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THE LEVEL OF HUMAN CAPITAL IN INNOVATIVE FIRMS LOCATED IN CHINA. IS FOREIGN CAPITAL RELEVANT?

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The level of human capital in innovative firms located in China. Is foreign capital relevant?

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Abstract

Studies on the impact of Foreign Direct Investment (FDI) on the Chinese economy have essentially focused on the relationship between FDI, productivity and economic growth, revealing a tendency toward sectoral and macroeconomic empirical studies. This work aims to complement these approaches and contribute to the rather limited literature on the relationship between FDI, Human Capital and Innovation at a corporate level. Based on a set of large and innovative firms (national and foreign capital) located in China, we have concluded that: i) the *direct* impact of foreign capital on the level of human capital in firms is negative, that is, no evidence was found suggesting that FDI has a positive influence on their human capital; ii) in *indirect* terms, by means of investment in R&D activities, FDI has a positive impact on general human capital (i.e., formal education). These results suggest that for China to benefit from FDI, it is necessary to implement a selective policy to attract FDI, taking into account more technologically advanced projects.

JEL-Code: F21; F23; J24; O32

Keywords: Foreign Direct Investment; Multinational firms; Human Capital; R&D; China.

1. Introduction

Accelerated economic growth took place in China following economic reforms in 1978, at an average of 9.7% a year between 1978 and 1999, a value that is significantly higher in comparison to the period prior to the reform, which was about 6.7%, between 1952 and 1977 (Tsen, 2006). This economic growth together with measures taken by the Chinese government, such as increased openness of the market and policies to attract Foreign Direct Investment (FDI), led to a spectacular increase in FDI in China. According to data from UNCTAD,[1] since the mid-1990s, China has received the largest amount of FDI in comparison to other developing countries. With an FDI inflow of about 72 billion dollars in 2005, China is one of the three largest FDI receiving countries worldwide. In terms of the employment created by foreign capital firms, China is the receiving country with the highest number of people working in the branch offices of foreign firms, reaching 24 million workers in 2004, which corresponds to 3% of the country's total employment (UNCTAD, 2007).

The implementation of institutional measures and policies by the Chinese government enabled national and foreign entrepreneurs to develop the Chinese economy (Tsen, 2006). However, after decades of FDI attraction policies, the Chinese Government is now facing new challenges. About 90% of the FDI received by China since 1989 is located in the coastal regions (Broadman and Sun, 1997). This imbalance could lead to social and political instability that could ultimately damage the country's economy. One of the greatest challenges facing the Chinese government is that of trying to attract FDI to the inland and western parts of the country (Fung *et al*., 2005).

Studies on the impact of FDI on the Chinese economy have focused essentially on the relationship between FDI, productivity and economic growth, revealing a tendency toward sectoral and macroeconomic empirical studies (for instance, Liu *et al*., 2001; Zhang, 2001; Liu and Wang, 2003; Zhang 2002; Vu *et al.,* 2007; Zhao and Du, 2007).

The aim of this work is to complement these approaches and thus contribute to the rather limited literature on the relationship between FDI, Human Capital and Innovation. Based on microeconomic data, we analyze the effect of FDI on human capital, mediated by R&D efforts and, more specifically, focus on the level of human capital in foreign capital firms located in China, comparing them with domestic firms.

[1] Data from "Rising FDI into China: the facts behind numbers", UNCTAD Investment Brief, Number 2 - 2007 *in* http://www.unctad.org/en/docs/iteiiamisc20075_en.pdf, accessed on 8th June 2007.

To the best of our knowledge, only two empirical studies compare the level of human capital in foreign and domestic firms. The authors of the first study (Narula and Marin, 2003), focusing on Argentina, concluded that, in general, multinational firms hire more professionals than domestic firms of the same size, besides seeking more qualified labour and providing more training than national firms. The other more recent study (Tavares and Teixeira, 2005), centred on Portugal, concluded that: (i) foreign capital has a direct and significant impact on the firms' general human capital; (ii) foreign capital has a direct and significant impact on the firms' specific human capital; (iii) the impact of foreign capital on the firms' level of human capital is higher in terms of formal education (general human capital component), as opposed to the level of qualification (specific human capital component).

There is no knowledge of similar studies for the Chinese case. This study thus intends to contribute to bridging this gap by providing empirical data on firms located in China. The data used in this study were obtained by way of a survey sent to a number of firms classified as being among the largest and most innovative multinational firms in China.

This study is structured as follows: Section 2 briefly summarizes the existing literature on FDI, Human Capital and Innovation in China and defines the main hypothesis to be tested. Next, Section 3 presents the methodology and the operation of the proxies for the relevant variables. The study's empirical results are presented in Section 4 and, finally, in the Conclusions, the main results are put forward, as well as the economic policy implications that may from there arise.

2. Human Capital, Innovation and FDI. An Overview of the Literature

Even though there is a vast amount of literature on the impact of FDI on the economy of receiving countries, the results tend to be inconclusive (Vu *et al.,* 2007; Zhao and Du, 2007). Studies on FDI impact in China are still scarce (Zhao and Du, 2007), and empirical literature in this domain has focused essentially on the relationship between FDI and economic growth, with results that are not unanimous (cf. Table 1). For instance, Zhang (2001) analyzed different FDI impacts on the Chinese economy and concluded that FDI contributes to the economy's growth, not only directly (through an increase in productivity and exports), but also indirectly through positive externalities (making technology transfer and transition easier).

Using sectoral data, Vu *et al.* (2007) analyzed the impact of FDI on the Chinese economy, and concluded that FDI has a positive and statistically significant effect on economic growth.

However, they found that this effect is not equally distributed across the different sectors – FDI only has a consistently positive effect in the manufacturing industry. More recently, Zhao and Du (2007) analyzed the relationship of causality between FDI and economic growth, and concluded that the two-way relationship between FDI and the Chinese economy is not particularly significant, which means that China's economic growth attracts FDI, thus validating the hypothesis of market size, but FDI flow has no significant impact on the economy's growth.

The relationship between FDI and Human Capital is potentially a two-way relationship, that is, human capital tends to be a factor in attracting FDI (e.g., Dasgupta *et al*., 1996; Broadman and Sun, 1997; Sun *et al*., 2002), but FDI also tends to have a positive effect on human capital (e.g., Narula and Marin, 2003; Tavares and Teixeira, 2005).

The existing literature on the relationship between FDI and Human Capital applied to the Chinese case, relates human capital mainly as a determinant for the allocation of FDI (Dasgupta *et al*., 1996; Broadman and Sun, 1997; Sun *et al.,* 2002). The opposite relationship, that is, human capital as an FDI effect, has been rather neglected in the literature and the few existing studies address the effect of FDI on productivity, mostly ignoring human capital. On this last aspect, Liu and Wang (2003) studied the impact of FDI on the total productivity of the Chinese industry and concluded that the presence of foreign capital firms, together with the level of domestic R&D (Research and Development) and the firm's size, are the main productivity determinants. Furthermore, they found that human capital is much more productive when the levels of FDI and R&D are higher.

Other authors also found a positive relationship between human capital and productivity. For instance, Zhang (2002) found a two-way relationship between FDI and work productivity in China. However, the author mentioned that even though FDI has a positive effect on productivity, it is not significant. The main factors that explain the increase in productivity and economic growth in China are, according to Zhang (2002), investment in fixed assets and human capital. Liu *et al*. (2001) analyzed the impact of FDI on work productivity in the Chinese electronics industry and concluded that FDI has a positive impact, although in terms of magnitude, human capital has a greater impact on work productivity.

Table 1: Summary of the literature overview on FDI in China

Subject	Author	Objectives	Methodology	Level of Analysis	Main Conclusions
FDI →>Economic Growth	Zhang (2001)	Quantitative analysis of FDI in Chinese economic growth.	Empirical	Macro	1) FDI contributes to the economy's growth: directly (through the increase in productivity and exports) and indirectly through positive externalities (thus making technology transfer and transition easier) 2) Impact is higher in the coastal area, as opposed to the inland areas of the country.
	Vu *et al.* (2007)	Analysis of the impact of FDI on the Chinese and Vietnamese economies, using sectoral data.	Empirical	Macro	1) FDI has a positive and statistically significant effect on economic growth 2) That effect is not equally distributed by the different sectors – FDI only has a positive and consistent effect on the manufacturing industry
	Zhao and Du (2007)	Analysis of the relationship of causality between FDI and economic growth in China.	Empirical	Macro	Two-way relationship between FDI and the Chinese economy is not very significant: - China's economic growth attracts FDI; - the FDI flow does not have a statistically significant impact on the economic growth
FDI→Productivity	Liu and Wang (2003)	Analysis of the impact of FDI on total productivity, using data from different industrial sectors.	Empirical	Meso	The presence of foreign capital firms, together with the level of domestic R&D (Research and Development) and firm size, are the main determinants for productivity.
	Zhang (2002)	Analysis of the contribution of FDI to the efficiency and increase in productivity in China, based on data from Chinese provinces.	Empirical	Macro	1) Two-way relationship between FDI and work productivity in China. 2) Even though FDI has a positive effect on productivity, it is not significant. 3) The main factors that explain the increase in productivity and economic growth in China are: investments in fixed assets and human capital.
	Liu *et. al.* (2001)	Analysis of the impact of FDI on work productivity, using data from the Chinese electronics industry.	Empirical	Meso	FDI has a positive impact on work productivity, although in terms of magnitude, human capital has a higher impact.
Human Capital →FDI[2]	Broadman and Sun, 1997	Empirical analysis of the geographical and sectoral distribution of FDI in China.	Empirical	Macro	1) The geographical distribution of FDI in China is largely determined by the GNP level and by the development of basic infrastructures. 2) Literacy among adults has a small yet significant effect on the allocation of FDI in China.
	Dasgupta *et al*., 1996	Identification of the features of Japanese firms that pursue FDI in the main countries in Asia, and identification of those countries' features.	Empirical	Micro	Firms investing in Asian countries are: - less prone to R&D; - less oriented to exports; - looking for human capital.
	Sun *et al., 2002*	Analysis of the changes in the importance of FDI determinants in the Chinese provinces.	Empirical	Macro	Evidence shows that the importance of the FDI determinants varies over time, and so labour quality (proxy % of engineers, researchers, scientists and technicians) has been an important factor when it comes to attracting FDI.

[2] Human Capital as a determining factor for FDI. There is no knowledge of studies on the Chinese case for the opposite relationship (human capital as an FDI effect).

The studies mentioned above show that the literature on the impact of FDI on the Chinese economy has focused essentially on the relationship between FDI, productivity and economic growth, revealing a tendency towards sectoral and macroeconomic empirical studies. The aim of this study is to complement these approaches and contribute to the relative lack of literature on the relationship between FDI, Human Capital and Innovation. Based on microeconomic data, the effect of FDI on human capital is analyzed, mediated by R&D, and more specifically, the level of human capital in foreign capital firms located in China is evaluated, and a comparison is made with domestic firms.

The importance of FDI in creating human capital has been largely neglected in the literature (Tavares and Teixeira, 2005). As mentioned previously, Narula and Marin (2003) and Tavares and Teixeira (2005) are the exception. Both studies concluded that there is empirical evidence suggesting that the presence of foreign capital may have a positive impact on the receiving country's human capital. Similarly, FDI may contribute to increasing the quality of demanded and supplied labour in the receiving country (Slaughter, 2002 *in* Tavares and Teixeira, 2005). Narula and Marin (2003) mentioned that the presence of foreign capital firms may increase the number of workers and, more importantly, the quality of the local workers, for instance, by providing training services and transferring higher knowledge. These authors added that the presence of multinational firms can also originate indirect spillover effects, that is, local clients and suppliers can also benefit from the higher knowledge and technology of multinational firms they contact with. Furthermore, local firms may also benefit from a supply of more skilled workers, trained by multinational firms. For instance, according to Rutkowski (2006), foreign firms aiming to exploit their sophisticated assets locally tend to hire qualified people, having observed, in a study performed on 13 Central and Eastern European countries, that foreign firms employ a larger percentage of graduates in comparison to domestic firms.

However, recent studies (Ritchie, 2002; Barry *et al.*, 2004 in Teixeira and Tavares-Lehmann, 2007) have revealed that foreign firms do not always provide more training than local firms. Thus, even though there is no consensus as to whether the FDI impact on human capital is positive, we propose the following hypothesis:

Hypothesis 1: Foreign capital firms have a higher level of human capital than domestic firms.

Additionally, we will take into consideration two other factors that may influence the relationship established in Hypothesis 1.

FDI, as well as international trade, may play an important role in the dissemination and production of knowledge and technological innovation internationally (Ciruelos and Wang, 2005). Girma *et al.* (2006) analyzed the impact of FDI on the innovative activity of Chinese state firms and concluded that the presence of foreign capital is associated to higher levels of innovative activity.

International technology transfer between firms has also been analyzed, that is, the transfer of knowledge from a mother firm to branch offices abroad (e.g., Siler *et al.,* 2003). This study concluded that work productivity in American multinational branch offices in Scotland is positively related to the R&D activity of the mother firm.

Studies (Borensztein *et al.* 1998; Xu, 2000; Lai *et al.*, 2006) on knowledge and technology transfer to the receiving country have highlighted the importance of a minimum level of human capital to absorb new knowledge, which indicates the existence of a complementary relationship between human capital and FDI.

On the other hand, if the existence of qualified workers in the receiving country is important for knowledge and technology transfer, the presence of FDI and innovative activities also contribute positively to human capital. In fact, Cohen and Levinthal (1989) had already highlighted the mediating role of R&D on the improvement of human capital. Similarly, Liu and Wang (2003) concluded that the higher the levels of FDI and R&D, the higher the productivity of the human capital.

Taking into consideration the vast amount of literature on the relationship between FDI and R&D and the importance of human capital, we intend to understand whether, for the Chinese case, the R&D activities of firms located in China may in any way be related to foreign capital, and assess the role played by human capital in this relationship.

Hypothesis 2: The effect of foreign capital on the level of human capital is higher when the firms' R&D efforts increase.

The interaction between multinational branch offices and local economic agents is necessary for the multinational firms in the receiving country to operate properly and, as a result of these relationships, skills and technology will be disseminated to the rest of the economy (Narula and Marin, 2003).

To the best of our knowledge, studies analyzing collaboration in R&D among multinational firms and universities are limited. An exception is the study carried out by Padilla-Pérez (2008) on technology transfer from multinational branch offices on four levels (from the

mother firm to the branch office; to its workers; from the branch office to the local firms; and from the branch office to local organizations, namely technical schools, universities, public research centres and industrial associations). Based on empirical evidence collected in two Mexican regions for the electronics industry, the study concludes that, as far as the relationship between firms and universities is concerned, contacts are based mainly on educational activities and to a much lesser extent on collaboration in research projects.

Nevertheless, some studies have focused on the relationship between firms (regardless of capital property) and universities, particularly on the link between the firm's innovation strategy and its partnership with universities in research projects (Bercovitz and Feldman, 2007). At the same time, these studies analyze the relationship between the features of the firm and industry and cooperation with universities (Veugelers and Cassiman, 2005), and also relate geographical proximity (between the firm and the university) with the probability of R&D cooperation (Abramovsky and Simpson, 2008). There are also studies centred on the impact of cooperation relationships among firms and universities on the firm's performance (Belderbos *et al.*, 2004; Georgea *et al.*, 2001).

For relationships among firms (domestic and multinational) and universities to be productive, it is necessary for the firms to have skilled resources capable of interacting with and understanding their partners (universities) (Tavares and Teixeira, 2005).

As a result, our aim is to understand whether foreign capital firms can take advantage of these partnerships and/or technological cooperation established with universities. Therefore, we propose the third and last hypothesis to be tested:

Hypothesis 3: The effect of foreign capital on the human capital level is higher when contacts between firms and universities are more frequent.

3. The Level of Human Capital in Innovative Firms Located in China. Methodological Considerations

This is a microeconomic study, that is, the analysis unit is the firm. For the Chinese case, and to the best of our knowledge, no databases are available with relevant information to test the hypotheses put forward, and it was thus necessary to collect information on the firms by means of a survey.

The survey was prepared in English and translated into Mandarin Chinese, considering that the potential respondents are native Chinese. Other than the paper version, the firms contacted

were also provided with an online version of the survey so that it would be less expensive and easier to reply.[3]

The first part of the survey requested general information on the organization, namely, the start-up year (important to establish the firm's age), the total number of employees, the number of engineers and workers with 12 or more years of schooling (proxy of the specific skills and qualifications of collaborators, respectively), sales average over the last 3 years, exports and R&D expenses performed by the firm, also over the last 3 years (important to assess the degree of openness and the weight of innovation in the organization), and the percentage of foreign capital (criterion of distinction between national and multinational firms). The second part of the survey included the degree of importance of the main sources of information and knowledge to the firm's innovation activities. As such, the firms were asked to assess the degree of importance of the different sources of information and knowledge to their innovation activities, where universities are highlighted.

Since one of the main purposes of this study consisted in assessing the mediating role that innovation plays in the development of human capital, it was important that the firms surveyed carry out activities related to innovation, namely R&D. Thus, the most innovative firms was one of the criteria so as to limit the target population. Additionally, since we also aimed to compare domestic and foreign capital firms, it was imperative that the target population included firms with foreign capital share. Thus, the reference population in this study were the firms on the list of "The 287 most innovative firms in China",[4] published by the Ministry of Science and Technology of the People's Republic of China,[5] and since most of the firms on this list are domestic (about 96%), it was also necessary to consider the list of "The 500 largest multinationals in China (2006-2007)", published by the Ministry of Trade of the People's Republic of China.[6] The reference population for our empirical analysis was made up of 667 firms.[7] Both lists have very little information on the firms, usually only providing the name in Mandarin Chinese and turnover, in the case of the multinational firms

[3] English version of the survey at http://webapps.fep.up.pt/survey/index.php?sid=24715&lang=en. Mandarin Chinese version of the survey at http://webapps.fep.up.pt/survey/index.php?sid=24715&lang=zh-Hans

[4] This list was originally entitled "Top 500 most Innovative Firms Located in China". However, when we started this study (August 2008), only two parts of the list had been published, which corresponded to a total of 287 firms.

[5] First part of the list at http://www.gov.cn/zwgk/2006-07/27/content_346906.htm, accessed on 25th April 2008. Second part of the list at http://www.most.gov.cn/jscxgc/jscxxgwj/200801/t20080118_58577.htm, accessed on 25th April 2008.

[6] List of the multinational firms at http://caefi.mofcom.gov.cn/aarticle/cz/tongzgg/200803/20080305443636.html, accessed on 15th June 2008.

[7] From of the list of the largest multinational firms, only 20% of the firms belong to the same Economic Group and about 4% of the firms had already been mentioned in the other list.

list. To implement the survey it was necessary to obtain other relevant information. Thus, we used the Internet to find information on the firms' contacts, namely e-mail address, telephone and fax numbers, and the firms' names in English or, otherwise, the name in *Thn.*[8]

We started the contacts by sending e-mails on 5th August, and afterwards, faxes were sent on 12th August. Only two firms replied. Since there was a lack of contact information on the firms' official websites, we also used external sources (e.g., online firm directories). However, in this latter case, we had no idea as to whether the information was authentic or updated, and thus had no way of knowing if the firm did indeed receive any information about the research project. This situation may explain, in part, the low number of replies. To overcome this lack of replies, direct contacts were made by telephone to the selected firms. Due to the time zone difference between China and Portugal, the calls were made from the facilities of the Faculty of Economics of the University of Porto, between 2 a.m. and 10 a.m., Monday through Friday.

After presenting the research project on the telephone, we obtained the e-mail address and/or fax number, depending on the firm's preference, to which additional information on the project and survey was sent. Two weeks after the first contact, the firms that had not replied were contacted again. Some of the surveys we received were incomplete, which forced us to contact the firms again to ask for the missing data. In the case of the firms that were not available to provide additional information, we resorted to annual reports and other official documents to obtain the necessary data. It was not possible to present our research project to all of the firms on the list because many of the telephone numbers were incorrect or outdated, some of the firms no longer existed and, in some cases, it was not possible to contact the person in charge. In total, we successfully contacted 379 firms. This process, which ended on 17th October, was fundamental to the research work, but it was extremely consuming in terms of time and resources. 92 responses were received, 77 of which were valid, which corresponds to a 20% response rate. This rate is consistent with the country's average rate since, according to Wang *et al.* (1998), the response rate to surveys by letter in China and Singapore is usually low, varying between 10% and 15%. Collecting information is particularly difficult in China because it is not enough to follow "normal" practices to obtain the firms' collaboration. In fact, it is usually necessary to go through appropriate channels, to have patience, and the *guanxi*[9] factor is also important to achieve a high response rate (Calantone *et al*., 1996).

[8] Scheme of the Chinese phonetic alphabet.
[9] Chinese expression that means good relations, contacts and trust among people.

To test whether foreign capital is an important determinant of the level of human capital in innovative firms located in China, we propose, based on the literature overview in the previous section, an empirical model with the following specifications:

$$H_i = a + b_1 E_i + b_2 (E_i * I \,\&\, D_i) + b_3 (E_i * U_i) + b_4 X_i + e_i$$

Where H_i is the model's expected value and corresponds to the "level of human capital" of firm *i*; E_i is a binary variable to assess whether firm *i* is a "foreign capital firm" (E_i=1) or a "national capital firm" (E_i=0); the *U*i variable represents the importance firms give to contacts with universities; $\boldsymbol{X}_i$ is a vector that includes other variables, which, according to the literature, may explain the level of human capital in firm *i*, namely the level of R&D (I&D), size and age of the firm, level of exports and industry, level of openness to external sources; e_i is the random error.

If $\hat{b}_1$ is positive and statistically significant, we can conclude that foreign capital firms have a higher level of human capital, as opposed to national firms (that is, Hypothesis 1 is confirmed). If the effect of foreign capital on the level of human capital is higher when the firms' R&D efforts increase (Hypothesis 2), and when contacts with universities are more frequent (Hypothesis 3), then $\hat{b}_2$ and $\hat{b}_3$ are, respectively, positive and statistically significant.

The proxies of the variables were chosen based on the relevant literature. Thus, to assess the level of human capital (expected value), the firms where questioned on two items: qualifications and skills (or professional qualifications). These two concepts, although related and referred to in countless studies as synonymous, are in fact distinct (Tavares and Teixeira, 2005). Skills are acquired mainly through activities at work, while formal education provides general knowledge and teaches how to learn (Teixeira, 2002)., The number of workers with 12 or more years of schooling in the total employment is used as a proxy to measure the weight of workers with "high qualifications" (cf. Wößmann, 2003 *in* Tavares and Teixeira, 2005), and the number of engineers in the total employment as the proxy for the weight of "highly qualified" workers (cf. Wood and Ridao-Cano, 1999; Noorbakhsh *et al.*, 2001 *in* Tavares and Teixeira, 2005).

As far as the explanatory variables are concerned, the following proxies were adopted: for the "foreign capital" variable, a binary variable is used which assumes the value "1" (E_i=1) when the foreign equity participation is equal to or higher than 25%, and "0" (E_i=0) in the opposite

case. In China, the general rule for the minimum legal limit of equity participation in foreign firms is 25%. Lower equity participations may be allowed in exceptional cases only.[10]

In our study, the level of R&D is measured in terms of the ratio of the firm's R&D expenses in the total sales (cf. Long and Ravenscraft, 1993; Belderbos *et al.*, 2004; Rutkowski, 2006). The size of the firm is measured in terms of number of workers (cf. Beugelsdijk and Cornet, 2002; Belderbos *et al.*, 2004, Veugelers and Cassiman, 2005). The firm's age is calculated based on the number of years of activity (Rutkowski, 2006), and the level of exports is measured through the firm's export ratio in total sales (cf. Veugelers and Cassiman, 2005).

4. The Level of Human Capital in Innovative Firms Located in China. Results of the Empirical Analysis

The firms in our sample are mostly (65%) domestic firms. Multinational firms (firms with equity participation higher than 25%) represent about 35% of the total of firms in the sample. Of the firms surveyed, about 30% stated that they spend more than 5% of their income on R&D activities.

In terms of the level of human capital, about 35% of the firms responded that the level of their workers' qualification (measured by the percentage of engineers in total employment) is above 20%. About 92% of the firms responded that the level of education (measured by the number of workers with 12 or more years of schooling) is higher than 20%. On average, 24.4% of the Chinese firms employ workers with 12 or more years of schooling (NBS,[11] 2005). In comparison to the national average, the firms in our sample have a higher level of human capital (education).

Based on data from the NBS (2003), in the universe of firms in China, about 82% are small (less than 50 workers) and only 0.6% of the firms are large (more than 1000 workers). Thus, we can conclude that the firms in our sample are large – about 66% of the firms employ more than 1000 workers and none of the firms reported having less than 50 workers, which is not surprising given that our target population included the largest firms.

To assess the importance of sources (internal and external) of knowledge and information for innovation activities, the firms were questioned about the importance (on a Likert scale of 0 to 5) they gave to the same sources of innovation (Table 2). About 82% of the firms considered

[10] Information published by The Department of Treaty and Law of the Ministry of Trade of the People's Republic of China, on 13th January 2003, at http://tfs.mofcom.gov.cn/aarticle/zcfb/200301/20030100062554.html, accessed on 10th November 2008.
[11] National Bureau of Statistics of the People's Republic of China.

their internal department an important or very important source of innovation, and about 72% of the firms considered technical rules and standards as important or very important sources of innovation. The average importance the firms gave to these two factors was 4.27 and 4.00, respectively. The entities of the scientific and technological system, namely universities and R&D units, were not viewed as very important to the surveyed firms' innovation activities. Only 20% regarded private R&D institutions as important or very important sources of innovation and the average importance attributed to these factors was 2.21. With regard to universities, even though 40% of the firms considered them to be an important factor of innovation, the average importance attributed by the firms was 2.84.

Table 2: Main sources of innovation

Sources of Innovation	Average (0-5 Likert scale)	Percentage of firms that believe this factor is important or very important
Internal department	4.27	81.8
Technical rules and standards	4.00	71.4
Environmental legislation and rules	3.70	53.2
Clients	3.62	61.0
R&D labs or firms	3.48	53.2
Health and hygiene legislation	3.47	53.2
Competitors	3.32	51.9
Public R&D Institutions	3.18	50.6
Advisers	3.18	49.4
Associations within a given sector	3.03	37.7
Technical literature and other literature on a given sector	3.01	35.1
Equipment suppliers	3.01	41.6
Meetings within a given sector	2.88	29.9
Universities	2.84	40.3
Other governmental institutions	2.44	26.0
Private R&D Institutions	2.21	19.5
Fairs and exhibitions	0.43	0.0

Source: Data collected via direct survey, August - October 2008.

To analyze the collected data in detail, we thought it would be useful to test the averages with human capital as a grouping variable (concretely, the two proxies, qualifications and level of education), given our two hypotheses.

The variables were divided into structural variables (characterizing the firms, such as age, number of workers, level of exports, level of R&D and percentage of foreign capital), and variables associated to sources of information and knowledge for innovation activities. We concluded that (Table 3) the results are sensitive to the proxy considered.

Table 3: Average Test

Dependent variables		Independent variables					
		Level of Human Capital (qualifications)			Level of Human Capital (education)		
		Higher quartile	Remaining firms	Kruskal-Wallis (Qui-2; sign)	Higher quartile	Remaining firms	Kruskal-Wallis (Qui-2, sign)
Structural variables	Age	18.67	21.80	0.20 (0.655)	22.06	20.78	0.04 (0.849)
	Number of workers	11101.00	18492.97	0.86 (0.354)	10351.47	18582.13	0.45 (0.503)
	Level of exports	0.12	0.27	4.51 (0.034) **	0.29	0.22	0.91 (0.340)
	Level of R&D	0.05	0.04	0.49 (0.485)	0.05	0.04	0.33 (0.563)
	Foreign Capital (%)	6.15	30.37	6.49 (0.011) **	25.94	24.36	0.04 (0.835)
Sources of information and knowledge for innovation activities	Internal Department	4.39	4.24	0.31 (0.578)	4.41	4.23	0.03 (0.863)
	Universities	3.22	2.73	1.14 (0.285)	3.06	2.78	0.74 (0.390)
	Public R&D Institutions	3.50	3.08	1.23 (0.267)	3.65	3.05	3.02 (0.082) *
	Other governmental institutions	2.67	2.37	0.40 (0.526)	3.06	2.27	2.90 (0.088) *
	Private R&D Institutions	2.33	2.17	0.16 (0.688)	2.71	2.07	2.03 (0.154)
	Equipment suppliers	3.72	2.80	6.75 (0.009) ***	3.71	2.82	5.87 (0.015) **
	Clients	3.39	3.69	0.51 (0.473)	3.94	3.53	1.34 (0.247)
	Competitors	3.67	3.22	1.07 (0.300)	3.53	3.27	0.41 (0.521)
	Advisers	3.44	3.10	0.99 (0.319)	3.59	3.07	1.85 (0.174)
	R&D Labs	3.56	3.46	0.09 (0.758)	3.82	3.38	1.03 (0.311)
	Meetings within a given sector	3.33	2.75	4.01 (0.045) **	3.06	2.83	0.71 (0.400)
	Associations within a given sector	3.50	2.88	3.94 (0.047) **	3.41	2.92	1.94 (0.164)
	Technical literature and other literature on a given sector	3.33	2.92	1.83 (0.177)	3.35	2.92	1.40 (0.237)
	Fairs and exhibitions	0.56	0.39	1.53 (0.217)	0.41	0.43	0.02 (0.875)
	Technical rules and standards	4.17	3.95	1.59 (0.208)	4.59	3.83	6.27 (0.012) **
	Health and hygiene legislation	3.44	3.47	0.03 (0.853)	3.41	3.48	0.03 (0.860)
	Environmental legislation and rules	3.39	3.80	0.50 (0.479)	3.76	3.68	0.08 (0.783)
	Degree of Openness	51.22	46.78	1.90 (0.168)	53.06	46.33	2.46 (0.117)

Legend: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%
Source: Data collected by means of direct survey, August - October 2008.

This means that the statistically significant differences (in terms of structural variables and innovation factors) in firms with a relatively more intensive level of human capital differed according to the proxy considered for the human capital.

Firms with a lower level of human capital (measured in terms of worker qualifications) presented a higher propensity to exports and higher foreign capital equity participation, that is, the national firms had more human capital (qualifications) than multinational firms. As for innovation sources, the firms with higher levels of human capital (qualifications) presented statistically significant differences in relation to other firms in terms of the following sources of innovation: equipment suppliers, meetings within a given sector and associations within a given sector. These three factors are more important to the innovation activity of firms with a higher level of human capital. When human capital was analyzed based on the level of the workers' education, we found that for firms with a lower level of human capital, public R&D institutions and other governmental institutions, equipment suppliers and technical rules and standards were the most important sources of innovation.

As mentioned previously, this study aimed to test the following hypotheses:

Hypothesis 1: Foreign capital firms have a higher level of human capital than domestic firms.

Hypothesis 2: The effect of foreign capital on the level of human capital is higher when the firms' R&D efforts increase.

Hypothesis 3: The effect of foreign capital on the human capital level is higher when contacts between firms and universities are more frequent.

Table 4 presents the estimated models that allowed us to test the abovementioned hypotheses for the sample of 77 large, innovative Chinese firms. Six models were estimated, 3 for each of the human capital proxies – education (weight of workers with 12 or more years of formal education in total workers) and qualification (weight of engineers in total workers). The base models (Models 1 and 4) only included the structural (Foreign Capital, Size, Age, Levels of R&D and Exports) and interaction variables (of foreign capital with R&D and contacts with universities). The remaining models added the direct effect of contact with universities (Model 2 and 5) and, apart from this last variable, Models 3 and 6 also included the variable of the firms' degree of openness to external sources of information and knowledge (calculated by summing the number of different external sources of information and knowledge the firm uses for its innovation activities).

In terms of adjustment quality, it is important to highlight that the estimated models do not fully explain (between 12% and 18%) the causal variable – human capital – regardless of the fact that some of the individual coefficient estimations proved to be statistically significant, thus making it possible to draw conclusions on the hypotheses raised by the literature regarding the relationship between foreign capital, innovation and human capital at a microeconomic level.

As can be seen in Table 4, the results of the estimation are sensitive to the proxy used for Human Capital. When qualifications are used as a proxy for human capital, only age appears as negatively and significantly related to the firm's level of human capital, which means that, on average, the more recent firms tend to have a larger share of engineers. In the models related to qualification, none of the key variables in our analysis – foreign capital, R&D, contacts with universities or degree of openness – are statistically significant, and so there is no possible conclusion in relation to their influence on the level of human capital in the firms. In other words, the research hypotheses are neither corroborated nor rejected.

For the alternative indicator of human capital – formal education – the results are more interesting. In the more restricted model (Model 1), we found that foreign capital is significant, but, contrarily to what would be expected theoretically, it is negatively related to human capital. This means that, on average, national capital firms, in relation to the so-called foreign capital firms (that is, those whose foreign capital weight is higher than 25%) tend to have a more skilled workforce, thus contradicting Hypothesis 1.

Thus, contrarily to the studies that concluded that there was a positive FDI impact, not only on the demand (Rutkowski 2006), but also on an increase in the offer of qualified labour (Narula and Marin, 2003; Slaughter, 2002 *in* Tavares and Teixeira, 2005), our study did not find any evidence supporting the idea that multinational firms have a higher level of human capital (formal education). Indeed, this relationship proved to be negative (Model 1), thus suggesting that FDI on its own does not seem to contribute to an increase in the level of human capital in the country. This result is consistent with the idea that Ritchie (2002) put forward, that the mere presence of FDI does not always lead to the transfer of technical or scientific skills to the local economy. According to this author, the creation (quantitatively and qualitatively speaking) of skills is higher when there are connections and cooperation with the government, industry, academic institutions and labour market.

A robust result emerging from the estimated models is that FDI has a positive and statistically significant effect when mediated by the firms' efforts in terms of investment in activities

associated to the innovation process, more specifically, investment in R&D activities. Thus, the results seem to corroborate Hypothesis 2, which says that the foreign capital effect is greater on general human capital (formal education) when the firms are more innovative (i.e., higher level of R&D). This result is, to some extent, consistent with the conclusions of the study by Liu and Wang (2003) for the Chinese industry sectors. According to these authors, the higher the levels of FDI and R&D, the higher the productivity of the human capital. Similarly, Kinoshita (2000), in a study on the Czech Republic, concluded that foreign presence on its own is not statistically significant in increasing the firms' productivity. According to the author, when foreign presence interacts with R&D, it has a positive and significant effect, which highlights the role played by R&D in increasing the firms' absorption capacity. These conclusions are consistent with the literature on innovation where the mediating role played by R&D in the improvement of human capital is highlighted (Cohen and Levinthal, 1989). According to these authors, R&D activities do not only generate new information, but also contribute to improve the firms' capacity to assimilate and explore existing information.

Similarly to Ritchie (2002), when we added the variables of contacts with universities and other external entities (degree of openness) – Models 2 and 3 – we found that the most open firms, that is, the firms with the largest number of sources to obtain information and knowledge for their R&D activities tend, on average, to have a higher level of human capital. Regardless, Hypothesis 3 is not corroborated or refuted by the data since the estimation of the coefficient of interaction between foreign capital and contacts with universities is not statistically significant. This may possibly be explained by the fact that contacts between firms and universities are limited mainly to educational activities and do not involve much collaboration in research projects. Padilla-Pérez (2008) also came to this conclusion in a study on Mexico.

In summary, based on the data collected directly from large, innovative firms operating in China, we can conclude that, when existent, the *direct* impact of foreign capital on the firms' human capital is negative, that is, no evidence was found (reported in other studies for countries such as Portugal or Argentina) suggesting that FDI has a positive influence on the human capital of the Chinese firms studied here. Nevertheless, in *indirect* terms, by means of investments in innovative activities, we have collected enough evidence to sustain that FDI has a positive impact on the general human capital (i.e., formal education) of large, innovative firms in China.

Table 4: Estimation of the model by least squares method (dependent variable: level of education or qualification)

		Education			Qualification		
		Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Structural variables	Foreign Capital (FC) (dummy=1 if weight of foreign capitals in total capital are > 25%)	**-0.224***	-0.114	-0.086	-0.160	-0.067	-0.070
	Size (number of workers in ln)	0.024	0.024	0.020	-0.003	-0.003	-0.002
	Age (years in business in ln)	0.028	0.017	0.013	**-0.065*****	**-0.003*****	**-0.074*****
	Level of R&D (R&D/Sales)	-0.946	-1.089	-1.210	0.817	0.697	0.710
	Level of exports (Exports/Sales)	-0.096	-0.084	-0.038	-0.084	-0.074	-0.079
Sources of knowledge and information for innovation	Universities (Importance of contacts with universities in ln)		0.096	0.054		0.081	0.085
	Degree of openness in terms of sources of innovation (number of different external sources for innovation activities)			**0.176***			-0.019
Interaction Variables	FC*R&D	**2.270****	**2.404*****	**2.189***	-0.992	-0.879	-0.856
	FC*Universities	0.104	0.007	-0.006	0.031	-0.050	-0.049
Constant		0.541	0.455	-0.152	0.452	0.379	0.444
	N	77	77	77	77	77	77
Quality of the model adjustment							
	R^2	0.12	0.14	0.18	0.16	0.18	0.18
	Durbin-Watson	2.51	2.45	2.39	1.71	1.66	1.67

Note: Models 1, 2 and 3 – proxy for human capital is education (weight of workers with 12 or more years of schooling in total workers); Models 4, 5and 6 – proxy for human capital is qualification (number of engineers in total workers).
Legend: *** statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%

5. Conclusions

The literature overview on FDI in China highlights that studies on the impact of FDI on the Chinese economy have focused essentially on the relationship between FDI, productivity and economic growth, revealing a tendency towards sectoral and macroeconomic empirical studies (for instance, Liu *et al*., 2001; Zhang, 2001; Liu and Wang, 2003; Zhang 2002; Vu *et al.,* 2007; Zhao and Du, 2007).

This study complements these approaches and contributes to the limited literature on the relationship between FDI, Human Capital and Innovation. More specifically, it aimed to assess the level of human capital in foreign capital firms located in China, establishing a comparison with domestic firms. To the best of our knowledge, there are no similar studies on the Chinese case. Contrary to some studies on these matters (Narula and Marin, 2003; Tavares and Teixeira, 2005), the data collected in this study from large, innovative firms operating in China led to the conclusion that the direct impact of foreign capital on the level of the firms' human capital is negative. This means that no evidence was found, as reported in other studies on countries such as Portugal (Tavares and Teixeira, 2005) or Argentina (Narula and Marin, 2003), to suggest that FDI has a positive influence on the human capital of Chinese firms. However, we found statistically solid evidence sustaining that, in *indirect* terms, by means of investment in innovative activities, FDI has a positive impact on the general human capital (i.e., formal education) of large, innovative firms located in China.

These results have implications in terms of public policies for the Chinese government. They suggest that for China to benefit from FDI, it is not enough for the government to implement policies to attract FDI. It is necessary to have some level of selectivity in this process of attraction, and preference should be given, for instance, to projects that are technologically more advanced and require a higher level of interaction with the scientific and technological system.

References

Abramovsky, L.; Simpson, H. (2008). "Geographic proximity and firm-university innovation linkages: evidence from Great Britain", *CMPO Working Paper Series No. 08/200*, University of Bristol.

Belderbos, R.; Carree, M.; Lokshin, B. (2004). "Cooperative R&D and firm performance". *Research Policy,* 33 (10): 1477-1492

Bercovitz, J.; Feldman, M.P. (2007). "Fishing upstream: Firm innovation strategy and university research alliances", *Research Policy*, 36 (7): 930-948.

Beugelsdijk S.; Cornet M. (2002). "A far friend is worth more than a good neighbour: proximity and innovation in a small country", *Journal of Management & Governance*, 6 (2): 169-188.

Borensztein, E.; De Gregorio, J.; Lee, J-W. (1998). "How Does Foreign Direct Investment Affect Economic Growth?", *Journal of International Economics*, 45 (1): 115 – 135.

Broadman, H.; Sun X. (1997). "The distribution of foreign direct investment in China", *Policy Research Working Paper* Series 1720. Washington D.C: The World Bank.

Calantone, R.; Schmidt, J.; Song, X. (1996). "Controllable factors of new product success: a cross-national comparison", *Marketing Science*, 15 (4): 341-58.

Ciruelos, A.; Wang, M. (2005). "International technology diffusion: effects of trade and FDI", *Atlantic Economic Journal* 33(4): 437–449.

Cohen, W.; Levinthal, D. (1989). "Innovation and learning: the two faces of R&D", *Economic Journal*, 99 (397): 569-596

Dasgupta, S.; Mody, A.; Sinha, S. (1996), "Japanese multinationals in Asia", *Policy Research Working Paper*, No. 1634. Washington DC: The World Bank.

Fung, K.C.; Garcia-Herrero, A.; Iizaka, H.; Siu, A. (2005). "Hard or soft? Institutional reforms and infrastructure spending as determinants of foreign direct investment in China", *Japanese Economic Review*, 56 (4): 408-416.

Georgea, G.; Zahrab, S.; Wood, D. (2001). "The effects of business–university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies", *Journal of Business Venturing*, 17 (6): 577-609

Girma, S.; Gong,Y.; Görg, H. (2006). "Can you teach old dragons new tricks? FDI and innovation activity in Chinese State-Owned Enterprises", *Institute for the Study of Labor (IZA)* Discussion Papers No. 2267.

Kinoshita, Y. (2000). "R&D and technology spillovers via FDI: innovation and absorptive capacity", *William Davidson Institute Working Paper* No. 349, University of Michigan.

Lai, M.; Peng, S.; Bao, Q. (2006). "Technology spillovers, absorptive capacity and economic growth", *China Economic Review* 17 (3) 300–320.

Liu, X.; Parker, D.; Vaidya, K.; Wei, Y. (2001). "The impact of foreign direct investment on labour productivity in the Chinese electronics industry", *International Business Review*, 10 (4): 421–439.

Liu, X.; Wang, C. (2003). "Does foreign direct investment facilitate technological progress? Evidence from Chinese industries*", Research Policy*, 32 (6): 945–953.

Long, W.; Ravenscraft, D. (1993). "LBOs, debt and R&D intensity", *Strategic Management Journal*, 14: 119-135.

Narula, R.; Marin, A. (2003). "FDI spillovers, absorptive capacities, and human capital development: evidence from Argentina", MERIT-Infonomics Research Memorandum Series 2003-016. Maastricht: MERIT and Infonomics, University of Maastricht.

NBS (2003). Communiqué on the Main Results of the Second National Census of Basic Units in China. National Bureau of Statistics of the People's Republic of China Office of the Leading Group for the Second National Census of Basic Units. http://www.stats.gov.cn/was40/gjtjj_en_detail.jsp?channelid=4920&record=35, acedido em 25/11/2008

NBS (2005). Communiqué on Major Data of the First National Economic Census of China No. 1. Office of the Leading Group of the State Council for the First National Economic Census National Bureau of Statistics of China. http://www.stats.gov.cn/was40/gjtjj_en_detail.jsp?channelid=4920&record=26, acedido em 25/11/2008

Padilla-Pérez, R. (2008). "A regional approach to study technology transfer through foreign direct investment: The electronics industry in two Mexican regions", *Research Policy*, 37 (5): 849-860

Ritchie, B. (2002). "Foreign direct investment and intellectual capital formation in Southeast Asia", *OECD Development Centre Working Papers* No. 194. Paris: OECD Development Centre.

Rutkowski, A. (2006). "Inward FDI, skilled labour, and product differentiation in the CEEC", *Journal for East European Management Studies*, 11 (2): 91-112.

Siler P.; Wang, C.; Liu, X. (2003). "Technology Transfer Within Multinational Firms and Its Impact on the Productivity of Scottish Subsidiaries", *Regional Studies*, 37 (1): 15 – 25.

Sun, Q.; Tong, W.; Yu, Q. (2002). "The determinants of foreign direct investment across China", *Journal of International Money and Finance*, 21 (1): 79–113.

Tavares-Lehmann, A.T.; Teixeira, A.A.C. (2005). "Human capital intensity in technology difference technology-based firms located in Portugal: Do foreign multinationals make a difference?", *FEP Working Papers* No. 187. Porto: Faculdade de Economia, Universidade do Porto.

Teixeira, A.A.C.; Tavares-Lehmann, A.T. (2007). *Investimento Directo Estrangeiro, Capital Humano e Inovação - Uma Aplicação ao caso Português*. Porto: Editora Vida Económica.

Teixeira, A.A.C. (2002). "On the link between human capital and firm performance. a theoretical and empirical survey", *FEP Working Papers* No. 121. Porto: Faculdade de Economia, Universidade do Porto.

Tsen, W. (2006). "Granger causality tests among openness to international trade, human capital accumulation and economic growth in China: 1952–1999", *International Economic Journa*l, 20 (3): 285–302.

UNCTAD (2007). *World Investment Report 2007: Transnational Corporations, Extractive Industries and Development*. New York and Geneva: UN.

Veugelers, R.; Cassiman, B. (2005). "R&D cooperation between firms and universities. Some empirical evidence from Belgian manufacturing", *International Journal of Industrial Organization*, 23 (5-6): 355– 379.

Vu, T.B.; Gangnes, B.; Noy, I. (2007). "Is foreign direct investment good for growth? Evidence from sectoral analysis of China and Vietnam", *Department of Economics Working Paper* No. 200801. Manoa: University of Hawaii.

Wang, P.; Wee, C.H.; Koh, P.H. (1998). "Control mechanisms, key personnel appointment, control and performance of Sino-Singaporean joint ventures", *International Business Review*, 7 (4): 351-375.

Xu, B. (2000). "Multinational enterprises, technology diffusion, and host country productivity growth", *Journal of Development Economics*, 62 (2): 477- 493

Zhang, K. (2001). "How does inward foreign direct investment (FDI) affect a transitional economy?", *Economics of Transition,* 9 (3): 679–693.

Zhang, Z. (2002). "Productivity and economic growth: an empirical assessment of the contribution of fdi to the Chinese economy", *Journal of Economic Development*, 27 (2): 81-95.

Zhao, C.; Du, J. (2007). "Causality between FDI and economic growth in China", *The Chinese Economy,* 40 (6): 68–82.

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