, ISE-Universita di Urbino.

Castellani, D. and Zanfei, A. (2002). Multinational Companies and Productivity Spillovers: is there a specification error, Mimeo, ISE-Universita di Urbino.

Cohen, W. and Levinthal, D. (1989). Innovation and Learning: the Two Faces of R&D, *Economic Journal*, 99, 569-596.

Chen, E. K. Y. (1983). *Multinational corporations, technology and employment*, Macmillan, London.

Chung, W. (2001). Identifying Technology Transfer in Foreign Direct Investment: Influence of Industry Conditions and Investing firm Motives, *Journal of International Business Studies*, 32, 211-229.

Das, S. (1987). Externalities, and technology Transfer through Multinational corporations, *Journal of International Economics*, 22, 171-182.

Dimelis, S. and Louri, H. (2002). Foreign Investment and Efficiency Benefits: A Conditional Quantile Analysis, *Oxford Economic Papers*, 54, 449-469.

Djankov, S. and Hoekman, B. (2000). Foreign Investment and Productivity Growth in Czech Enterprises, World Bank Economic Review, 14, 49-64.

Dunning, J. H. and Gugler, P. (1994). Technology Based Cross-Border Alliances, in David J. J. (eds.), *Technology and Business Enterprise*, Cheltenham, UK: Edward Elgar.

Dunning, J. H. and Rugman, A. M. (1985). The Influence of Hymer's Dissertation on the Theory of Foreign Direct Investment, *The American Economic Review*, 75, 228-232.

Dunning, J. H. (1992). *Multinational Enterprises and the Global Economy*. Wokingham, England: Addison-Wesley Publishing Company.

Findlay, R. (1978). Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model, *Quarterly Journal of Economics*, 92, 1-16.

Fosfuri, A., Motta, M. and Ronde, T. (2001). Foreign direct Investment and Spillovers through Workers' Mobility, *Journal of International Economics*, 53, 205-222.

Glass, A. and Saggi, K. (2002). Multinational Firms and Technology Transfer, *Scandinavian Journal of Economics*, 104, 495-514.

Gershenberg, I. (1987). The Training and Spread of Managerial Know-How: A Comparative Analysis of Multinational and Other Firms in Kenya, world Development, 15, 931-939.

Girma, S., Greenaway, D. and Wakelin, K. (1999). Wages, Productivity and Foreign Ownership in UK Manufacturing, University of Nottingham, Working Paper, No. 99/14.

Görg, H. and Strobl, E. (2001). Multinational Companies and Productivity spillovers: A Meta-Analysis with a Test for Publication Bias, *Economic Journal*, 111/475, 723-739.

Haskel, J. E., Pereira, S. C. and Slaughter, M. J. (2002). Does Inward Foreign Investment Boost the Productivity of Domestic Firms?, NBER Working Paper, No. 8724.

Hymer, S. H. (1960). The International Operations of National Firms: A Study of Direct Foreign Investment. Ph.D. Dissertation, Published by MIT Press, Cambridge, (also published under same title in 1976).

Hymer, S. (1968). La Grande Firme Multinationale, *Revue Economique*, 14, 949-973, Translated in English in M. C. Casson (eds.), Multinational Corporations, Cheltenham: Edward Elgar.

Karpaty, P. and Lundberg, L. (2004). Foreign Direct Investment and Productivity Spillovers in Swedish Manufacturing, Working Paper, No. 2, Orebro University, Sweden.

Kaufmann, L. (1997). A Model of spillovers Through Labor Recruitment, *International Economic Journal*, 11, 13-33.

Kokko, A. (1996). Productivity Spillovers from Competition between Local Firms and Foreign Affiliates, *Journal of International Development*, 8, 517-530.

Konings, J. (1999). The Effects of Foreign Direct Investment on Domestic Firms: Evidence from Firm Level Panel Data in Emerging Economics, LICOS Discussion Paper DP 8699.

Kopecky, K. J. and Koizumi, T. (1977). Economic Growth, Capital Movements and the International Transfer of Technical Knowledge, *Journal of International Economics*, 7, 45-65.

Liu, X., Siler, P., Wang, C. and Wei, Y. (2000). Productivity Spillovers from Foreign Direct Investment: Evidence From UK Industry Level Panel Data, *Journal of International Business Studies*, 31/3, 407-425.

Meyer, K. and Sinani, E. (2005). Spillovers from Foreign Direct Investment: A Meta-Analysis, Working Paper, Department of Economics, University of Reading.

Mody, A. (1989). Strategies for Developing Information Industries, In Cooper, C. and Kaplinsky, R. (eds.), *Technology and Development in the Third Industrial Revolution*, London: Frank Cass.

Nakamura, T. (2002). Foreign Investment, Technology Transfer, and the Technology Gap: A Note, *Review of Development Economics*, 6, 39-47.

Narula, R. and Marin, A. (2003). FDI Spillovers, Absorptive Capacities and Human Capital Development: Evidence from Argentina, Working Paper, No. 2003-016, Maastricht Economic Research Institute on Innovation and Technology, The Netherlands.

Perez, T. (1998). *Foreign Investment and Spillovers*, the Netherlands: Harwood Academic Publishers.

Rugman, A. M. and Verbeke, A. (2001). Subsidiary Specific Advantages in Multinational Enterprises, *Strategic Management Journal*, 22, 237-250.

UNCTAD (2003). World Investment Report, FDI Policies for Development: National and International Perspectives, New York and Geneva: United Nation.

Wang, J-Y and Blomström, M. (1992). Foreign Investment and Technology Transfer: A Simple Model, *European Economic Review*, 36, 137-155.

Yudayeva, K., Kozlov K., Melentieva N, and Ponomareva N. (2000). Does Foreign Ownership Matter? Russian Experience, Working Paper, No. w0005, Center for Economic and Financial Research, Russia.

Annex: The model

Equation (1) is derived from a Cobb-Douglas production function with added value Y a function of two inputs, capital and labor

$$Y_{i,t} = A_{i,t} L_{i,t}^{\alpha 1} K_{i,t}^{\alpha 2}, \tag{2}$$

The level of productivity is given by $A_{i,t}$, which is assumed to vary across firms within each sector j and across time t.

After taking logarithms of variables to get into a linear form equation (2) and adding a stochastic disturbance term $u_{i,t}$ to account for variations in the productive capabilities of the i-th firm, we can rewrite equation (2) for $t-3$ =2001 and t =2004 as

$$LnY_{i,t} = a_{it} + \alpha_1 LnL_{i,t} + \alpha_2 LnK_{i,t} + u_{i,t}, (a_{i,t} = LnA_{i,t}), \tag{3}$$

$$LnY_{i,t-3} = a_{i,t-3} + \alpha_1 LnL_{i,t-3} + \alpha_2 LnK_{i,t-3} + u_{i,t-3}, (a_{i,t-3} = LnA_{i,t-3}). \tag{4}$$

Then, taking the difference (3-4) yields the change in value-added for domestic firms between 2004 and 2001. Δ denotes the variation between 2004 and 2001

$$\Delta LnY_i = \Delta a_i + \alpha_1 \Delta LnL_i + \alpha_2 \Delta LnK_i + \varepsilon_{i,}. \tag{5}$$

We test the hypothesis that productivity growth is affected by the share of foreign presence at the industry level, its interaction with human capital of the i-th firm, and the increase in the level of industry competition, by modeling the change in a as

$$\Delta a_i = \alpha_3 FP_{j,t-3} + \alpha_4 HC_{i,j,t} + \alpha_5 FP_{j,t-3} * HC_{i,j,t} + \alpha_6 \Delta Comp_j + \alpha_7 \text{Si}\, ze_{i,j,t} + \alpha_8 Age_{i,j,t} + \alpha_9 Industry_{i,j}, \quad (6)$$

where, the change in a is also assumed to vary across sectors, the human capital of the domestic firm, and its size.

Finally, combining equations (5) and (6) yields equation (1).

Table 2: FDI participation in manufacturing in Switzerland: annual shares of foreign firms in sales and employment (percent)

Year	Total employment	Total sales	Number of foreign firms	Number of domestic firms	Total
2001	19	21.6	185	1016	1201
2004	17.6	19.6	182	952	1134

Table 3: FDI participation in manufacturing in Switzerland: sectoral shares of foreign firms (percent)

Sector	Total employment		Total sales	
	2001	2004	2001	2004
Manufacturing				
Food	13.3	4.3	15	2.9
Textiles	13.8	14.9	16.5	13.6
Wood products	9.5	5.4	25.3	6.5
Paper	32.1	25	38.3	29
Printing and publishing	2.5	8.3	8.8	12.7
Chemicals	25	22.2	21.8	25.6
Pharmaceuticals	13.2	13	7.1	23.5
Plastics	20.6	23.7	29.1	32.4
Non-metal mineral products	16.9	11.3	15	13.4
Metal production	6.9	11.9	10.9	13.8
Metalworking	12.9	10	17.7	13.9
Machinery	28.9	22.9	32.4	21.3
Electrical machinery	26.4	49.7	31	59.3
Computer and office equipments	84	11.6	94.7	11.4
Communication equipments	15	40.1	13.5	54.1
Medical instruments	20.1	27.1	21.8	35.4
Watches	5.1	2.2	9	0.7
Transport equipments	33.2	24.8	43.9	23.2
Other manufacturing	15.9	4.4	21.7	8.1

Table 4: The relative position of foreign versus domestic firms: sales, labor, and export (2004)

Ratio of the mean of the foreign variable to the mean of the corresponding domestic variable			
Sector	sales	labor	export
Manufacturing	1.5	1.14	1.7***
Food	0.8	0.9	1
Beverage	4**	2	0.3
Textiles	0.8	1	1.6*
Wood products	0.8	0.8	3.8*
Paper	1.8	0.9	1
Printing and publishing	1.2	1.4	1.5
Chemicals	0.5	0.7	1.4*
Pharmaceuticals	0.4	0.4	1.5
Plastics	2.4**	1	1.9*
Non-metal mineral products	1.9	1	2
Metal production	1.1	0.7	1.4
Metalworking	2.5***	1.2	1.5
Machinery	1.1	1.1	1.3**
Electrical machinery	4	2.1	1.1
Computer and office equipments	4.5***	7.7*	0.04
Communication equipments	3.2	1.5**	1.3
Medical instruments	1.2	1.2	1.3
Watches	0.5	0.7	3.3***
Transport equipments	5.5**	2.6*	1.8
Other manufacturing	1.8	0.8	2.3*

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Affiliates' technological behavior relative to domestic firms: labor productivity, R&D labor, and the share of innovative products in sales

Ratio of the mean of the foreign variable to the mean of the corresponding domestic variable						
	Labor productivity		R&D labor		The share of innovative products	
Sector	2001	2004	2001	2004	2001	2004
Manufacturing	1.2***	1.2	1.3*	1.4***	1.1	1.1
Food	1.8***	1.1	1.9	1	0.9	0.7
Beverage	2.2	2	0.2	3.3	0.2	0.1
Wood products	2.5***	0.9	0.6	0.7	0.4	0.05
Paper	1.3	1.2	0.6	0.4	0.6	1.5
Printing and publishing	2.2***	1.2	8***	8***	1.3	1.7
Chemicals	1	2*	0.5**	0.6*	1.1	1.3
Pharmaceuticals	1.3	1.3	0.9	2.3	1.3	1.4
Plastics	1.2	1.2	0.3	0.9	1	1.5
Non-metal mineral products	1.2	1.6	1.1	0	0.6	0.6
Metal production	1.3	1.2	0.2	1	1.5	0.2
Metalworking	1.1	1.3*	0.8	0.3	0.8	0.7
Machinery	1.2***	1.1*	1.3	1.4*	1.1	0.9
Electrical machinery	1.1	1.4***	1	1.6*	0.8	0.9
Computer and office equipments	1.4	1.2	1.4	0.2	1.5	0
Communication equipments	1.1	1.5**	0.6	1.9*	1.1	1.1
Medical instruments	1.1	1.5***	1.2	0.6	1.1	0.9
Watches	1.6**	0.26	1.7	0.5	2.4*	1.5
Other manufacturing	1.3	2.1***	0.2	3.4*	0.7	1.8

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Human capital development: difference between foreign and domestic firms (2004)

Ratio of the mean of the foreign variable to the mean of the corresponding domestic variable			
Sector	Professional employees	Labor quality	Labor cost
Manufacturing	1.1***	1.7***	1.2**
Food	1.2	3***	1.1
Beverage	1.3	2.1	1.1
Textiles	0.9	0.7	1.1
Wood products	1.1	0.8	1.2
Paper	1	1	1
Printing and publishing	1.1	2.6***	1.1
Chemicals	1.1*	3.2***	1.1
Pharmaceuticals	1.1	2.2	1.1
Plastics	1	0.9	1.2**
Non-metal mineral products	1	0.7	1.1
Metal production	1.1	0.9	1.1
Metalworking	1	0.9	1.1
Machinery	1	1.4	1.2***
Electrical machinery	1.1	1.2	1.3***
Computer and office equipments	1.4	7.5***	1.3*
Communication equipments	1	0.7	1.3*
Medical instruments	1	1.2	1.1
Watches	1.4	1.1	0.4
Transport equipments	1	1	1.5**
Other manufacturing	1	0.7	1.3

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Estimation results for manufacturing: Spillovers from FDI and the level of absorptive capacity of domestic firms

	1	2	3	4	5	6
Variables	Full	Small GAP	Mid GAP	Large GAP	High $INVEST$	Small $INVEST$
ΔLnK	-0.0004	0.45***	-0.005	-0.006	0.002	-0.006
	(0.004)	(0.04)	(0.006)	(0.005)	(0.005)	(0.01)
ΔLnL	0.77***	0.38***	0.71***	0.79***	0.95***	0.67***
	(0.07)	(0.1)	(0.09)	(0.05)	(0.07)	(0.1)
HC	0.42***	0.23***	0.57***	0.66***	0.41***	0.37
	(0.06)	(0.07)	(0.1)	(0.07)	(0.08)	(0.2)
FP_j	0.0002	0.0005	0.009***	0.005***	0.004***	-0.002
	(0.0009)	(0.001)	(0.002)	(0.001)	(0.001)	(0.006)
$FP_j{*}HC$	0.006	-0.00007	0.01*	0.011***	0.005*	0.004
	(0.004)	0.003	(0.006)	(0.003)	(0.003)	(0.02)
$\Delta Comp$	1.54***	-0.36*	1.76***	1.43***	1.67***	1.45***
	(0.14)	0.19	(0.15)	(0.1)	(0.1)	(0.2)
$Size$	-0.001	0.03***	0.01	-0.007	0.004	-0.02
	(0.008)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)
$\bar{R}^2$	0.67	0.88	0.69	0.77	0.79	0.6
$F-Chow$			15.6		8.16	
N	370	71	106	193	179	61

Notes: All estimations include industry dummies. All standard errors, in parentheses, are corrected for heteroskedasticiy.

Variables (HC and FP) used for interactions are centered by subtracting the full sample means, so that (1) multicollinearity between the variables and their product is reduced, (2) better estimates of (HC and FP) are ensured, and (3) more meaningful interpretations of those estimates are granted (Aiken and West, 1991).

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.