Are There Regional Spillovers from FDI in the Swiss Manufacturing Industry?

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Abstract

This paper examines whether there are signs of regional spillovers from FDI, wherein evidence is still very scarce. It hypothesizes that (a) spillovers to local firms tend to be geographically bounded within the same region as foreign affiliates; (b) the assessment of regional spillovers relies upon a detailed analysis of these effects according to the channels by which they occur (viz. the increase of competition, worker mobility, and demonstration effects); and (c) the size and the extent of these effects depend upon the interaction between their channels and the levels of the absorptive capacity of local firms. Using detailed firm-level data from manufacturing in Switzerland, we find that local firms gain from the presence of foreign firms in their region, but loose out if the firms are located in different regions. Competition-related spillovers appear to be fully absorbed by local firms with high technological capacities; worker-mobility-related spillovers are fully absorbed by low technology firms; while demonstration-related spillovers are absorbed by all groups of firms with mid technology firms experiencing the larger benefit. In addition, our results demonstrate that only local firms which have largely invested in the absorptive capacity gain benefit from spillovers, stemming mainly from the technology transfer. This benefit seems to occur at both the regional level and from outside the region.

Keywords: FDI; Spillovers; Regional effect, Demonstration effects; Competition effects, Worker mobility; Local absorptive capacity

JEL classification: D21; D62; F21; F23; O33; R11

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1. Introduction

MNCs are widely considered the main source for spillover benefit reflected in productivity improvements of the local host country's firms. This benefit is the main motive of many governments in host countries, both developed and developing, for liberalizing their FDI regulations and encouraging the inflow of FDI (Dunning 1992 and Buckley et al. 2003). In fact, MNCs are generally assumed to possess the advanced technology (production technology, marketing and management technique, etc.) they tend to exploit in many host countries and, consequently, other firms, particularly the host country's, expect to learn from this technology so as to get the necessary strength to face the foreign competition.

The literature of MNCs distinguishes two groups of spillover effects: the competitive disciplinary effects and knowledge spillovers. The competitive effects operate through either a more efficient use of existing technology and resources or an assimilation of foreign technologies. While, knowledge transfer effects may result from the introduction of new know-how to local firms, by among other things, demonstrating new technologies and training workers who later work for local firms. Spillovers may occur either in the foreign affiliates' own industry or in other industries – among the affiliates' suppliers or customers.[1]

The number of empirical studies analyzing the incidence of intra-industry spillovers is rapidly growing (among others Haddad & Harrison, 1993; Kokko, 1994; Kokko at al., 1996; Konings, 1999; Yeaple and Keller, 2003; Dimelis, 2005; Ruane and Ugour, 2005; Liu and Wei, 2006; Buckley et al., 2007; and Barbosa and Eiriz, 2009).[2] However results thus far have been mixed for country analyses and evidence on spillovers has not been conclusive yet. This heterogeneity on spillover results could be a result of misspecification of spillover effects. That is spillovers might not be observed at the aggregate level (for all firms/industries/regions), but only in the sub-set of firms which share some common characteristics and are located not far from foreign affiliates.

When spillover effects are measured for local firms in all regions (i.e. at a national level), the regional benefits might not be observed if they are too small to offset the overall negative

[1]The focus in this paper consists on studying the intra-industry spillovers, although the effects via vertical linkeage are also of great importance and worthy to explored.

[2]Meta-analyses of spillover studies are presented in Görg and Strobl (2001) and Meyer and Sinani (2005).

impact across all regions (Aitken and Harrison, 1999). Spillover benefits tend to be captured firstly by neighboring local firms, and gradually spread to other, more distant ones. In fact, firms in the same location tend to follow the same technological trajectory wherein technological disparities are expected to be smaller, since MNCs are more likely to establish affiliates in more competitive regions (Dunning, 1992, and Dunning and Gugler, 2008). Then, local firms within the same location are more likely to benefit from spillovers than other, more distant ones. Furthermore, given that labor turnover and demonstration are among the important channels of spillovers, local firms located nearby in the same region may be more likely to benefit from foreign affiliates than other ones, since knowledge is generated and transmitted more efficiently via local proximity and its transmission costs are assumed to increase with distance (Audretsch, 1998). However, despite these strong arguments supporting that foreign investment generate spillover benefits but only for local firms located nearby, a very little attention has been paid by scholars to the fact that learning is highly localized (Yildizoglu and Jonard, 1999) and that spillovers are geographically bounded.

Besides geographic dimension, the literature suggests that local characteristics may also influence the magnitude and the scope of spillovers, in that only local firms with high absorptive capacities are assumed to gain benefit from FDI spillovers (Cantwell, 1989). Spillover effects are not identically distributed between local firms at different technological levels and the size and the extent of these effects then vary according to the level of local absorptive capacity. In addition, spillovers are assumed to occur through a variety of channels and thus the assessment of spillovers calls upon a detailed analysis of these effects according to the channels by which they occur (Kokko, 1996; Ben Hamida, 2008; and Ben Hamida and Gugler, 2009). Spillovers are far from being proportional to the share of foreign presence which has, by and large, employed by scholars. This variable does not take into account the effect of competition increase and/or that of worker mobility. We thus believe that additional variables to measure spillovers regarding the ways they occur are required to provide a thorough analysis of these effects in which the process of spilling-over would be exactly identified.

According to the above claims, we recognize that the assessment of spillovers calls upon a detailed analysis of the circumstances under which they occur. Firstly, the regional dimen-

sion has a significant role in assessing spillover benefits and, secondly, the binomial spillover channels/technological conditions of local firms is also important to consider when measuring these effects. This paper attempts to examine empirically the intra-industry spillover effects from FDI using firm-level data from manufacturing in Switzerland. It uses the regional distribution of FDI to test for spillovers within and across Swiss regions and hence tends to propose some components for a research agenda on regional spillover effects which deserve more attention. It also calls upon a detailed analysis of these effects according to the ways they occur – the share of total sales in the industry accounted for by foreign firms is employed to capture the demonstration-imitation effects, while other control variables are used to assess the competition- and worker mobility-related spillovers. And it supports the hypothesis that local absorptive capacity also affect the size and the extent of spillovers. As it has been recently argued by Ben Hamida (2007), our paper allows for potential interaction effects between the spillover channels and the levels of the absorptive capacity of local firms.

Switzerland is a particularly interesting example for this study. First, it experiences increasing flows of inward FDI over time – Switzerland is one of the smaller European countries which, like Austria and Norway, recorded sharp increases in inward FDI over the last years mainly in 2003 which even surpassed those of outward investment (OECD, 2004). FDI in Switzerland is not equally distributed across regions – the Alps for example are not internationalized, while the cantons of Vaud, Geneva, Zurich, Basel, Fribourg, and Ticino experience large inward investment which is above the national average (Crevoisier and Roth, 2005). This heterogeneity lends support to the hypothesis that spillovers would have a regional dimension and be highly localized. Second, Switzerland is regarded to have achieved competitive technological levels in many industries and then possesses sufficient level of the absorptive capacity to efficiently exploit spillovers.[3] Third, it has an open and welcoming attitude towards FDI (UNCTAD, 2006). Swiss government authorities, especially cantons, attempt to attract MNCs to Switzerland using substantial fiscal and financial incentives; favorable tax treatment is provided for many forms of foreign investment (Sermet, 2003).[4] Fourth, to date, there has been no investigation of the

[3]MNCs tend to concentrate their activities in more dynamic and competitive industries (Rugman and Verbeke, 2003).

[4]Recently, after the failure to attract the American MNC "Amgen" to set up affiliate in Switzerland, Joseph Deiss "the head of economic department in Switzerland" claims that efforts should be gathered to reinforce the

potentially regional FDI spillover benefits in Switzerland. Therefore, it is promising to study these effects and assess their key determinants for Swiss firms, so as to give insights to Swiss policy makers (especially at the regional level) about how to promote these benefits as well as to draw general conclusions.

The structure of the paper is as follows. Following this introduction, section 2 analyzes the theoretical framework underlying our hypotheses, together with a review of the relevant empirical studies. Section 3 presents the econometric model, section 4 discusses the Swiss data, section 5 presents the estimation results, and section 6 concludes the paper.

2. Inward foreign investment and spillovers: The potential for regional dimension

As previously noted, positive spillovers represent one of the main elements justifying the effort made by government to attract foreign investors (Narula and Dunning, 2000). A large literature has been developed over the last two decades around the concept of intra-industry spillovers. Nonetheless, despite the policy relevance, spillover effects of FDI on host economies are not well understood – empirical results have been mixed for country studies and evidence on spillovers has not been conclusive yet. This could be due to some troubles related to the specification of spillovers; that is, firstly, existing studies have mostly analyzed spillovers at the national level – for local firms in all regions – and ignored that spillovers is highly likely to be localized. Secondly, the share of total (output, employment, or capital) in the industry accounted for by foreign firms, largely used by scholars as a proxy of spillovers, might be inappropriate to capture much of the competition- and worker mobility-related spillovers. Thirdly, spillovers might not be observed for all firms but only in the subset of firms that largely invest in the absorptive capacity.

Our study recognizes the above problems as important arguments to take into consideration when exploring spillovers in Swiss manufacturing firms. In the following sub-sections, we discuss the theoretical and empirical frameworks underlying these arguments. Sub-section 1 highlights the role of the regional dimension in assessing the benefit of spillovers and sub-section 2 calls for a detailed analysis of spillovers according to the channels by which they

attractiveness of Switzerland on the part of foreign MNCs by developing clusters, essential to increasing the competitive power of the Swiss economy (Nussbaum, 2006).

occur as well as the technological levels of local firms. Sub-section 2 further demonstrates that the assessment of spillovers largely depend on the interaction between the ways they occur and the levels of the absorptive capacity of local firms.

2.1. Spillovers at the level of the region

Recent literature suggests that learning is highly localized (Yildizoglu and Jonard, 1999) and that spillovers are geographically bounded. They tend to be captured firstly by local firms located in the same region as foreign affiliates and may gradually spread to other, more distant ones (Aitken and Harrison, 1999). It is argued that, first, firms in the same (location/ region) tend to follow the same technological trajectory; wherein technological disparities are expected to be smaller, since MNCs are more likely to establish affiliates in more competitive regions (Dunning, 1992). Local firms within the same region are then more likely to benefit from spillovers than others – Blomström et al. (2001) assume as well that the regions with significant location advantages gain the most benefit from the presence of foreign firms.[5] Second, knowledge is transmitted more efficiently via local proximity and its transmission costs are assumed to increase with distance (Audretsch, 1998). Firms located nearby in the same region observe and imitate more efficiently foreign technology than other ones and the transfer of technological know-how via the mechanism of worker mobility is more likely to occur within the regional boundaries than outside the region. The channels of technological diffusion are then reinforced at the level of the region (Crespo et al., 2008) and spillovers are expected to be larger.

Accordingly, we recognize that scholars assessing FDI spillovers without considering the geographic dimension may yield misleading results. That's why the absence of significant and positive effects of spillovers measured for local firms in all regions (i.e. at a national level) may be that the entry and presence of foreign investors generate spillovers, but only for firms located nearby. Then, when spillovers are measured at a national level, these regional benefits might not be identified if they are too small to offset the overall negative effects across all regions.

Aitken and Harrison (1999) advanced the idea that spillovers have a regional dimension. To test for the possibility that spillovers occur at the regional level, they include regional foreign

[5]Girma and Wakelin (2002) also indicate that more-developed regions gain more from spillovers than others.

share and that from outside the region in the specification rather than sectorial foreign share. Regional foreign share is measured by the share of employment in an industry within a region employed by foreign firms. Using firm panel data for Venezuela, they found that regional foreign investment has positive and significant impact on the productivity of Venezuelan firms, while sectorial foreign investment has negative effects. This evidence for regional spillovers has been latter on confirmed by a number of scholars. For example, using sector-level data in the UK, Driffield (2004) found positive productivity spillovers from FDI in the same region, while FDI outside the region has a negative impact on productivity. Driffield argues that this negative effect is consistent with a negative competition effect from foreign firms outside the region, which is not offset by the positive spillovers at the regional level. Also, using firm panel data for China, Liu and Wei (2006) found evidence of regional spillovers from FDI. Spillovers across Chinese regions are negative and insignificant; this may be due to the existence of barriers to the movement of production and output factors across regions in China. Also,

Then the above discussions point to these hypotheses:

Hypothesis 1: Using the full sample of Swiss manufacturing firms, there is on average no evidence for spillovers at the national level.

Hypothesis 2: By taking into account the regional dimension, spillovers occur for the Swiss manufacturing firms located in the same region as their foreign counterparts and loose out across regions.

At the end of this sub-section, it is noteworthy that there exist studies which failed to confirm that the regional dimension matters such as Sjohölm (1999) and Halpern and Muraközy (2005). Sjohölm examined Indonesian firms in 1980 and 1991 and found evidence of positive spillovers at the national level, whereas regional spillovers from FDI were negative. Using panel data for Hungarian manufacturing firms, Halpern and Muraközy also find that spillovers within or across regions were not different from each other, both were insignificant. They attributed this finding to the fact that Hungary is a homogenous country from the viewpoint of spillovers because of its small size. Regional boundaries in these cases do not seem to be boundaries for spillovers.

In the following sub-section, we demonstrate that foreign share that has been used by scholars to measure spillovers is not appropriate to assess the whole effect of spillovers in the region

and that spillovers do not occur automatically but other factors such as the technological characteristics of local firms may influence these effects. Then scholars disregarding these argument may fail in assessing regional spillovers.

2.2. The binomial spillover channels/local absorptive capacity

2.2.1. FDI and spillover channels

As previously noted, spillovers occur, firstly, when the foreign firms after entering the market demonstrate their advanced technologies and local entrepreneurs, after observing a product innovation or a novel form of organization adapted to local conditions, may recognize its feasibility and thus strive to imitate it (Meyer, 2003). Secondly, when the increase in competition that occurs as a result of foreign entry forces local firms to introduce new technology and/or work harder.[6] Thirdly, when local workers trained by or having worked in MNCs' affiliates may decide to leave and join an existing or open up a new local firm, taking with them some or all of the MNC-specific knowledge.

Relatedly, the value of FDI spillovers depends broadly upon the mechanism by which they occur. That is, on the one hand, firms differ in their technological competence and in turn they differ in their choice of the way to benefit from the presence of FDI (Ben Hamida and Gugler, 2008). Then, the relevance of each spillover mechanism varies with the technological characteristics of local firms, in that if technological accumulation is continuous in each local firm, raising its productivity or lowering its costs along a given line of technological development, then no firm would abandon its existing pattern of innovation and imitate the technological knowledge of foreign competitor (Cantwell, 1999 and Silverberg and Verspagen, 1994). On the other hand, the amount and nature of the technologies transferred from foreign to local firms depend largely upon the mechanism by which they are transmitted. That is, spillovers via worker mobility for example are likely to be higher than through demonstration effects, since worker mobility can lead to substantial improvements in productivity throughout the local economy by transferring not only public technology, but also the tacit element that is unlikely to be transferred through

[6]It is noteworthy that in short run the competition effects could be of a negative sign (crowding-out effects or market stealing effects). These negative effects occur when foreign firms with superior technology force local firms to exit, since they attract demand away from them (Damijan et al. 2007).

informal contacts between firms.[7]

Thus, we strongly believe that the assessment of the existence and the extent of spillover benefits for a given firm, industry, or country calls upon a detailed analysis of these effects according to the ways they occur. Empirical studies analyzing spillovers at both national and regional levels are, however, focused on given partial analyses of these effects. In fact, they, by and large, measured spillover effects by the share of foreign presence in the corresponding industry within the (region/nation) – e.g. foreign employment/sales share.[8] This variable seems to be inappropriate to capture much of the competition and worker mobility related spillovers.[9] As suggested by Kokko (1996) and Ben Hamida (2007), 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 competition and worker mobility effects.

Consequently, if the share of foreign presence is not appropriate to assess the whole spillover effects from the increase of competition and the worker mobility, it seems clear that studies using this measure may yield misleading results. Assessing the overall spillover effects then needs to disentangle the effect of competition and worker mobility from that of demonstration by employing different control variables for each spillover mechanism.

2.2.2. On the role of the interaction effect between spillover channels and the local absorptive capacity

The literature suggests that spillovers largely depend on the level of the absorptive capacity of local firms, in which only local firms possessing sufficient levels of absorptive capacity are likely to efficiently exploit spillovers (Cohen and Levinthal, 1989, 1990; Cantwell, 1989; and Narula, 2003a and b). The concept of absorptive capacity encompasses the firm's ability to recognize valuable new knowledge, integrate it into the firm and use it productively. The firm's level of absorptive capacity depends then upon its existing level of technological competence as well as its learning and investment efforts undertaken to be able to use productively foreign

[7] Wojnicka (2004) asserts that the mobility of labor is a source of tacit knowledge essential for innovativeness and competitiveness of local enterprises.

[8] Examples of scholars who used this measure are Aitken and Harrison (1999), Sjöholm (1999), Kokko et al. (2001), Castellani and Zanfei (2002), Barrios and Strobl (2002), Dimelis and Louri (2002), Buckley et al. (2003), Görg and Strobl (2004), Marin and Bell (2006), and Tian (2007).

[9] The spillovers from competition are not determined by the share of foreign presence alone, but rather by the simultaneous interaction between foreign and local firms (Kokko, 1996 and Wang and Blomström, 1992).

knowledge. As suggested by Narula and Marin (2003, p. 23), "*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 local firms raising their productivity. Thus it is expected that only local firms which largely invest in absorbing foreign technologies benefit from FDI spillovers.

This theoretical argument have been broadly employed by scholars when testing for FDI spillovers at the national level (by among others, Konings, 1999; Liu et al., 2000; Girma, 2003; Damijan et al., 2003; and Dimelis, 2005). However, at the regional level, a small number of scholars paid attention to the fact that local absorptive capacity may influence spillovers in the region. Using firm panel data for UK, Girma and Wakelin (2002), for example found that local firms located in sectors characterized by low technology gaps between foreign and local firms – used as a measure of the absorptive capacity – gain more from regional spillovers and loose out if the firms are located in different regions. Girma and Görg (2005) considered also in their specification the local absorptive capacity, which is quadratically related to the spillover effects. They found an U-shaped relationship between the absorptive capacity and spillovers from FDI in the region, while there is an inverted U-shaped relationship for spillovers from FDI outside the region. Conversely, Girma (2003) found that the relationship between spillovers and absorptive capacity is an inverted U-shape, either from FDI located in the same region as UK firms or outside the region.

Yet, existing studies disregarded the importance of learning and investment efforts in determining the absorptive capacity of local firms and, mostly, retained their existing level of technological capacity or their technological gap vis-à-vis foreign firms as proxies. Doing so, the influence of the learning and investment efforts on spillovers is not tested for and then the whole effect of the local absorptive capacity is not assessed. Two exceptions are Narula and Marin (2003) and Ben Hamida and Gugler (2008) who appropriately defined the local absorptive capacity by employing a thorough measure of local absorptive capacity in which the learning and investment efforts of local firms come with their existing technological capacities. They tested spillovers a the national level and they reported that only local firms that largely invested in the absorptive capacity received positive spillovers from FDI. Investment and learning efforts are

proxied in Narula and Marin's paper by investment in new equipment for product/process innovation and training activities undertaken by Argentinean firms between 1992 and 1996, while in Ben Hamida they are measured by the level of investment expenditures in new equipment and training activities for product/process innovation undertaken by Swiss firms within the period 2001-2004. Yet, the distinction of Argentinean firms according to different levels of industrial technology gap (high and small) does not provide any significant spillovers.

The literature recognizes, in addition, that the size and the extent of spillovers may largely depend upon the interaction between the mechanisms by which they occur and the existing technological levels of local firms – first component of the local absorptive capacity (Mody, 1989 and Ben Hamida, 2006a and b). 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 local 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 (Ben Hamida, 2006b).

Recently, Ben Hamida and Gugler (2008) tested this interaction for Swiss manufacturing firms at the national level and found that local firms with high technological capacity appear to gain benefit from spillovers from the increase of competition, while mid technology firms benefit a lot from demonstration effects. Yet, low technology firms manage to reap the spillover benefits via the recruitment of MNCs labor.

In this paper, we pursue the idea at the regional level by testing whether the increase in the productivity of local firms located in the same region as foreign affiliates is a function of the interaction effects between spillover channels and the technological capacities of local firms. By identifying the high, mid, and low technology firms separately, we are able to look at the effects of the regional spillovers within different technological settings. In addition, we make use of a thorough measure of local absorptive capacity in which the learning and investment

efforts of local firms come with their existing technological capacities. These details are of a great importance to policy makers in leveraging the potential benefits of regional FDI spillovers, especially, the Swiss government.

Hence, section 2 highlights further hypotheses:

Hypothesis 3: The magnitude of competition-related benefit of regional spillovers absorbed by local firms is largest in the sub-sample of Swiss manufacturing firms with high technological capacity.

Hypothesis 4: The magnitude of demonstration-related benefit of regional spillovers absorbed by local firms is largest in the sub-sample of Swiss manufacturing firms with mid technological capacity.

Hypothesis 5: The magnitude of worker mobility-related benefit of regional spillovers absorbed by local firms is largest in the sub-sample of Swiss manufacturing firms with small technological capacity.

Hypothesis 6: Regional Spillover benefit (whatever the channel by which it occurs) is only absorbed by local firms which largely invest in the absorptive capacity.

3. Econometric model

We model the effects of regional spillovers within the context of a production function,[10] in which the change in the natural log value-added of the i-th local firm is determined as follows:

$$\begin{aligned}\Delta LnY_{i,j} = \alpha_0 + \alpha_1 \Delta LnK_{i,j} + \alpha_2 \Delta LnL_{i,j} + \alpha_3 FP_{j,r} + \alpha_4 FP_{j,R-r} + \alpha_5 HC_{i,j} \\ \alpha_6 FP_{j,r} * HC_{i,j} + \alpha_7 FP_{j,R-r} * HC_{i,j} + \ \alpha_8 \Delta Comp_{i,j} + \alpha_9 \,\mathrm{Si}\, ze_{i,j} \\ + \alpha_{10} Industry_j + \alpha_{11} \,\mathrm{Re}\, gion_r + \varepsilon_{i,j,r}, \qquad (1)\end{aligned}$$

where the subscripts i, j, and r denote firm, industry, and region, respectively. Δ represents changes in the variables between 2001 and 2004, and α_0, α_1, α_2, α_3, α_4, α_5, α_6, α_7, α_8, α_9, α_{10}, and α_{11} the parameters to be estimated. Table 1 describes the variables and their measurements.

Y denotes value-added at firm level, K its physical capital, L its employment, and HC

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

the level of its human capital. The coefficients of those variables are expected to be positive and significant. $\mathrm{Si}\,ze$, defined by the sales of firm i, is expected to increase productivity since larger sized firms may be more efficient (Dimelis and Louri, 2002). The inclusion of industry dummies, $Industry$, in equation (1)[11] and the use of changes over time control for industry-specific productivity differences; they correct for the omission of unobservable variables that might undermine the relationship between spillover variables and the productivity growth of local firms (Aitken and Harrison, 1999 and Narula and Marin, 2003).

To assess the overall spillover effects of foreign firms on local counterparts, we employ three different control variables with respect to the three possible intra-industry spillover channels: first, the main effect[12] of the share of foreign presence at the four-digit industry level,[13] 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, 2007). 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 local market. Third, we use price markup, $\Delta Comp$, as a measure of competition effects.

Following Aitken and Harrison, we include in equation (1) both the regional foreign share, $FP_{j,r}$, and that from outside the region, $FP_{j,R-r}$, rather than sectorial foreign share in order to test for the regional dimension.[14] Regional foreign share is measured by the share of sales in an industry within a region employed by foreign firms, which is used as a proxy of regional spillovers from demonstration effects. In addition, the interaction term $FP_{j,r} * HC_{i,j}$ is assumed to determine the regional spillovers from worker mobility. The regions considered here are: the Lemanic region, Mittelland space, North West Switzerland, Zurich, Western Switzerland, Central Switzerland, and Ticino. We also include regional dummies, $\mathrm{Re}\,gion$, to account

[11] There are 23 industry dummies.

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

[13] We make use of the maximum available disaggregation industry level to be able to effectively assess the intra-industry spillover benefits.

[14] The data available allows only for testing the role of the regional dimension in determining the size of spillovers arising from the technology transfer process. To make such test for the competition-related spillovers, we would need additional information, particularly those related to the type of the firm's product.

for agglomeration effects that may result in an upward bias of a region-specific spillover coefficient, since some foreign firms could be attracted to regions which benefit from agglomeration economies (Aitken and Harrison, 1999).[15]

The use of an interaction term between foreign presence and human capital to determine the worker mobility-related spillovers could be explained as follows. This interaction assesses the combined effect of these variables on productivity of local firms; that is the influence of foreign firms would be co-determined by the level of human capital of the local firms. It is argued that human capital increases the ability of local firms to benefit from positive spillovers (Borensztein et al., 1998 and Meyer and Sinani, 2002) – 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 technological 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 technological firms are not 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, these firms tend to invest in recruiting local employees already trained by or worked in foreign firms by given them higher salary than foreign firms do – it is assumed that when leaving the MNCs these employees will take with them some or all of the firm specific knowledge (Blomström and Kokko, 2002).

Regarding competition-related spillovers, we use price markup or the so-called Lerner index

[15] According to the number of the regions considered here, we use 7 regional dummies.

as a measure of competition – the difference between the firm's price (p) and its marginal cost (mc) over its total price. Lerner Index measures the degree to which firms can markup prices above marginal cost; the larger the Lerner index, 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 a tight value of (p - mc) and low Lerner index.

Unfortunately the data sets available do not allow for the firm's price and marginal cost information. So, following Narula and Marin (2003) and Chung (2001) we use the difference between the 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.[16] since 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 use 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 a productivity increase.

To test our hypotheses 3, 4, 5 and 6, in which the size and the extent of spillover effects may vary according to the diverse levels of technology capacity of local 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 our full sample of local firms into three sub-samples characterized by the size of their existing technological capacities and estimate equation (1) separately for local firms with high, mid, and small technological capabilities.

The existing technological capacities of local firms are measured by their technology gaps, GAP, compared to their foreign counterparts. GAP is defined as the ratio of the average labour productivity of foreign-owned firms in the relevant four-digit industry to a local firm's own labor productivity, calculated for 2001. Hence, GAP is equal to one if local firms operating at the same labour productivity as the average of their foreign counterparts. Values that are smaller than or equal to one – the technological frontier of the industry – are interpreted as signs of

[16]Note that in some cases a higher markup may be due to industry specificities such as, for example, in the luxury industry (Narula and Marin, 2003).

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 technology gaps, whereas demonstration- and worker mobility-related benefits tend to take place in sub-samples with mid and high technology gaps, respectively.

As a second step, we divide the full sample into two sub-samples according to the investment level of local 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 local 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 are robust and 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 research "KOF".[17] 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.

Tables 2, 3, and 4, and figures 1-7 present a summary of the samples and descriptive statistics of the variables used in the study by type of ownership (foreign and local firms). All these calculations are based on weighted data sets so as to give a representative picture of Swiss economy.[18] As shown in table 2, the share of foreign investment in manufacturing total employment accounted for 2001 was about 19 (21.6 in total sales) which slightly decreased in 2004

[17] Questionnaires can be downloaded from www.kof.ethz.ch (Industrieökonomik), but the firm-level data are unpublished and highly confidential.

[18] 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.

Table 1: Variable definitions

Variables	Definitions
$\Delta LnY_{i,j}$	The log change in value-added 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.
$FP_{j,r}$	The share of total sales in an industry j within the region r accounted for by foreign firms, $r = 1...R$, with $R = 7$.
$FP_{j,R-r}$	The share of total sales in an industry j outside the region r 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 local 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.

(about 17.6 in total employment and 19.6 in sales). This share hides significant differences across regions as shown in table 3, in which Zurich experienced the highest share 32.7 percent (34.8 in sales) followed by North West Switzerland and Western Switzerland (about 18 in total employment) and to only 10.6 percent (8 in sales) in Leamanic region.

Regarding sectors, in 2001 figure 1 shows that foreign share in chemicals, machinery, and medical instruments was preeminent in the Lemanic region. Central Switzerland also holds large foreign share in chemicals as well as in plastics (figure 6). While foreign share in Mittelland space is preeminent in paper, textiles, and electrical machinery (figure 2). North West Switzerland recognizes large shares, mainly, in electrical machinery and other manufacturing (figure 3). Foreign firms dominate in transport equipment within both Zurich and Western Switzerland[19] (figures 4 and 5), while in Ticino they are rather dominant in pharmaceuticals (figure 7). In 2004, the results change considerably across regions; some sectors recognize a decrease in foreign shares, mainly chemicals in the Lemanic region and Central Switzerland, food in Western Switzerland, and textiles in Zurich; whereas an increase in foreign shares is identified within, for example, Western Switzerland and Zurich in, mainly, electrical machinery; also within North West Switzerland in communication equipment. The foreign share in Western Switzerland recognizes also an increase in chemicals. Other sectors, such as pharmaceuticals, witness a decrease in foreign share within the boundaries of Ticino and at the same time an increase within the Mittelland space.

Table 4 compares the relative technological performance of foreign and local firms across regions in 2004, measured by the share of innovative products in sales. At the aggregate level, the significant difference in favor of local firms is in Lemanic region and North West Switzerland, stemming, for the most part, from metal production and machinery, respectively. This shows that MNCs attempt to invest in Lemanic region and North West Switzerland to be close to local knowledge, and this could result, in our view, in spillover benefits for foreign affiliates.[20] While in other regions, such as Mittelland space and Western Switzerland, foreign firms predominate, although the difference is not significant, stemming mainly from communication

[19] Western Switzerland holds large foreign shares in other sectors such as food.

[20] Although it is not significant, the difference in favor of local firms is also present in Ticino and Central Switzerland.

equipment.

Moreover, it is noteworthy that, in the same region, the dominance change across sectors. In the Lemanic region for example, foreign firms seem to innovate more in sectors like non-metal mineral products, medical instruments, and chemicals, whereas local firms perform largely in metal production. In Mittelland space, foreign firms predominate in paper, printing and publishing, and communication equipment; while sectors like food and metalworking are rather dominated by local innovations. These results clearly demonstrate that within the same region, possible signs of spillovers from and to the MNCs' affiliates may take place – this provides evidence confirming our hypothesis that spillovers are highly likely to be localized. Moreover, the table shows that for some sectors foreign firms dominate in a region while their local counterparts dominate in another; this shows that for the same sector both may occur spillovers and reverse spillovers depending on the region.[21]

Are there regional spillovers from FDI in the Swiss manufacturing firms – arising from the learning process of foreign technologies within regional boundaries – is the focal point of our empirical analysis discussed in the next section.[22]

5. Regression results

Regression estimates, column 1 in table 5 shows the results at the national level of the spillover tests of the full sample of 370 Swiss manufacturing firms. At this stage we do not take into consideration the effect of the regional dimension on spillovers and instead assume that spillover effects dissipate through the whole industry, regardless of location. The value added of the firms in Switzerland for the full sample increases with changes in the employment and the human capital of local firms. However, local firms do not seem to increase their value added from spillovers at the national level, which supports our hypothesis 1. In fact, the estimated coefficient of the variable FP is negative and insignificant, indicating that foreign presence does not have any effect on productivity growth of local firms; so on average there is no evidence of technological spillovers from demonstration effects at the national level. Alike, the interaction

[21] For example, the machinery and chemicals sectors are dominated by foreign firms in Western Switzerland and by local firms in Central Switzerland.

[22] The regression analysis makes use of a sample of only 370 manufacturing firms. This is due to missing data on some variables when matching the two data sets of 2002 and 2005 surveys.

term between FP and HC is also insignificant, indicating that the full sample data have not demonstrated the change in response with FP at the national level depends on the level of human capital. The increase in competition also impede the productivity growth of local 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 local firms.

Columns 2-7 in table 5 are confined to test the role of the regional dimension on spillover effects. They report the spillover results at both the regional level and from outside the region. Compared with the regression results for the full sample of manufacturing, wherein spillovers do not seem to occur at the national level, column 2 reports different results in which the coefficients of $FP_{j,r}$ and $FP_{j,r} * HC$ become positive and significant at the regional level and remain insignificant and even significantly negative outside the region. This finding corroborates hypothesis 2 in that spillovers have a regional dimension. local firms gain from the presence of foreign firms in their region, but loose out if the firms are located in different regions. This confirms the results of, among others, Aitken and Harrison (1999), Driffield (2004), and Liu and Wei (2006). Yet, the $\Delta Comp$ estimates remain positive and significant. There is still no evidence for competition-related spillovers all the firms are taken together. The benefit seems to be only in the form of technology transfer. The coefficients of HC and ΔLnL remain positive and significant, suggesting that the change in human capital and employment levels of local firms is broadly associated with productivity increase. The ΔLnK and Si ze estimates remains negative and insignificant.

In column 3-5, we have divided our full sample of manufacturing into sub-samples of firms characterized by the level of the technological gap between foreign and local firms and we have made various tests of regional spillover effects using equation (1). The FP at the regional level, $FP_{j,r}$, is positive and significant for all the sub-samples, with mid technology firms – when GAP is slightly greater than one – experiencing the larger regional demonstration-related spillover effects. This finding supports hypothesis 4, in which the magnitude of demonstration-related benefit of regional spillovers absorbed by local firms is largest in the sub-sample of firms with mid technological capacity. In sharp contrast, the FP outside the region, $FP_{j,R-r}$, is not significant for all the sub-samples except for the mid technology manufacturing firms

which appear to gain benefit also from outside their region – such benefit is by far smaller than that of $FP_{j,r}$. The estimated coefficients of $FP_{j,r} * HC$ are significantly positive only for the high gap firms' sub-sample, indicating that for such kind of firms the combined effect of these variables contribute to a productivity increase. For low technology firms, the size of such an interaction effect is larger than that of $FP_{j,r}$, suggesting that the influence of regional FDI on the productivity development of these firms is broadly co-determined by the level of their human capital – this could be evidence for worker mobility-related spillovers. Low technology firms do not seem to benefit from foreign firms located outside their region, since neither $FP_{j,R-r}$ nor $FP_{j,R-r} * HC$ are significantly positive. Given that, we can conclude that regional spillover benefits gained through the mechanism of worker mobility across the full sample of local firms (column 2) are totally absorbed by low technology firms. This lends support to our hypothesis 5.

$\Delta Comp$ becomes negative and significant for small gap firms; mid and large gap firms do not seem to benefit from competition-related spillovers. High technology firms appear to also gain benefits from spillovers from technology transfer since $FP_{j,r}$ is positive and significant – the size of this benefits is much smaller than that of $\Delta Comp$. Our hypothesis 3 is then supported in which high technology firms gain benefit, mostly, from the effect of the increase of the competition.

In columns 6 and 7 in table 5 we report the results of spillover effects at the regional level for the sub-samples characterized by the values for the variable $INVEST$. Only local firms which have highly invested in the absorption capacity gain benefits from regional spillovers. Such benefits result from technology transfer – $\Delta Comp$ does not appear to have any positive spillover effects. $FP_{j,r}$ and $FP_{j,R-r}$ are positive and significant indicating that manufacturing firms which have largely invested in the absorptive capacity gain demonstration spillover benefits in the region and from outside the region, with the benefit from outside the region is smaller than that of $FP_{j,r}$. The coefficient $FP_{j,r} * HC$ is also significantly positive for the high-$INVEST$ group, showing that the regional spillovers are also co-determined by the level of the firms' human capital. This could be a sign of worker mobility-related spillovers in the region. Hypothesis 7 is then confirmed.

The Chow tests soundly support our divisions (with respect to GAP and $INVEST$) of manufacturing sample.

6. Conclusions

The effect of FDI spillovers on the productivity performance of host countries is a challenging research topic. Spillovers is viewed as the main motivation of host government to attract FDI and many governments pay special attention to this benefit when measuring the successful performance of their FDI policies. Nonetheless, empirical findings are mixed for country studies and the evidence on spillovers has not been conclusive yet. This could be due to some troubles related to the specification of spillover effects.

In this paper, we study the effect of FDI spillovers on the productivity performance of Swiss manufacturing firms and we recognize that the assessment of spillovers is a very difficult task, since the benefit does not occur automatically but depends on many parameters. Our paper assumes that the geographic proximity between foreign and local firms is an important element in determining spillover benefit and highlights the importance of taking into consideration this dimension for the specification of spillovers – as argued by Aitken and Harrison (1999), spillovers to local firms tend to be geographically bounded within the same region as foreign affiliates. Our paper calls upon a detailed analysis of these effects according to the channels by which they occur (viz. demonstration effects, competition effects, and worker mobility). Relatedly, it hypothesizes that the size and the extent of regional spillovers depend largely upon the interaction between their channels and the absorptive capacities of local firms. In this respect, it examines whether spillovers from foreign to local firms in Switzerland have some regional dimension and hence propose some components for a research agenda on regional spillovers wherein evidence is still scarce. Our data seem to substantiate our hypotheses, giving evidence from Switzerland.

Based on a sample of Swiss manufacturing firms, we show that spillover from FDI occur at the regional level and that the channels of spillovers as well as the technological heterogeneity of local firms are important to consider when evaluating regional spillovers generated from FDI. That is, taking all the firms together the results do not report significant evidence for

spillovers in Switzerland at the national level. However, once taking into account the regional dimension, spillovers occur for the Swiss manufacturing firms located in the same region as their foreign counterparts and loose out across regions. Competition-related spillovers are found to be totally absorbed by local firms with high technological capacities. Worker-mobility-related spillovers are fully absorbed by low technology firms. While demonstration-related spillovers are absorbed by all groups of firms with mid technology firms experiencing the larger benefit.

In addition, our regression results demonstrate that only local firms which have largely invested in the absorptive capacity gain benefit from spillovers, stemming mainly from the technology transfer. This benefit seems to occur at both the regional level and from outside the region. Spillovers, however, affect negatively the productivity growth of local firms which have not been actively engaged 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 occur at the regional level and require sufficient level of human capital, especially for high gap firms, to be able to efficiently use foreign knowledge. In addition, how local firms benefit from regional spillovers depends largely on their levels of technological capacity and Swiss government, especially, the cantons have to take into account the heterogeneity of the local firms plays a crucial role in benefiting from spillovers. At the same time, actions to motivate subsidization of foreign investment as well as to support learning and investment in local firms seem to be necessary ingredients in a policy package to maximize the technological spillovers from FDI. And foreign firms might be established near to local counterparts, in particular, mid and low technology firms to better absorb foreign resources and then upgrade their technological competitiveness

One promising extension of this research would be to analyze spillovers from local firms to MNC's affiliates. As we have noted from the data analysis, MNCs, in some regions, attempt to set up affiliates in Switzerland to be able to learn from the best Swiss technologies and hence we could expect that foreign affiliates gain benefits from spillovers from Swiss-leaders. Authors such as Driffield and Love (2006), Singh (2007), and Sanna-Randaccio and Veugelers (2007) highlighted that the test for the reverse spillover effects, especially for developed economies, could also be interesting.

In addition, exploring other kinds of spillovers in the region such as inter-industry spillovers could also be of a great importance, since it is argued that the commercial ties between MNC's affiliates and either "upstream" local suppliers or "downstream" local customers lead to a transfer of technical and commercial information to suppliers and customers. To test for this kind of spillovers, additional information is needed which is not available from our data. For example, a detailed analysis of the inter-industry relationships (input-output matrices) to identify local customers and suppliers – detailed information on the flow of commodities from production through intermediate use by industries and purchases by ultimate customers – so as to determine the share of foreign affiliates in the output of both upstream and downstream sectors.[23]

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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 local 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 regional 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

$$\begin{aligned}\Delta a_i &= \alpha_3 FP_{j,r,t-3} + \alpha_4 FP_{j,R-r,t-3} + \alpha_5 HC_{i,j,t} + \alpha_6 FP_{j,r,t-3} * HC_{i,j,t} \\ &\quad + \alpha_7 FP_{j,R-r,t-3} * HC_{i,j,t} + \alpha_8 \Delta Comp_j + \alpha_9 \mathrm{Si}\, ze_{i,j,t} + \alpha_{10} Industry_{i,j} \\ &\quad + \alpha_{11} \mathrm{Re}\, gion_r + \varepsilon_{i,j,r}, \qquad (6)\end{aligned}$$

where $FP_{j,r,t-3}$ measures the share of foreign presence in the industry within the region and $FP_{j,R-r,t-3}$ measures the share of foreign presence in the industry from outside the region.

The change in a is also assumed to vary across sectors, regions, the human capital of the local firm, $HC_{i,j,t}$, 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 local firms	Total
2001	19	21.6	185	1016	1201
2004	17.6	19.6	182	952	1134

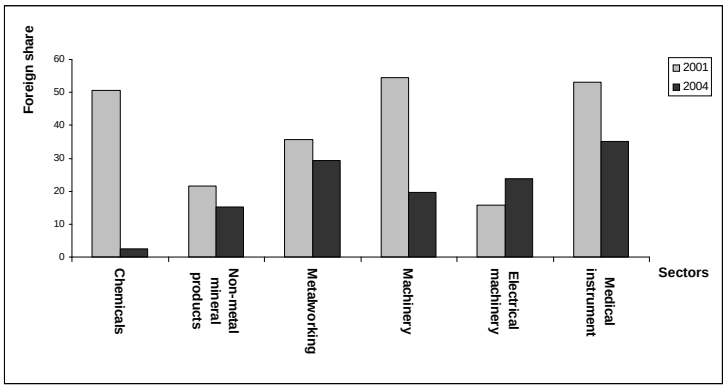

Figure 1: Percent share of foreign firms in total sales in the same sector and region "Lemanic region".

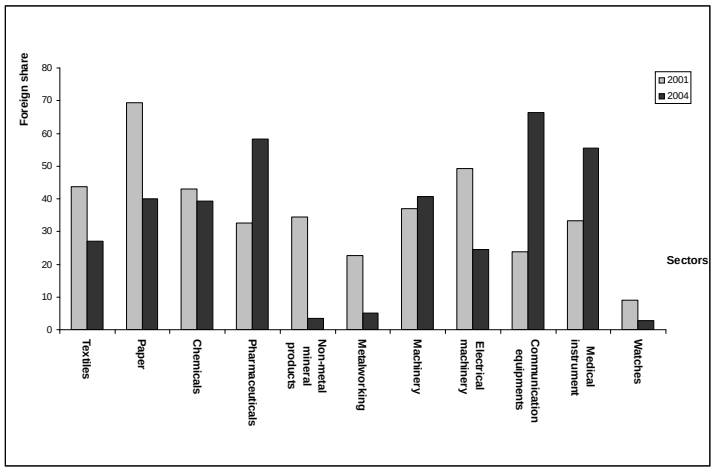

Figure 2: Percent share of foreign firms in total sales in the same sector and region "Mittelland space".

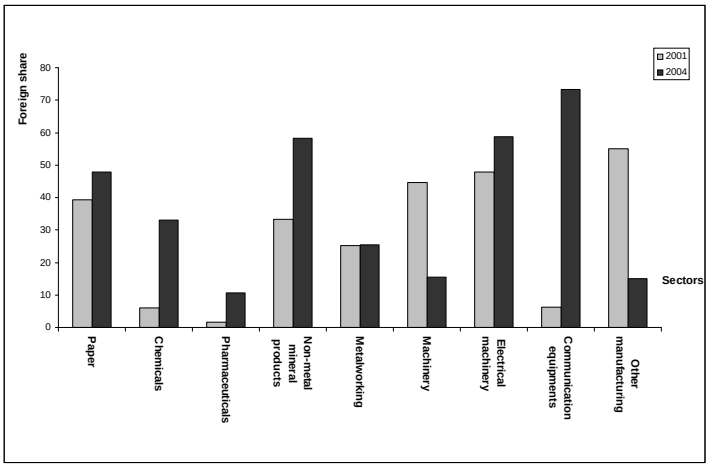

Figure 3: Percent share of foreign firms in total sales in the same sector and region "North West Switzerland".

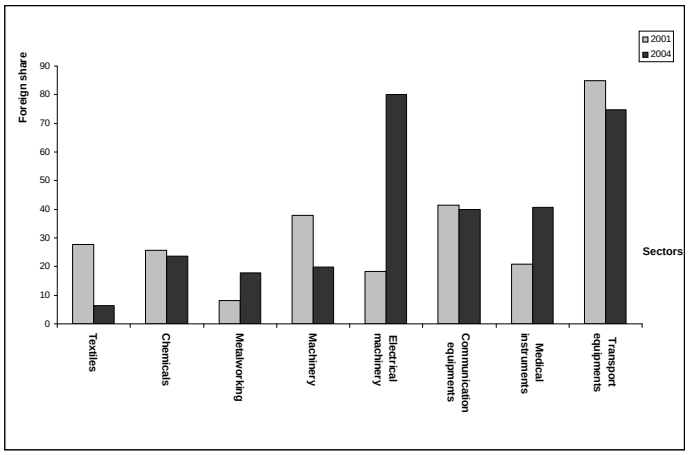

Figure 4: Percent share of foreign firms in total sales in the same sector and region "Zurich".

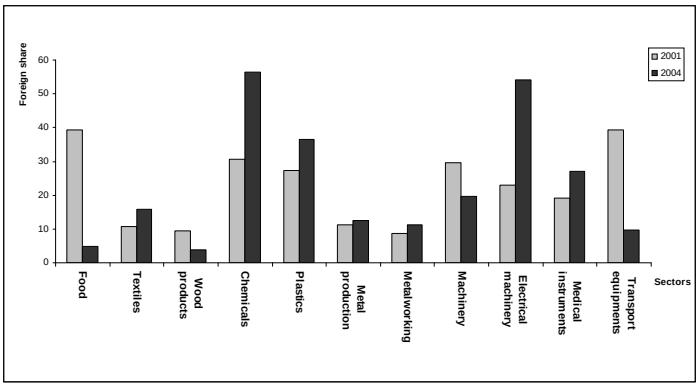

Figure 5: Percent share of foreign firms in total sales in the same sector and region "Western Switzerland".

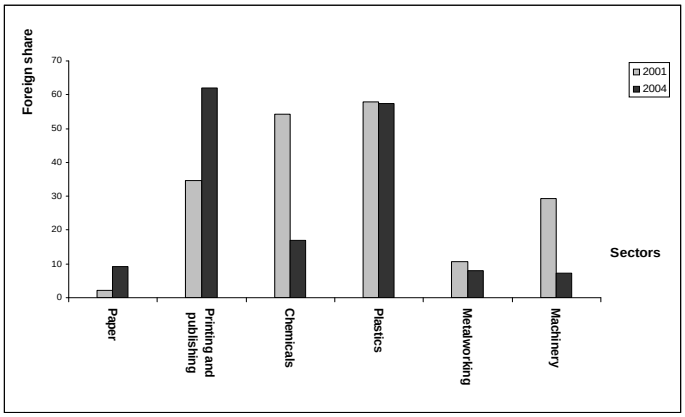

Figure 6: Percent share of foreign firms in total sales in the same sector and region "Central Switzerland".

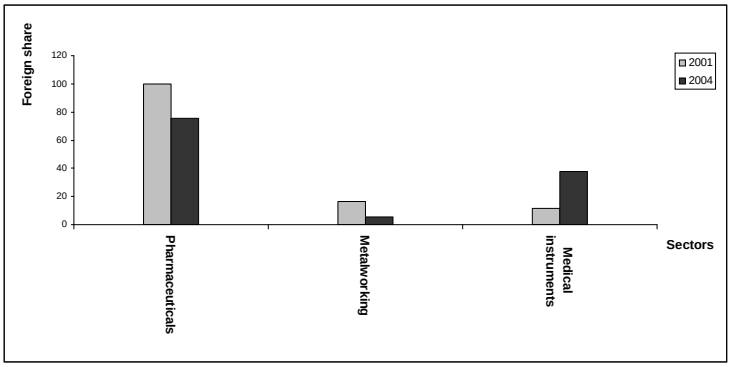

Figure 7: Percent share of foreign firms in total sales in the same sector and region "Ticino".

Table 3: FDI participation in manufacturing in Switzerland by region: annual shares of foreign firms (percent in 2004)

Region	Total employment	Total sales	Number of foreign firms
Lemanic region[a]	10.6	8	12.5
Mittelland space[b]	14.4	17.1	14.6
North West Switzerland[c]	17.5	23.2	18.3
Zurich	32.7	34.8	24
Western Switzerland[d]	18	18.5	18
Central Switzerland[e]	13.1	16.6	16.7
Ticino	11.3	9	11

a: Lemanic region includes the cantons of Vaud, Valais, and Geneva.

b: Mittelland space includes the cantons of Bern, Fribourg, Jura, Neuchâtel, Solothurn.

c: North West Switzerland includes the cantons of Aargau, Basel-Stadt, and Basel-Landshaft.

d: Western Switzerland includes the cantons of Appenzell Ausserrhoden, Appenzell Innerrhoden, Glarus, Graubünden, Schaffhausen, St-Gallen, and Thurgau.

e: Central Switzerland includes the cantons of Lucerne, Nidwalden, Obwalden, Schwyz, Uri, and Zug.

Table 4: Affiliates' technological behavior relative to local firms: the share of innovative products in sales within region (2004)

Ratio of the mean of the foreign variable to the mean of the corresponding local variable[#]							
	The share of innovative products in sales						
Sector	Reg.1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6	Reg.7
Manufacturing	0.4**	1.1	0.5*	1.2	1.7	0.7	0.2
Food		0.8			0.4	1.4	
Beverage					0.2		
Textiles		1		1.4	0.6		
Wood products			0.1				
Paper		1.4	3.3				
Printing and publishing		2.5				1.4	
Chemicals	1.2	1	0.9		0.8	3	
Pharmaceuticals			1				
Plastics					1	5.3*	1.1
Non-metal mineral products	1.4			0.4			
Metal production	0.5				0.1*		
Metalworking		0.8	0.9		0.9	0.9	
Machinery	1.1	0.9	0.1*	1.1	0.9	1.9	
Electrical machinery	0.9	0.9	0.6	1.1	1.1	1.6	
Computer and office equipment		0					
Communication equipment		3**		0.7	1.7	0.6	
Medical instruments	1.8	1		1	0.4	1	0.4
Watches		1.2					
Other manufacturing			2.4				

Two-sample t-test for equal means, which for simplicity does not take into account the sample design specificities.

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

Reg.1 refers to Lemanic region, Reg.2 is Mittelland space, Reg.3 is North West Switzerland, Reg.4 is Zurich,

Reg. 5 Western Switzerland, Reg.6 Central Switzerland, and Reg.7 Ticino.

Table 5: Estimation results for manufacturing: Spillovers from FDI and the absorptive capacity of local firms

	1	2	6	7	8	5	6
Variables	Full	Full	Small GAP	Mid GAP	Large GAP	High $INVEST$	Small $INVEST$
ΔLnK	-0.0004	-0.001	0.43***	-0.006	0.19***	-0.002***	-0.01
	(0.004)	(0.004)	(0.04)	(0.004)	(0.04)	(0.0006)	(0.009)
ΔLnL	0.77***	0.86***	0.38***	0.9***	0.66***	1.12***	0.79***
	(0.07)	(0.07)	(0.07)	(0.09)	(0.008)	(0.02)	(0.1)
HC	0.42***	0.47***	0.44***	0.54***	0.77***	0.51***	0.14
	(0.06)	(0.07)	(0.1)	(0.1)	(0.12)	(0.02)	(0.1)
FP_j	0.0002						
	(0.0009)						
$FP_{j,r}$		0.001*	0.002*	0.003**	0.001*	0.004***	-0.0004
		(0.0006)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.001)
$FP_{j,R-r}$		0.0003	0.00008	0.0019*	0.0008	0.002***	-0.0006
		(0.0004)	(0.0003)	(0.001)	(0.0005)	(0.0003)	(0.0004)
$FP_j{*}HC$	0.006						
	(0.004)						
$FP_{j,r}{*}HC$		0.006*	0.002	-0.002	0.009***	0.003***	-0.014
		(0.003)	(0.004)	(0.005)	(0.003)	(0.001)	(0.01)
$FP_{j,R-r}{*}HC$		-0.002**	-0.004**	-0.002	0.0008	-0.003***	-0.004***
		(0.0009)	(0.001)	(0.002)	(0.001)	(0.0002)	(0.001)
$\Delta Comp$	1.54***	1.52***	-0.289*	1.52***	0.29	1.8***	1.47***
	(0.14)	(0.1)	(0.17)	(0.1)	0.29	(0.04)	(0.1)
$Size$	-0.001	-0.002	0.01	-0.001	-0.01	0.001	0.001
	(0.008)	(0.009)	(0.009)	(0.01)	(0.01)	(0.003)	(0.01)
$\bar{R}^2$	0.67	0.7	0.9	0.67	0.79	0.79	0.78
$F-Chow$				9.73		6.29	
N	370	269	61	93	115	120	62

Note: 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.