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Is human capital relevant in attracting innovative FDI to China?

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Abstract

The impact of human capital on foreign direct investment has been assessed in an essentially descriptive manner. Most quantitative studies focus on the macroeconomic level. Microeconomic studies are scarce internationally and even more so in the case of China. Based on a survey performed on innovative firms located in China, this study assesses the importance of human capital in attracting FDI to China. Using a sample of 77 innovative firms, and logistic estimation techniques, we concluded that even though human capital does not constitute a *direct* factor in attracting FDI to China, it is a positive *indirect* factor through firms' R&D efforts. Moreover, we found that connections with universities have a positive impact on the attraction of FDI although the impact of human capital on the attraction of FDI is not sustained on the basis of additional contacts with universities. Evidence gathered suggests that it is important that public authorities recognize the interconnections between education and innovation policies and the implementation of FDI policies - human capital is only capable to attract innovative foreign capital when associated to high levels of R&D.

Keywords: Foreign Direct Investment (FDI); Human Capital; Research and Development (R&D); Innovation; China.

JEL-Codes: F21; J24; O32

1. Introduction

One of the most important elements in the Chinese economic reform has been the promotion of Foreign Direct Investment (FDI) (Fung, Herrero, Iizaka and Siu 2005; Girma, Gong and Görg 2009). In 1978, when China introduced its external openness policies, the FDI inflow was relatively low. Since then, however, the central government and the local authorities have implemented several preferential measures and benefits to attract foreign investment (Fung *et al*. 2005; Zheng 2011). Three decades after the economic reform, the FDI policies followed by the Chinese government have indeed led to a higher level of FDI. According to data from UNCTAD (2007), since the mid-1990s, China became the country receiving the highest level 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 receivers worldwide.[1] FDI in China has been an important "driving force" towards a market economy (Fu and Li 2009).

Even though much has already been written about how to attract FDI and its profile in China (for instance, Broadman and Sun 1997; Fung *et al.* 2005; Zhang 2000, 2001; Ng and Tuan 2001; Luo, Brennan, Liu, and Luo 2008), only a few studies have quantitatively analyzed the importance of human capital as a determining factor of FDI in China. The empirical evidence supporting this hypothesis is lacking and it has not yet been possible to clearly determine the relevance of this factor, based on representative and broad samples. To our knowledge, there are few empirical studies on this matter. These studies analyze human capital together with other factors that may influence the decision on where the FDI will be used, and are predominantly macroeconomic and aggregated. One exception is the study by Dasgupta, Modyand Sinha (1999) which contains a microeconomic analysis that identifies the profile of (173) Japanese multinational firms pursuing FDI in several Asian countries. It shows that Japanese investors prefer to invest in locations where human capital is well developed. Even though the study analyzes human capital as a crucial factor for FDI, it only addresses Japanese multinational firms, and does not thus consider firms from other countries. In the present study, we take into consideration the multinational character of the firms located in China, thus making an additional contribution with empirical evidence.

The studies of Broadman and Sun (1997) and Sun, Tong and Yu (2002) develop their analysis at a sectorial and macroeconomic level, using macrostatistics to understand the relationship between human capital and FDI. For instance, Broadman and Sun (1997) used data on

[1] Data from "Rising FDI into China: the facts behind the numbers", UNCTAD Investment Brief, Number 2, 2007 at http://www.unctad.org/en/docs/iteiiamisc20075_en.pdf, accessed on December 2011.

Chinese provinces for the year of 1990 and concluded that the level of literacy among adults has a small positive effect, and yet it is statistically significant for FDI. The study by Sun *et al*. (2002) used FDI data on 30 Chinese provinces, in the period between 1986 and 1998, found that the importance of the FDI determinants varies over time, and labour quality is an important factor to attract FDI.

Our study aims to analyze the importance of human capital in attracting FDI to China at a microeconomic level. We argue that micro analyses are critical in this domain as there is no reason to assume or expect macro and meso behaviour to be in any way similar or analogous to the behaviour of individual units (Janssen 2008). Additionally, human capital is assessed taking into consideration not only the direct, but also the indirect impact of human capital on FDI, based on the firms' R&D efforts. There is no knowledge of similar studies for the Chinese case and thus this study aims to fill this gap, by contributing with additional empirical evidence.[2]

The paper is structured as follows: the following section (Section 2) provides a brief review of the relevant literature. In Section 3 we justify the variables-proxies used in the empirical model and describe the data collection procedures. Section 4 presents the estimations of several logistics models, and discusses the results. Finally, in the Conclusions, the main points and results of the research work are summarized.

2. Literature review on FDI determinants with a focus on China

There is a variety of theoretical models attempting to explain FDI and the mode and location decision of MNEs (Faeth 2009). The eclectic or OLI paradigm of FDI, put forward by Dunning (1979), proved to be a better approach of explaining FDI as linked to MNEs (Stoian and Filippaios 2008). In accordance, FDI is explained by identifying three types of special advantages that MNEs have: ownership (O), location (L) and internalization advantages (I). OLI paradigm offers a holistic framework to investigate the significance of factors influencing both the initial expansion of MNEs by foreign production and the subsequent growth of their activities (Tolentino 2001). Such framework establishes a common ground between various approaches and the different levels of analysis (Cantwell and Narula 2001). Thus, the present study is developed under this theoretical framework putting particular emphasis on location related factors such as the role of human capital, R&D and Firms-Universiy contacts for FDI attraction.

[2] Only studies published in scientific journals and written in English were surveyed – non-published or studies written in Chinese were not screened.

A reasonable number of studies have been conducted on FDI in China, following different perspectives. Some authors, such as Vu, Gangnes and Noy (2008) and Zhao and Du (2007), analyzed the impact of FDI on the Chinese economy. Specifically, Vu *et al.* (2008), based on sectorial data, analyzed the impact of FDI on the Chinese and Vietnamese economies. They concluded that FDI has a positive and statistically significant effect on economic growth in both countries, but this effect is not equally distributed across the different sectors – FDI only has a consistent positive effect in the manufacturing industry. Zhao and Du (2007) analyzed the relationship of causality between FDI and growth in China, but they reached different conclusions. According to these authors, the two-way relationship between FDI and economic growth of China is not very significant: economic growth in China attracts more FDI, but the FDI flow does not have a statistically significant impact on economic growth. Liu and Wang (2002) gathered data from different industrial sectors to study 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 and the firms' size, are the main determining factors of productivity. Lai, Peng and Bao (2006) introduced innovation matters, studying the relationship between technology spillover effects and the receiving country's ability to absorb funds. The study was based on data at the level of the Chinese provinces, in the period between 1996 and 2002, and concluded that the capacity for technology spillovers depends on investment in human capital and on the degree of openness of the receiving country. Furthermore, they also concluded that FDI is a more significant spillover channel than imports.

Another (complementary) analysis perspective involves FDI determinants. Studies focused on the determining factors of FDI in China can be grouped into two categories: 'factors to attract FDI in China' and 'the origin and motivations for FDI'. Some studies analyzed factors to attract FDI in China (for instance, Broadman and Sun 1997; Fung *et al*. 2005; Luo *et al*. 2008), evaluating the importance of certain factors, such as market dimension, salaries, quality of the workers, the level of infrastructure development, tax and other preferential policies, to attract FDI in China. For instance, Luo *et al*. (2008) analyzed different determinants for the use of FDI in inland China, based on 686 observations of 98 cities from 16 provinces between 1999 and 2005. The authors concluded that improved industrial foundations, the associated cluster effects and incentive policies are the most important factors foreign investors take into consideration when choosing areas in inland China. The level of literacy among adults has a low, yet positive and significant effect on the location of

FDI in China. The study by Fung *et al.* (2005), based on FDI data from the United States, Japan, Hong Kong, Taiwan and Korea, relative to several regions in China, between 1990 and 2002, explored the importance of infrastructures when trying to attract FDI. The authors concluded that, in general, soft infrastructures (such as transparency and institutional reforms) are more important than hard infrastructures (for instance, road and railway infrastructures) when it comes to attracting FDI.

The matter of attracting FDI has also been analyzed for the Chinese provinces. For instance, Ng and Tuan (2001) studied the allocation of FDI in the province of Guangdong and concluded that foreign investors in Guangdong consider that economic and governmental policies (including factors such as the disposition of preferential tax policies, the firms' degree of autonomy and the stability of economic policies) and the dimension of government and governmental administration (including factors such as the efficiency and transparency of the governmental administration and the government's ability to regulate the economy), are the most important factors for investment decisions.

There are also studies centred on the origin of FDI, that is, the main countries involved in FDI in China and their motivations. More specifically, the study carried out by Fung, Iizaka, Lee and Parker (2000) concluded that both American and Japanese FDI are significantly influenced by the quality of workers, whereas Hong Kong's FDI in China is more sensitive to local labour costs.

Even though much has been said about FDI in China, empirical evidence supporting the importance of human capital as a determining factor for FDI in this country is still scarce, and it has thus not been possible to clearly determine this factor's relevance to date, despite the few studies which are based on representative and broad samples.

Studies analyzing human capital as a determining factor of FDI have focused not only on developed countries, but also on developing ones, and the conclusions are not unanimous. For instance, Mina (2007), based on data for six countries of the Gulf Cooperation Council between 1980 and 2002, analyzed the importance of human capital when it comes to attracting FDI, and concluded that it has a negative influence on FDI. According to this study, an improvement in the quality of human capital (measured by the number of students enrolled in high school or university) of about 1%, reduced the FDI flow between 3% and 4%. There were two possible explanations for this result: on the one hand, the increase in the quality of human capital (in terms of education) can encourage national entrepreneurs to make

investments domestically, and consequently increase the proportion of domestic investment in relation to the GDP. On the other hand, the variable used in the model may not represent the current situation of the quality of human capital in the six countries, which possibly discourages FDI flows.

Rodríguez and Pallas (2008), based on 252 observations between 1993 and 2002, studied human capital as a determining factor for FDI in and concluded that human capital has a positive impact on the FDI inflow. In contrast, Cociu and Gustavsson (2007) studied the motivations of Sweden and Germany in pursuing FDI in the Baltic Countries in Transition and concluded that during the period of analysis (1995-2005), foreign investment was attracted by the cost economy, and not so much by the quality of the workforce.

Focusing on Chinese provinces and analysing the impact of FDI spillovers according to human capital thresholds, which reflect countries'/regions' development level, Fu and Li (2009) suggest that above a given human capital threshold (10.99 per cent), the negative effects of FDI transform into positive spillover effects. They further add that while most developed countries exceed the threshold of 10.99 per cent, some developing countries, including China, are below this threshold. Thus, in this latter case it might happen that human capital endowments are not sufficient to overcome potential FDI negative impacts.

The analysis of the literature reveals that current knowledge of the impact of FDI on human capital in China is scarce. The very few works that are published relating human capital and FDI (e.g., Fu 2007; Fu and Li 2009) focus on the regional dimension. To bridge this gap, our intention is to understand, at a microeconomic level, to what extent is human capital an important factor when it comes to attracting FDI, controlling for other factors (namely the importance of labour costs for firms) that may influence FDI inflows in the Chinese case. The following hypothesis will be tested:

Hypothesis 1: Human capital has a positive influence in attracting FDI.

Another essential aspect to better understand the relationship between human capital and FDI is innovation or, more specifically, the Research and Development (R&D) activities of firms. Several studies suggest that there is a direct relationship between R&D activities and FDI. For instance, Amitendu and Shounkie (2007), based on data from UNCTAD on FDI flows for 14 Asian countries between 1994-2003, concluded that countries with well-developed technological capacities, namely the ability to innovate, develop and effectively apply new technologies through R&D activities, have an advantage in comparison to other economies in

attracting FDI. For India, the authors concluded that the country's technological capacity (measured by the annual expenditure on R&D activities) is a critical determinant in attracting FDI. Artige and Nicolini (2006) selected three European regions (Baden-Württemberg, Lombardy and Catalonia) to analyze R&D as a potential FDI flow determinant between 1995 and 2002 and concluded that R&D only has a positive influence in Catalonia when it comes to attracting FDI. Conversely, in the other two regions, R&D is not statistically significant in this regard. According to the authors, this can be explained by the fact that Catalonia is at a different stage of economic development, when compared to Baden-Württemberg and Lombardy.

Studies on the importance of R&D in attracting FDI in the Chinese case are scarce. Chen (1996) and Wei, Liu, Parker and Vaidya (1999) are among those very few. For the period between 1988 and 1993, Chen (1996) concluded that R&D (proxy by proportion of scientists and researchers in the total number of workers) has a negative influence when it comes to attracting FDI in the eastern and central regions of China. Wei *et al*. (1999) examined FDI in 27 Chinese provinces, and found that the provinces with the highest number of people working in R&D, with low salary levels, and better local infrastructures, attract more FDI. According to this study, a 1% increase in the number of scientists and researchers working on R&D leads to a 0.5% increase in the (contracted) FDI flow.

As mentioned previously, even though there are some empirical studies on China related to human capital with FDI and R&D with FDI inflow, the majority are macroeconomic in focus. The literature does not mention the relationship between R&D, FDI and human capital at the level of firms. Thus, we intend to evaluate the relationship between human capital and FDI, considering not only the direct impact of human capital on FDI, but also its indirect impact, by means of the firms' R&D efforts. To this end, the following complementary hypothesis will be tested:

Hypothesis 2: The impact of human capital in attracting FDI is higher when the firms' R&D efforts increase.

To the best of our knowledge, there are no studies explicitly and directly centred on the relationship between the firms' contacts with universities and FDI. There are, however, a reasonable number of studies that evince the importance of the role played by educational institutions – specifically universities – in attracting FDI and in the geographical location of firms, without taking into consideration the origin of the corresponding capital inputs.

Audretsch and Lehmann (2005), when analyzing 281 firms in Germany who participated in the Initial Public Offering of Stocks between 1997 and 2002, found that university outputs influence the firm's decisions regarding location. The number of new knowledge-based firms, located near universities geographically, is positively influenced by the knowledge they generate. According to the authors, universities with a higher level of research in the natural sciences tend to attract high-tech firms. Based on the abovementioned arguments, the following hypothesis will be tested:

Hypothesis 3: The connections between firms and universities have a positive impact when it comes to attracting FDI.

Additionally, according to Tavares and Teixeira (2005), for a relationship between a firm and a university to be productive, it is necessary for firms to have competent human resources that will interact and understand their partners (universities). This leads us to an additional hypothesis:

Hypothesis 4: The influence of human capital in attracting FDI increases as the contacts with the universities become more important

3. Methodological considerations

This is a microeconomic study, which means that companies are the single unit of analysis. For the Chinese case the information required to test the hypotheses in this study are not publicly available, and thus it was necessary to use primary data collected directly (survey) from a set of firms in China.

The survey performed on the firms is identical to the one carried out by Tavares and Teixeira (2005) in their study of the Portuguese case. Since some of the respondents would be Chinese, the survey was sent in English and Mandarin Chinese. To make it easier for respondents to answer and send questions, apart from a paper version, an online version of the survey was also created (in English and Mandarin Chinese). The survey was tested before being sent to the firms, so as to ensure the vocabulary employed was accessible and clear, and no technical problems persisted when filling in and submitting the online surveys. Since one of this study's aims was to analyze, not only the direct effect of human capital on attracting FDI, but also to quantify its importance via the firms' R&D efforts, and so as to limit the target population, the firms were obtained from the lists: "The 287 most innovative firms in China" and "The 500 largest multinationals in China". These lists were published jointly – "The 287 most innovative firms in China" was published by the Ministry of Science and Technology, the

Commission for the Supervision and Administration of State Property of the State's Council and the National General Union of the People's Republic of China, while "The 500 largest multinationals in China" was published by the Ministry of Trade of the People's Republic of China. Due to the fact that about 20% of the firms on the list "The 500 largest multinationals in China" belong to the same Economic Group and about 4% of the firms were already on the other list, our reference population covered 667 firms.

Even though the lists of firms are public, highly relevant and broad-ranging, and include national and foreign capital Chinese firms, from different sectors and of different sizes, which potentially using R&D, there is a great lack of information on those firms (only the firms' names in Chinese are provided and, in the case of multinational firms, their turnover). Thus, the task of data collection required much time and effort. This process followed several stages, lasting 3 months, combining email and phone contacts. In the end of the process 379 firms were successfully contacted with 92 answering, though 15 responses were incomplete. Thus, we obtained 77 valid surveys, representing an effective rate of response of 20%, which nevertheless compares favourably with response rates to surveys performed by letter in China - between 10% and 15% (Wang *et al.*1998).

4. Results

For reference period (2005-2007), the respondent firms have, on average, 21 years of business experience, employing 16765 workers, 14296 of which (85%) with 12 or more years of schooling. Furthermore, 3712 (22%) of theses employees were engineers. The respondent firms exported, on average, 28 billion RMB (about 2.8 billion Euros) and spent, on average, 385 million RMB on R&D activities (about 38.5 million Euros). About 55% of the respondent firms are entirely national, meaning that the percentage of foreign capital is null, and 21% declared that foreign entities hold over 50% of their capital. Globally, about 35% of the firms have foreign investment participation above 25%, referred to in this study as 'multinational firms'. The firms in the sample present a high level of human capital in terms of education levels (general human capital) and in terms of qualification (specific human capital). About 78% of the firms declared that the percentage of engineers in the total number of workers was above 5%. On the other hand, 35% of the firms declared that the number of engineers represented more than 20% of the firm's total employment. With regard to R&D, the firms in this sample spent on average 3.9% of their sales on R&D activities. Approximately 30% of the firms declared an average rate of R&D above 5%.

The aim of the study is to empirically evaluate and validate the importance of human capital as a determining factor in attracting FDI in China. The binary nature of the data observed on the dependent variable [foreign capital? (1) Yes; (2) No] causes some restrictions to the choice of estimation model. Furthermore, the assumptions required to test the hypothesis of conventional regression are necessarily violated (for instance, it no longer seems viable to assume that the distribution of errors is normal). The values forecasted in a multiple regression analysis cannot be interpreted as probabilities because this does not restrict the forecasted value to drop between 0 and 1. Consequently, conventional estimation techniques in the context of a discrete dependent variable do not constitute a valid option.

We chose to adjust the equation of the logistic model to a restricted model in terms of the log odds that an event will occur, which helped us directly and clearly identify the coefficients of the logistic function. Thus, the following logit model was obtained:

$$\log\left(\frac{Foreign}{Domestic}\right) = \beta_0 + \beta_1 HC + \beta_2 RD + \beta_3 Size + \beta_4 Age + \beta_5 EXP + \beta_6 UNIV + \beta_7 (HC \times RD) + \beta_8 (HC \times UNIV) + \mathbf{\beta_9 IND} + \mu$$

One way to interpret the logistic coefficient would be the change in odds ratio associated to a unitary change in the independent variable:

$$\left(\frac{Foreign}{Domestic}\right) = e^{\beta_0 + \beta_1 HC + \beta_2 RD + \beta_3 Size + \beta_4 Age + \beta_5 EXP + \beta_6 UNIV + \beta_7 (HC \times RD) + \beta_8 (HC \times UNIV) + \mathbf{\beta_9 IND} + \mu}$$

In this case, since e to the power of β_i is the factor that causes the odds to change when the independent variable i^{th} increases in each unit, when β_i is positive, this factor will be higher than 1, which means that the odds increase and the factor positively influences the attraction of FDI; if β_i is negative, this factor is lower than 1, which means that the odds are reduced, and thus the factor negatively influences the attraction of FDI; when β_i is equal to 0, the factor will be equal to 1, which means that the odds do not change. As such, the factor does not have any impact on the attraction of FDI.

The proxies of the variables were chosen from the relevant literature. The dependent variable, multi-nationality or being a so-called 'foreign capital' firm. Currently, there are two different criteria to classify foreign participation in firms' capital. Bellak (2004) and De Backer and Sleuwaegen (2005) consider a limit of 50% or more of equity participation for a firm to be considered a foreign capital firm, that is, if the firm's capital has a percentage of foreign participation of 50% or more, it can be considered a foreign capital firm. The OECD is less demanding, adopting a 10% minimum limit of equity participation, according to the MFA

definition (OECD, 2008). In this work, the criterion adopted to classify whether a firm is national or multinational is 25% since, according to the document of the Chinese government, number 575 - "Report on the Reinforcement of Authorization Management, Record, Currency and Tax in Foreign Capital Firms", issued in 2002 by the Ministry of Economy and Foreign Trade (replaced by the Ministry of Trade in 2003), other than under special circumstances, the entities considered as foreign capital firms are those whose foreign capital is not below 25%.[3] Based on this classification criterion, in this sample, out of the 77 firms with valid responses, 50 are national and 27 are multinational firms.

Human capital is generally perceived as a relevant determinant for FDI. *Ceteris paribus*, locations (countries, regions) with more qualified workers have greater advantages when competing for FDI with other locations (Broadman and Sun 1997). Human capital can be acquired through formal education (*general* human capital) and at work (*specific* human capital) (Tavares and Teixeira 2006). The present study takes into consideration both human capital components. The firms were queried on the number of workers with 12 and more years of schooling in the total number of workers, which corresponds to the more *general* component of human capital. The more *specific* component of human capital is measured by the number of workers with a degree in the total number of workers (Teixeira 2002). The R&D intensity variable is the result of the firm's ratio of R&D expenditure divided by total sales for a reference period. This variable is widely used in the literature (Mohnen and Hoareau 2003).

The following are also considered as control variables: the firm's size, measured in terms of number of workers (Bob, René, Bert and Roy 1997); the firm's age, calculated by the number of years the surveyed firms have been in activity (Rutkowski 2006), and the level of exports, measured from the ratio between each firm's exports on the sales value (Estrin, Meyer, Wright and Foliano 2008).[4]

The empirical results obtained from the estimation are shown on Table 1. Models 1 and 2 preset the results of the logistic model estimation with all the independent variables considered in the econometric specification. Models 3 and 4 include a new variable, besides the previous variables, that intends to reflect the "degree of the firm's openness in terms of

[3] Data from the "Report on the Reinforcement of Authorization Management, Record, Currency and Tax in Foreign Capital Firms" in http://tfs.mofcom.gov.cn/aarticle/zcfb/200301/20030100062554.html (in Chinese), accessed on December 2011.

[4] In this study, firms were queried on the medium values of the relevant variables over the last 3 years (2005-2007).

sources of information and knowledge for innovation activities". This 'degree of openness' is quantified by the (logarithm) of the number of different external sources of information and innovation that the firms benefit from. In Models 5 and 6, the location factors (clients, labour costs, tax incentives and transport network) are added as factors that potentially explain multi-nationality/FDI. In Models 1, 3 and 5, the proxy for human capital is education (general human capital – weight of workers with 12 or more years of schooling in the total number of workers), while in Models 2, 4 and 6, the proxy used for human capital is qualification (specific human capital – weight of engineers in the total number of workers).

In any of the estimated models, the structural variables related to the human capital proxies (education and qualification) are not directly related to foreign capital. This indicates that, in the Chinese case, human capital does not constitute a direct factor to attract FDI, which means that, for the sample under analysis, we cannot corroborate Hypothesis 1 - "Human capital has a positive influence in attracting FDI in China". This conclusion is contrary to the results of the studies mentioned previously (Section 2) on the Chinese case, where several authors (e.g., Luo *et al*. 2008; Fung *et al.* 2000) identified a positive relationship between human and foreign capital. However, it is important to mention that these authors used different proxies to measure the human capital variable: in the study carried out by Luo *et al*. (2008), this variable was measured by the adult literacy levels, whereas Fung *et al*. (2000) use the number of students enrolled in higher education institutions to measure capital.

As far as the level of R&D is concerned, the result of our estimation indicates that the intensity of R&D has a negative influence in attracting foreign capital when human capital is measured by academic qualifications (the more *general* human capital) (cf. Models 1 and 3). This means that the multinational firms located in China have, on average, a lower level of R&D activities. This evidence partially confirms Motohashi's conclusion (2006) that an increase in R&D was found both for foreign and national (Chinese) firms, even though in our study the level of R&D in foreign firms is relatively lower than in the national ones. According to Jefferson, Hu, Guan and Yu (2003), this can be the result of the fact that foreign companies are supported by the technological capacities of their parent firms, outside China, and thus they do not need, due to similar characteristics, the same level of R&D activities. This means that FDI in China does not seem to contribute to an increase in that nation's ability to innovate.

Even though human capital does not have a direct impact on the attraction of foreign capital, and the level of R&D shows a negative relationship with FDI, it is important to note that

when we test the role R&D can play as a mediator in the relationship between human capital and FDI, human capital interaction and R&D activities emerge as positive and statistically significant in explaining FDI (cf. Models 1 and 3).

In other words, the relevant impact of human capital on foreign capital is indirect, through R&D activities. Thus, human capital only has an (positive) impact on the attraction of foreign capital when there is capacity for innovation. The more active firms are in terms of R&D, the higher the impact of human capital on the attraction of foreign capital. This evidence is consistent with the conclusions of Li and Zhong (2003). Using a sample of 276 R&D alliances in China, between 1995 and 2000, the authors concluded that over the last few years the volumes of FDI in R&D activities in China increased. According to these authors, this is due to the fact that multinational firms are increasingly attracted by the existence of highly qualified researchers and policies that are favourable to this type of FDI.

Another interesting result is related to connections with universities. Controlling for the other variables in the model, contacts with universities are an important direct determinant in attracting FDI to China (Models 1-5). The firms that contact more frequently with universities have a higher probability of attracting foreign capital. Our model's estimations corroborate the results of Almeida (1996), according to whom, in the United States' semiconductor industry, the foreign subsidiaries located in Silicon Valley are more inspired by local sources of specific knowledge than by domestic firms in the same region.

According to Kuemmerle (1999), firms invest abroad in order to benefit from exclusive resources and to capture externalities created by the institutions and local firms, whereas their subsidiaries are normally located near universities, local governmental labs and other non-profit research institutions.

Indirectly, through general human capital (qualifications), contacts with universities tend to be more relevant for national capital companies. This evidence is consistent with Chang and Shih (2004), who stated that universities in China are the main objects of collaboration for firms, research institutes and other universities because they gather the most research resources, especially qualified human resources. According to Padilla-Pérez (2008), contacts between foreign subsidiaries and universities are strongly concentrated in educational activities, namely traineeships for students, design of degree programmes and donations of equipments, and not so much in research project collaborations.

Size and age arise as negative signs and present statistically significant results in estimated models (cf. Models 1 and 2). Thus, it is possible to conclude that, on average, multinational firms are younger and smaller in size. This also has to do with the fact that it was only recently (after 1978) that China introduced its external openness policies (Fung *et al*. 2005). When we include the variable "Degree of openness in terms of innovation sources" (Models 3 and 4), the results do not differ greatly from the ones obtained with previous models (Models 1 and 2), and hence this variable is not statistically significant.

Table 1

The broader models (Models 5 and 6) include, apart from the abovementioned variables, location factors. Among the most relevant location factors is the transport network, which has a positive and significant influence on the attraction of FDI (Model 6). This evidence is consistent with Broadman and Sun (1997), who found that FDI flows in China tend to be used in places where basic infrastructure is more developed. These authors showed that the extension of the transport network had a positive and significant effect on the allocation of FDI. As Khan and Bamou (2006) noted, the development of infrastructures in a region is very important in the sense that it indicates how hard and expensive it is to do business in a country. The more developed the roads are in a certain country, for instance, the easier it will be to access markets, and transportation costs will decrease. Thus, the incentives for investment in that country will be higher. On the contrary, tax incentives present a negative and significant relationship (Models 5 and 6). This means that the allocation of tax incentives seems to be, on average, more important to national firms than to foreign firms located in China. This fact seems to be in contradiction with the empirical evidence provided by Head and Ries (1996). These authors argued that tax incentive policies are important to attract FDI in China. It should be noted though that only the FDI by the USA, Japan, Europe, Austria and Canada was considered in this study. According to the authors, FDI from Hong Kong, Macau and Singapore represents about two thirds of the investment in continental China. These firms were excluded from the sample due to the fact that some investors in continental China, aiming to receive foreign investment incentives, establish firms in Hong Kong, Macau and Singapore and, through these firms, invest in continental China. According to Wei (2000), investments from the USA, UK and Japan are more sensitive to the tax burdens of the host country because many multinational firms from these countries prefer to reinvest a substantial part of their foreign revenue in the host country, instead of transferring the results of the subsidiaries to the country of origin.

5. Conclusions

Even though much has been said about the attraction of FDI in China and its FDI profile, studies that quantitatively analyze the importance of human capital as a determinant for FDI in China are scarce. The empirical evidence that supports this hypothesis is thus insufficient and it has not yet been possible to clearly determine this factor's relevance, based on samples of firms. The (few) studies that relate these variables are essentially macroeconomic. Contrary to this tendency, this study aims to analyze the importance of human capital in attracting FDI in China at a microeconomic level. Additionally, we evaluate its impact considering not only the *direct*, but also the *indirect* effect of human capital on FDI, based on the firms' R&D efforts. There is no knowledge of similar studies for the Chinese case. The present study aims to bridge this gap, contributing with empirical evidence. Additionally, even though there is already a significant number of studies focusing on the importance of educational system institutions, specifically the universities, in terms of the firms' geographical location, without considering the origin of the respective capital inputs, to the best of our knowledge, there are as yet very few studies that explain and directly focus their analysis on the relationship between the firms' contacts with universities and FDI. Thus, we intend to empirically contribute to the literature in this area by collecting evidence for the Chinese case.

Based on the data collected from 77 innovative firms located in China, we concluded that human capital is not directly related to the 'multi-nationality' of the firms, that is, it does not constitute a factor in attracting FDI in China (Hypothesis 1 is thus not corroborated). Regardless of this result, however, we did find that human capital, when combined with R&D efforts, is positively and significantly related to 'multi-nationality'. In other words, human capital constitutes an important factor in attracting FDI through the firms' R&D efforts, which supports Hypothesis 2 ("The higher the firms' level of R&D, the higher the impact of human capital in attracting foreign capital"). We thus concluded that connections with universities have a positive impact on the attraction of FDI (i.e., Hypothesis 3 is corroborated). However, the impact of human capital on the attraction of FDI is not sustained on the basis of additional contacts with universities, which contradicts Hypothesis 4.

The results of this research contribute to the FDI-oriented policies in China. Through the analysis of the data collected directly from the firms, we found that even though China is one of the countries that receives the highest levels of FDI in comparison to other developing countries (UNCTAD, 2007), human capital in China does not contribute *directly* to the attraction of foreign capital. Human capital only attracts foreign capital when associated to a

high level of R&D. Hence, it is important to recognize that the implementation of FDI policies should be complemented by other more general policies, namely educational ones.

So as to bolster its policy of opening the Chinese market to the exchange of more advanced technologies ("*market for technology"* – Cheung and Lin 2004), it is extremely important that the Chinese government implement long-lasting strategies, aimed at improving human capital at an educational level, so as to attract FDI with higher added value in terms of high technology. Consequently, the implementation of more coordinated and systemic strategies is required, including governmental entities (promotion of both investment and education) and educational institutions (public and private), to guarantee improvement not only in the quantity, but also in the quality of human capital. To do so requires a clear strategy and long-term investment.

Additionally, our results confirm the importance of developing infrastructures, which makes attracting FDI possible. As a result, investment in infrastructures in poorer (inland) regions in China may constitute a mechanism for economic development, through the attraction of foreign capital.

As with any research work, there are a number of limitations that may open interesting paths for future research. The low number of answers to the survey is at the outset the most obvious limitation. However, as acknowledged by Chang and Shih (2004), Chinese firms do not generally provide much information, even for academic purposes. Future research, with a wider timeframe, could broaden this study, with application to a larger number of firms, not only to the most innovative, but also to the smaller ones or those with less technological skills. Given China's geographical vastness, it could be interesting to establish a comparison between the Chinese provinces, based on a survey similar to ours, and identify the similarities/differences between them. Another interesting research path, following Schartinger, Schibany and Gassler (2001), who point out the existence of a large number of interactional types among universities and the business sector (recruiting, supervision and funding of MSc and PhD theses, joint research, licence purchasing, etc.), it would be interesting to empirically identify which type or types of contacts with universities attract the most foreign capital in China.

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Table 1: Estimation of the logit model (dependent variable: ratio of the log odds for the firm to be a foreign capital firm as opposed to a national capital firm)

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Structural variables	Human Capital (HC)	1.218	1.914	1.070	2.344	1.323	-3.961
	Size	-0.386*	-0.526**	-0.403*	-0.540**	-0.410*	-0.546**
	Age	-1.472**	-1.918***	-1.474**	-1.931***	-1.703**	-1.966***
	Level of R&D	-44.772*	6.998	-46.210*	6.488	-38.776	0.577
	Level of exports	0.818	-0.002	1.038	0.134	0.848	-0.028
Sources of information and knowledge for innovation	Universities	2.886**	1.818*	2.776**	1.762*	2.321*	1.064
	Degree of openness in terms of sources for innovation			0.474	0.342	-1.209	-2.275*
Interaction Variables	HC*R&D	44.441*	-76.278	45.152*	-75.523	-39.012	-37.798
	HC *Universities	-1.433**	-3.428	-1.438**	-3.518	-1.287*	-1.874
Location factors	Clients					0.671	0.723
	Labour costs					1.577	0.308
	Tax incentives					-2.115*	-2.408**
	Transport network					1.560	2.680*
Constant		4.690**	7.194***	3.238	6.039	7.078	16.243***
Sectorial dummies		Yes	Yes	Yes	Yes	Yes	No
N		77	77	77	77	77	77
Foreign capital		27	27	27	27	27	27
National capital		50	50	50	50	50	50
Quality of the model's adjustment							
Hosmer-Lemeshow Test (significance)		13.142 (0.107)	9.620 (0.293)	9.141 (0.331)	9.765 (0.282)	6.210 (0.624)	7.083 (0.528)
Nagelkerke R^2		0.474	0.578	0.476	0.579	0.526	0.567
Percentage of correct responses		80.5	83.1	80.5	81.8	81.8	84.4

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