Globalization of Innovation and Regional Innovation Systems: Lessons from the new China

Chen YUN-CHUNG (ycchen@ust.hk)
Hong Kong University of Science and Technology, Hong-Kong

Jan VANG (jv@imi.aau.dk)
Copenhagen Institute of Technology, Aalborg University, Denmark

Cristina CHAMINADE (cristina.chaminade@circle.lu.se)
CIRCLE, Lund University, Sweden

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Abstract

The global location of R&D labs by MNCs is a rather new phenomenon; especially when it comes to establishing R&D labs in developing countries. The existing and rather limited literature on globalization of innovation provides four possible explanations of why multinationals locate R&D labs in developing countries: reduce research costs, access large markets, tap into a large pool of qualified human resources or benefit from knowledge spillovers available in the local/regional system of innovation. The empirical research presented in this paper reveals that none of these arguments can fully explain the increasing location of R&D labs in China. The in-depth study of MNCs R&D labs in Beijing and Shanghai, China, reveals that specific aspects of market, technological and political uncertainty provide a more adequate explanation to the increasing presence of R&D labs from MNCs in developing countries such as China and thus calls for an integration in the regional innovation systems framework.

Globalization of Innovation and Regional Innovation Systems: Lessons from the new China

1. Introduction

Since IBM first established their wholly owned IBM Research facility in Beijing in 1995, well-known Multinational Corporations (MNCs) such as Intel, Microsoft, Nokia, Ericsson, SAP, Samsung and Matsushita started to set up their research labs and/or research and development (R&D) centres in China. Understanding why China, a developing country in terms of GDP, has been able to attract this form of knowledge-intensive FDI is the empirical purpose of this paper.

For several decades research on developing, emerging or transition countries has been the domain of development studies. The research focused initially on decoupling strategies and later on the implications of the Washington consensus on the degrees of freedom of developing countries in choosing their own development trajectories. In this context, multinational corporations were either conceptualized as agents that exploited the developing countries or as agents that *could,* under certain conditions stimulate growth and development through the transfer of capital, knowledge and technology to the indigenous industry. Independently of the approach taken, the general understanding was that developing countries were, at best, followers or imitators[i].

However, this dominant conceptualization has been recently challenged. The last decades have witnessed a rapid growth of certain industries and regions in developing countries, particularly in China and India, which are quickly moving from low-cost production sites to knowledge-intensive centres attracting a large proportion of R&D FDI which was previously canalised to developed countries (UNCTAD 2005). Innovation (as opposed to imitation) and regions (as opposed to nation states) have emerged as central drivers explaining the flows of knowledge intensive activities to some emerging regions tapping on the opportunities opened by economic globalization (Archibugi and Pietrobelli 2003; Chaminade and Vang, 2008; Lundvall et al, 2009). This has spurred a lively debate on how to conceptualize global shifts in the location of innovation activities giving the limitations of existing literature.

International business studies have long argued that one of the reasons for MNCs to locate production facilities abroad was the access to markets and the reduction of costs. This "classical"

arguments were also used to initially explain why MNCs would locate R&D intensive activities (and not only production) in developing countries (Dunning and Lundan, 2009): to reduce the research costs by tapping in pools of technical and scientific skills at lower costs than in more developed countries (Reddy, 1997, 2000) and to access large emerging markets which may require adaptations to local standards, customs and tastes (Blanc and Sierra, 1999; Castellani and Zanfei, 2006, Zedtwitz 2004; Sun et al. 2006). Research applying the Regional Innovation Systems-approach (henceforth, RIS) has contributed significantly to this rapidly growing stream of research trying to understand the role of regions as knowledge hubs in the global economy (Chaminade and Vang, 2008) based on the accumulation of capabilities in certain regions (Lewin et al, 2009) and, more importantly, how technology-based FDI is sensitive to institutional factors such as government policies and incentives (Amsden and Tschang, 2003; Amsden et al, 2001).

Based on an exploratory study of the motives and determinants for MNCs to relocate or establish R&D labs in Beijing and Shanghai, China, this paper attempts to test if the aforementioned factors can explain the increasing presence of MNCs R&D labs in two regions in China. It concludes that the explanations provided in the literature do not seem to be completely relevant in the Chinese case. The analysis suggests that market uncertainty (product standards, and uncertainty about classes of consumers and local competitors' strategies in coping with these), technology uncertainty specific to the country context and political uncertainty are important factors shaping MNCs decisions to locate R&D labs in regions in developing countries. The paper is based original data collected by one of the authors through a combination of survey and semi-structured interviews with 33 MNCs R&D labs (not headquarters) in the ICT industry in Beijing and Shanghai (see details in the methodological section below) in 2002 and follow-up fieldwork in 2005.

The paper is structured as follows. First, we introduce the current research on the MNCs' location choices concerning establishing R&D labs in developing countries while highlighting the central omissions in the dominant framework and empirical research and how the regional innovation literature can provide some alternative explanations. This is followed by a methodological section describing how the data was collected and the introduction to the case. Thirdly, we turn to the case. The case starts with providing some stylized facts about the two regions and it is followed by and in-depth analysis of the (different) motives and determinants behind MNCs location of R&D labs in Beijing and Shanghai. The paper is rounded off with a concluding section that inserts the case-based findings in the more general literature.

2. Understanding the location of MNCs R&D labs in developing countries

There is not one single stream of literature offering a comprehensive view of how and why MNCs would locate knowledge intensive activities abroad. Rather than this, the literature is fragmented and contributions scattered in different fields like international business or economic geography. The international business literature takes as a point of departure the firm and the motivations of the firm to locate activities abroad. The regional innovation system literature, rooted in economic geography, in contrast, focuses on the role of regional factors explaining the location of certain economic activities. Both research streams are complementary.

2.1. International business literature and the motivations of MNCs to locate R&D labs in developing countries. Possibilities and constrains

In international business literature, there are two traditional explanations to why MNCs decide to locate production or innovation activities abroad (Castellani and Zanfei, 2006): Asset exploiting and asset seeking. Asset exploiting strategies aim at exploiting the prior advantages of the firm. Related to R&D, asset exploiting strategies occur when a firm wants to extend the market of innovations by selling them abroad and adapting them to the specific requirements of local markets (Dunning and Narula, 2004). Asset seeking strategies, on the other hand, aim at augmenting the capabilities of the firm to conduct innovation. While asset exploiting strategies are related to cost reduction and market access, asset seeking strategies are driven by the accumulation of competences in certain regions around the world.

As suggested by Reddy the access to a surplus of relevant human capital has become over time a crucial factor attracting MNCs R&D labs to developing countries. Based on his analysis of MNC R&D investment in India, Reddy (1997, 2000) concludes that there are four waves of R&D globalization. In the first wave (up to 1960), MNCs globalize their R&D to enter local markets abroad. In the second wave (in the 1970s), they do so to build market share in the local markets aboard. In the third wave (in the 1980s), they are driven by the need for worldwide learning and new technology inputs. In the fourth wave, they are aiming at accessing cheap and highly skilled R&D personnel and lowering R&D cost. In his later work Reddy (Reddy, 2000) compares the MNC R&D investment in India and Singapore. He stands by his original argument that "huge reservoirs" of scientists and engineers are the pull factors for the location of MNC R&D labs, particularly to certain regions.

This argument of the oversupply of scientists could be adequate for some developing countries but not for all and not for the whole country. Despite the fact that some developing countries are not highly industrialized, they have internationally reputed academic establishments and those are usually concentrated in certain regions in the country. This is the case of China. While the country as a whole may not be participating in global R&D-related FDI, certain sub-national regions have been able to rapidly accumulate capabilities and attract global R&D flows (Castellacci and Archibugi 2008; Chaminade and Vang, 2008). The research on Regional Innovation Systems (RIS) has long tried to understand the innovation dynamics at a local or regional level. The purpose of this section is to introduce the concept of RIS while focusing on and underscoring the limited conceptual relevancy and empirical contribution of RIS in explaining why MNCs locate R&D labs in certain regions and extending it by incorporating some additional explanations provided by other streams of literature. This provides the point of departure for final re-conceptualization of RIS.

2.2. Regional innovation systems and the motivations for MNCs to locate R&D labs in developing countries. Possibilities and constrains

Despite the importance of firm-level characteristics in the decision to locate production or innovation activities abroad, foreign direct investment is strongly influenced by the context where the firm is located. In the case of the globalization of R&D, we expect that the systems of innovation of both the host and the home country of the MNC strongly influence the location of R&D. As Asheim and Gertler (2005) indicate, for any adequate understanding of the dynamic of technology driven activities, it is necessary to look at the context in which firms are located. It is argued that the *local* environment and the social context where firms are embedded create a favourable milieu for the transfer of tacit knowledge through direct face to face contacts, spontaneous mechanisms of learning, common cultural and traditional values, and interpretive schemes (Asheim and Gertler, 2005; Asheim and Vang, 2006; Bathelt et al., 2004; Malmberg and Maskell, 2004). The extent to which these arguments apply for large multinational companies will be discussed next.

Regional innovation systems can be defined as "constellation of industrial clusters surrounded by innovation supporting organizations" (Asheim and Coenen, 2005). There are basically two types of actors whose interactions shape the functioning on the RIS. First, the companies in a region's main industrial clusters, including their customers and suppliers which represent the production component of the regional innovation system or the knowledge exploitation subsystem (Porter,

1998; Pietrobelli and Rabellotti, 2004). Second, the research and higher education institutes (universities, technical colleges, and R&D institutes), technology transfer agencies, vocational training organizations, business associations, finance institutions, etc which represent the knowledge exploration subsystem and the business support subsystem (Asheim and Coenen, 2005)[ii]

RIS research has long stressed the endogenous factors associated with localized growth such as local learning, local spillovers or knowledge dissemination throughout the local networks in which indigenous firms are engaged. These endogenous factors have been used to explain how regions and firms upgrade. More recently this almost exclusive focus on the endogenous factors has been substituted by a growing interest in the intersection between local and non-local/global agents (Moodysson, 2008; Martin and Moodysson, 2010; Plechero and Chaminade, 2010; Tödtling et al, 2011). This local-global interaction is even more relevant for developing countries (Giuliani et al, 2005).

RIS main focus of attention has traditionally been the upgrading of the – often small and medium size - indigenous firms. The RIS literature claims that upgrading is only possible when there is an environment (i.e. institutional setting) that supports *interactive learning* and innovation (Malmberg and Maskell, 2004; Maskell, 2004; Marshall, 1920; Piore and Sabel, 1984). *Interactive learning* is defined as the acquisition of knowledge and competences through interactive collaboration with firms and knowledge providers. Scholars in the RIS tradition argue that interactive learning benefits from *physical proximity* (Gertler 1995; Morgan 2004) as physical proximity is considered pivotal in the emergence of the cognitive social capital (for a critique, see Amin and Cohendet 2005). Physical proximity implies that the firms are embedded in the same institutional setting and thus share certain norms, conventions and mindsets. Hence, a shared institutional setting facilitates the transmission of complex tacit knowledge needed for innovation. As opposed to the externalities that might emerge by the simple co-location of firms in related activities in one region (Marshall, 1920), the deliberate cooperation between actors leads to interactive learning and increased innovation (Nadvi and Schmitz, 1999; Cantwell and Piscitello, 2007).

With few exceptions (Chaminade, 2011; Barnard and Chaminade, 2011) most of these studies are more focused on the role of the region supporting upgrading and globalization of indigenous firms than on the role of the region attracting knowledge intensive activities, to developing countries. In other words, despite an increased interest on the intersection of the strategic coupling between

the region and indigenous firms on the one hand, and MNCs on the other, the literature is almost devoid of suggestions as to when or why MNCs decide to relocate or establish an R&D centre in a certain region in a developing country.

Arguably, the aforementioned arguments on the importance of interactive learning, proximity and social capital for the upgrading and growth of firms located in a certain regions is of limited relevance when trying to understand why MNCs locate R&D labs in a certain region.

First, MNCs are very different from indigenous SMEs. SMEs external relations are more confined to the region than those of large firms (Asheim et al., 2003; Cooke and Morgan, 1998). One of the reasons for this is that SMEs are more dependent on complex, tacit knowledge and less capable of searching for and using codified knowledge. This forces them to rely more on personal ways of transferring (tacit) knowledge and on learning-by-doing and interacting as opposed to relying on globalized (and more codified) modes for knowledge acquisition. However, MNCs are not confined to local search and are more capable of tapping into the global sources of codified knowledge (see Reddy 2000) or in their own in-house sources of knowledge. In Bangalore, for example, some MNCs, have established their own training and research centres to compensate for the scarcity of qualified human capital and research capabilities. This makes them less dependent of the local environment and local interactions than, for instance, the local SMEs.

Second, none of the recent countries attracting MNCs R&D labs – India and China – are characterized by a high degree of trust (Asheim and Vang 2006, Vang and Asheim 2006, Chen 2008a, 2008b), thus questioning the importance of social capital for MNCs. For example, some of the most successful regions in attracting global R&D such as Bangalore, show very low levels of social capital and interactions with other local firms does not seem to have had a major impact on the location of R&D labs by MNCs in the region (Chaminade and Vang, 2006 and 2008). The (lack of) importance of trust for MNCs can be partly explained by the power over the value chains the MNCs posses (Gereffi et al, 2005). Power over value chains makes MNCs less vulnerable to opportunistic behaviour. In addition, MNCs can often modularize their R&D and keep central critical dimension outside the reach of the indigenous firms. This further supports the idea that they are less likely to become victims of opportunistic behaviour.

Thus, RIS arguments on the importance of engaging in interactive learning with local firms (suppliers, competitors, etc) or local sources of knowledge (universities or research centres) seem

to be limited to explain why MNCs would locate R&D labs in regions in developing countries. Other streams of literature might provide some alternative explanations.

The extent to which the previous arguments: the importance of reducing R&D costs; or of accessing the market; of accessing R&D personnel; of local linkages -access to local suppliers or other local firms, access to local universities-, hold true to explain the location of MNCs R&D labs in China, and more particularly in Shanghai and Beijing will be analysed in the next section.

3. The selected regions: Shanghai and Beijing

China displays a super-normal concentration of regional assets in a few regions. Their ability to create regional assets and exploit assets formed in previous periods was initially the consequence of Deng's market reforms in the early 1980's (for details see Chen 2006, 2007, 2008a). Beijing and Shanghai are the two most important regions in the national hierarchy of RIS (albeit none of them actually qualify as fully fledged regional innovation systems (Vang and Asheim 2006, Chen 2006). These two cities have a high concentration of universities, public research institutes, state owned enterprises (SOEs) and public agencies from both the city and the central government. The elites trained in the best universities in these two cities often compete to stay in the work units in the central and city governments in Beijing or the city government in Shanghai because of prestige and better welfare and the proximity to better schools for their kids. The two city-regions became attracting poles of talents as soon as the old restrictive labour mobility systems were abandoned (Chen 2006, 2008a) thus gradually accumulating a pool of skilled labour in both regions.

In addition, Shanghai and, to a lesser extent, Beijing have relatively capable city managers. Beijing and Shanghai can cash in on their proximity to the central government to dash forward after a late start in the early 1990s, 10 years after the open door policies were launched in southern China. By recapitalizing their "public assets," such as the privatization of 100% public owned urban land though land leasing, they were able to gain enormous land rent to modernize their urban infrastructure in the shortest possible time. Because of their late start, Beijing and Shanghai has to do more than just another FDI city. Thus, they began their quest to become "proxy global cities". "Proxy global cities" are both real and imagined. The historical assets and cultural capital embedded in the cities of Beijing and Shanghai are easily repackaged and resold by the mayors' offices, urban planners and bureaucrats to the awaiting expatriate community.

They are not yet a global city, but was aggressively packaged and marketed by the major office as a way to attract talents, especially the returnee Chinese (including the Chinese diaspora) and foreign managers. The city mayors also implement preference migration policy – city-based green card – to highly skilled labour domestic and internationally at the expense of the unskilled migrant labours. The local unskilled migrant workers was not given the "green-card" to become formal citizen of the city, thus cannot enjoy the welfare only limited to the citizen, such as free schooling and medical health. Together, the environment of a proxy global city and preference migration policy attract talents, which in turn become a magnet to high value added FDI in the service sectors in the mid 1990s. R&D labs, often categorized as one of the most desirable service sector, have become another real and imagined commodity in the marketing plans of the mayor offices in the new century.

4. Data and methodology

This section introduces the methods used for identifying the motives and determinants of the MNCs in relocating or establishing R&D labs in China. Data was collected through a survey followed by semi-structured interviews with selected key actors in Shanghai and Beijing.

4.1. Survey

The *survey* targeted selected companies and aimed to understand the significance of Beijing and Shanghai in the global innovation strategy of the company. The selection of the MNCs' R&D centers are based primary on size and accessibility. Only those larger than 50 R&D personnels and also willing to do the survey were selected for this survey. Due to the difficulty of conducting surveys on R&D activities, we conducted the survey through two channels. The first method was by mail. We sent out questionnaires to R&D centers. As expected, the return rate was very low, 6 out of 60 were returned. The second method was more productive. We brought the survey with me to the face to face interviews with the employees of the R&D centers. Each survey was conducted before the interview session. The advantage of this method was multiple. Firstly, the interviewees were more willing to do the survey with the interviewer. Secondly, we had a chance to clarify some of the confusions in the questionnaires that might be straight forward for academics but confusing for the practitioners. For example, the distinction between process innovation and production innovation is not transparent to some interviewees. Thirdly, we could follow-up on some of the survey questions during the interviews. I managed to get 27 valid

surveys through this method. All together, we collected 33 valid survey data over my major fieldwork between June 2002 and January 2003.

The survey covered 33 R&D labs belonging to 17 MNCs. The majority of the MNCs have their HQ in the U.S. (11 out of 17). Other nationalities include 2 MNCs from Japan and 1 MNC each from Finland, Sweden and Korea. U.S. firms are highly represented in this survey because they dominate this new form of knowledge intensive FDI in China. The other reason is accessibility. Major employees from the U.S. based R&D labs are more willing to speak to scholars and the media partly because most of them are Chinese returnees who are more willing to entertain the curious (or sceptical) Chinese public through the media or the scholars.

Broadly speaking, all of them belong to the IT sector, except one from industrial machinery. Most of them are in the telecommunication hardware sector, which include 5 MNCs in cellphone infrastructure and 2 MNCs in optical networking. The rest are in computer hardware (3), business software (2), semiconductor manufacturing (2), measuring equipment (1) and industrial machinery (1). As China is becoming the largest cell phone market in the world, all major cellphone equipment companies have lined up their factory, distribution networks, after-sales service, and eventually R&D labs in China since the late 1990s. The study included 27 hardware R&D labs and almost all engage in different levels of software development. Due to the increasing weight of embedded software in hardware design, many MNCs are locating their software R&D labs in China. In fact, 7 out of 27 are exclusively embedded software centres. There are 19 individual R&D labs located in Beijing, 12 in Shanghai and 2 in Hangzhou. Most of the ones established earlier are located in Beijing. Shanghai began to gain momentum since 2000 mainly due to the continuing agglomeration of IT hardware manufacturing clusters in the Shanghai city-region since the mid 1990s. Yet, an attractive place does not in itself explain the fundamental reasons for why MNCs locate R&D labs in developing countries.

The survey had three main blocks of questions. Firstly, the R&D labs were asked on specific nature of the research activity carried out in these MNCs R&D labs in China, as compared to their R&D labs in other countries to determine whether they are production or process innovation related[iii]. Secondly, they were asked abouth the main reasons for the location decision of MNC R&D labs in China (rather than other countries), and particularly the reasons behind a decision to locate in Beijing or Shanghai. Thirdly, the survey contained some questions on the interaction of MNCs with local universities.

4.2. Interviews

The survey was followed by *semi-structured interviews* focused on the R&D activities of MNCs and their collaborators such as joint-research labs in the universities. The interviews took place in 2001, 2002, 2005 and 2009. Interviews were conducted not only at the R&D centers of MNCs but also with key actors in the region. In total, 80 interviews were conducted

At the R&D Center, the director, R&D manager or team leader and the engineers currently or previously working in the centre were interviewed. The interviews were also useful to follow up on some of the issues identified during the survey. The second group of interviewees were the major officials in innovation-related agencies, think-tanks and mayor's offices. They were enquired about their visions and strategies of innovation governance. The third group of interviewees were the key agents who participate in this knowledge-economy building, including professors and students in local universities and research institutes who participate in incubators, university-affiliated technology firms, technology-transfer offices, and human resource offices.

The information collected through the survey and the semi-structured interviews was triangulated with a throughout analysis of existing documents about all the above mentioned firms and institutions, such as corporate annual reports, company news, company journals, reports and presentations, news, critiques, evaluations and reports on university-run high-tech park projects, incubator projects, operation of technology transfer offices, university enterprises, joint research labs of MNCs and alumni networks and on the role of the public and semi-public institutions like the city science committee, the technology exchange agency, the technology transfer promotion center, the national science park authority and the city science park authority.

Next section reports the findings on the reasons why MNC relocate or establish R&D labs in China. The section starts by introducing some stylized facts about the two regions included which is followed by the analysis of the results of the survey and the interviews.

5. Empirical results

Table 1 summarises the importance given by the MNCs to different explanations of why they were locating their R&D lab in Beijing or Shanghai. The firms were asked to indicate the degree of

importance of each motivation, from 1 (not important at all) to 4 (extremely important). The last column indicates the rank of that specific motivation attending to the average response. Two are the most important conclusions that can be extracted from Table 1:

Firstly, the most important reasons for the MNCs to locate R&D labs in China refer to the access to the Chinese market and the reduction of costs and R&D cycle. These, as argued in the previous section, are the most traditional arguments for the internationalization of production and, as this research conclude, also for the internationalization of R&D. Indeed, while lowering production cost is the prominent explanation that turned developing countries – especially China - into a world factory, increasingly, there is recognition that local market penetration is an even more important reason behind the motive of FDI in emerging markets such as China. Shatz and Venables (2000: 142) claim that "on average, affiliates in developing countries sell a majority of their output in their host economies." Therefore, one could argue that the access to the local market is undoubtedly the predominant reason behind the location of MNCs not only in China, but also in developed economies and developing countries. And that also refers to R&D-related activities.

TABLE 1 MOTIVATION OF SETTING UP R&D LABS IN CHINA

Motivation	**Average**	**Ranks**
1. Functioning of the RIS		
Better access to local universities and research institutes	*2.67*	*4*
Support local suppliers/vendors	*2.40*	*7*
Support local production	*2.38*	*8*
Better incentives by local government	*2.14*	*12*
2. Access to qualified human capital (scientists) and related assets		
Access to better R&D personnel with basic research skills	*2.41*	*6*
Access better R&D with applied research skills	*2.33*	*10*
Better access to technology information	*1.62*	*14*
3. Government incentives		
Better access to new policy information	*2.31*	*11*
Better access to central government key agencies & key officials	*1.74*	*13*
4. Cost reduction & related		
Reduction of R&D cost	*2.78*	*3*
Reduction of R&D cycle time	*2.81*	*2*
5. Access to markets		
Close to the Chinese Market	*3.05*	*1*
Better access to market information	*2.35*	*9*
6. Other		
Generate a better public image	*2.53*	*5*

Source: Modified from Table 5.2 Chen (2004: 193).
Note: The degree of importance range from 0 to 4. More significant figures – large than 3.0 – are shown in italics and bold.

Second, despite the access to the local market is the most important adduced reason, none of the listed motivations was considered to be extremely important in explaining the location of the R&D in Shanghai or Beijing. The in-depth interviews maintained with key managers of the MNCs, revealed that some other aspects should be taken into account. They refer to market, technological and political uncertainties, which are discussed in the following section.

5.2. Motivations beyond international business and RIS literature - Interviews

The in-depth interviews revealed that the thrust of the argument as to why MNCs locate R&D labs in China – Beijing and Shanghai – has to do not merely "large market" (a static explanation) but rather with the multiple uncertainties embedded within emergent markets, such as China. These are uncertainties caused by (1) the fierce competition from the local firms (market uncertainties), (2) the competition for the technological standards (technological uncertainties), and (3) the state intervention in controlling market access (political uncertainties). Thus, the localization of R&D labs to China is mainly driven by the motives to reduce these three uncertainties, as we will discuss yet.

5.2.1. Market uncertainty

According to the interviewees, market uncertainties in China are the result of the unusual demand of Chinese urban consumers for the latest high-tech products. MNCs strategies to dump older models on the Chinese market in order to compete on price or to mainly adapt earlier models to the supposedly 'primitive' consumers in developing countries, failed completely. Chinese consumers, especially the urban consumers in the coastal cities of Beijing and Shanghai, have unusually high demand for the "newest" and "latest" technology for any given product. They just would not trade off between the price and technology. They want both. For example, the DVD player almost wiped out the VCR after it hit the Chinese market in the 1990s, because of this unexpected demand for "high-tech" goods. Hence, the assumption that a developing country will start off consuming inferior and cheaper products which are obsolete in the developed market (such as the VCR) and upgrade to higher-end products later (such as the DVD), was proven to be wrong, hence MNCs needed to locate R&D labs that could target the specific market preferences

and developed technological advanced products for the local market that are changing rapidly. This was only possible locating R&D labs close to the final consumer.

The need to be close to the local market is further accentuated by the fierce competition from local imitative firms on price and short production cycles. The new model of MNCs were quickly copied and reproduced with much lower price, thus forcing the MNCs to shorten the product life cycle. As the result, feedback from the distributors and sales department are critical in designing the next product. As the result, many MNCs realize the imperative to reintegrate R&D, production, distribution, sales and services in China. Consequently, the market-driven and production-driven R&D labs have to be set up in China to integrate production and sales networks. This is considered the only way to speed up flexible production and gear up competition on high-end products with other foreign MNC rivals, and on low to medium end products with the local Chinese competitors. As a result, almost all the major brand name producers which were interviewed, Motorola, Ericsson, Nokia, Nortel, Samsung, Matsushita, Alcatel, Philips, NEC, Lucent Technologies as well as other communication MNCs, have all set up their R&D labs in China to support their design, production and sales as well as their suppliers and vendors.

5.2.2. Technological uncertainty

By technological uncertainties we refer to both technological standard setting and betting on future technologies for the Chinese market. The former form attracts advanced applied R&D labs while the later form attracts the basic research labs to China in order to compete directly with other MNCs, local firms and leading public research labs.

In the technological standard setting competition in many sectors, many large MNCs have to compete for market share in order to use their market share as a bargaining chip to tilt the standard to their favour. The competition in the communications sector regarding standard setting is not new. It is a global phenomenon. What is new is that the fight in other continents already have obvious winners and losers (like CDMA2000 in the US, WCDMA in Europe), but in large emerging markets like China, the competition has just begun. Turf fights between China telecom and local broadcasting agencies in the provision of telephone service exert extra uncertainties in the future of the regional market. For example, even though China has entered the WTO, the national firms' monopoly over the telecommunication service sectors will still enjoy 6 years of monopoly. Even after the "official" end of monopoly in 2008, most likely, MNCs continue to

encounter bureaucratic and technical delaying in opening up this monopolized market. Therefore, lobbying for "non-market" special contracts and preferential policies are crucial for their competition in this new market. This is the biggest challenge any telecommunications MNCs face in China. Setting up R&D labs is the first step to show the MNCs long-term commitment in technology transfer. The importance of setting the standards can be illustrated by looking at the 3G standard setting process in China. The Chinese government 3G standard, the so called TD-SCDMA standard, was the most under researched standard at the time when it won the recognition as the third international standard in 2001. Many MNCs tried many ways to "kill" the Chinese government's desire for using their own standard. For example, the WCDMA league led by Nokia proposed a low 3G license fee of 5% per cell phone in order to rally the Chinese service providers on their side in order to bargain with the Chinese government. The attempts failed. The main reason is that the Chinese state is eager to support their own technical standard – TD-SCDMA, thus will not approve the license for the mature standard from Europe (WCDMA) and the USA (CDMA2000). Therefore the opening of 3g licenses is purposely delayed to allow TD-SCDMA to catch up with their two foreign competitors. Therefore, MNCs telecommunication hardware firms have no choice but to also invest in the TDS-CDMA based technology. They rushed to join the TD-SCDMA research consortium in China or they form joint ventures with the Chinese communication firms in order to develop TD-SCDMA based products before the opening of the 3G cell phone market supposed to take place in June of 2005, then delayed to May 2009. The competencies in the Chinese local standard (TD-SCDMA) were also not developed in the HQ R&D labs as they were initially considered inferior. Hence the specificities of the standard and the standard setting procedure influence the MNCs decision to establish or relocate and R&D centre in order to stay in the competition.

In betting on future technology for the Chinese market (5-10 years), MNCs are locating their basic research labs in China in order to explore new research domains while the windows of opportunity are still wide open. One of the technologies that almost all MNC basic research teams in IT sectors in China are focusing on is speech technology. This is a very complex technology domain that requires long-term research investment and close collaboration with the Chinese Academy of Science; the largest public research institute) (CAS) labs and top university labs. Chinese labs might have some preliminary research in this area. The whole research domain intensifies in China due to the rush of five to six MNC research teams into the picture. The competition and collaboration in this future technology domain have resulted in the rapid accumulation of this

technology domain in unprecedented pace, putting China in the forefront of this technology in the world even with its late start.

5.2.3. Political uncertainty

The political uncertainties are tricky in China and hold implications for MNCs location strategies. They refer to the explicit but unwritten "market for technology" policies that "forced" many large MNCs to set up R&D labs in China in exchange for market access. However, the interviewees indicated that the political uncertainty can be considered more like the last extra weight in favouring the final decision to locate R&D in China, once that the MNCs discover the advantages of setting up R&D labs in China - that is, the ability to minimize the other two uncertainties – market and technology uncertainties.

For example, Motorola was the only foreign company together with the other 17 local companies to be granted a CDMA cell phone manufacturing license in 2001. If Motorola did not set up its cell phone R&D centre in Beijing to engage in the CDMA product innovation and the testing of the CDMA system in a few cities, it would not have passed even the basic requirement for a market access license. Thus, the market access license should be regarded as a reward for their "political commitment to more technology transfer" (from the bureaucrat's point of view), and their first mover advantage of setting up an R&D centre ahead of other foreign competitors.

6. Discussion – rethinking the RIS framework

Unless extended, the Regional Innovation System (RIS) approach seems to be inadequate as a theoretical and analytical approach for understanding the globalization of innovation activities (represented by MNCs R&D labs). Some regions in the world economy are becoming (or arguably have become) global knowledge hubs and their strategy is partly based on attracting an increasing proportion of global R&D FDI investments. This is clearly the case for Shanghai and Beijing. Yet, the RIS approach has been almost exclusively focused on the local conditions that support upgrading in indigenous firms, hence neglecting almost completely the role of local conditions attracting R&D sites from MNCs. While RIS implicitly incorporates most of the elements that other alternative streams of literature provide, such as the importance of scientists and engineers (implicitly in the knowledge exploitation subsystem), the role of the government, the importance of

the institutional framework etc, the approach needs to be lifted up and extended to be fully comprehensible to explain why MNCs might locate R&D labs in certain RIS in developing countries.

For example, the role of the government in the RIS might be significantly different if the purpose is to stimulate upgrading of the indigenous firms or attracting and retaining MNCs R&D activities. While in the first case, the focus might be on developing local capabilities and providing support services and financial support for the local business, in the second case the focus might be more on the institutional conditions in the RIS (tax incentives, IPR regime, standard setting, regulations and incentives for the establishment of R&D labs in the region, establishment of outstanding pockets of publicly financed research) and the market conditions.

While (R)IS literature stresses the role of the user-producer interaction, much remains to be said on the role of technologically advanced users, as drivers of innovation and attraction poles for global R&D players. The existence of this pool of advanced users has proved to be extremely relevant to explain the location of R&D labs of MNCs in Shanghai and Beijing. This goes beyond the arguments on the importance of accessing large markets and points out to the technological sophistication of the market rather than merely its size[iv].

We would argue that even though it is partly true that the scale of the emerging market matters, the other attributes embedded in this large market actually matter more, when we deal with the issue of innovation. Due to the fact that agglomeration of innovation and large market do not have direct causal relations, we have to find out about the attributes of the emerging market that can explain the agglomeration of innovation activities in China. Uncertainty and competition within emerging markets might be the answer. We argue that it is the high uncertainty and high competition in the emerging market that attracts the MNCs R&D labs (and potentially hold them down in the future).

7. Concluding remarks

Uncertainty and competition comes in different forms in an emerging market. These variables greatly influence the decision among the MNCs to locate R&D labs in developing countries (at least in China).

1) The market uncertainties; being product standards, uncertainties in the different classes of consumers and how local competitors address these challenges.

2) The technological uncertainties being related to especially standard setting (our empirics have a strong bias in countries with a potentially large home market).

3) The political uncertainties. It is easy for a company to turn from a friend to a foe if it is not careful or if it does not spend enough time to nurture their relations with the local governments;

While the systemic aspects of the RIS might be a strong argument explaining the upgrading of – mainly - small and medium sized indigenous companies, it is not a determining factor in attracting MNC labs to a country. Institutional, technological, market and political uncertainties seem to be more important than the systemic propensities of the RIS – which confirms some of our previous findings. However, RIS does play a role in specific location decision of the MNC labs within the country (that explain why they concentrate in Beijing and Shanghai that provide rich knowledge assets to *best* facilitate them in minimize multiple uncertainties (Chen 2006; Chen 2008a). In this sense, the RIS literature should expand its focus on not only upgrading the local firms, but also attracting global innovation. More research should be conducted on the institutional and socio-economic and political aspects of the RIS in the context of globalization of innovation.

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Annex 1: Company Survey question for the MNCs' R&D centers in China

1. In what five countries did your company conduct most of its overall R&D in 2001? Please name and rank them in terms of total R&D investment and R&D personnel.

	R&D Investment (US$)		R&D personnel (as % of total employees)
Name of country	2001	2001	
HOME country	_____	_____	_____, _____ %
Country 1	_____	_____	_____, _____ %
Country 2	_____	_____	_____, _____ %
Country 3	_____	_____	_____, _____ %
Country 4	_____	_____	_____, _____ %
Total	_____	_____	_____, _____ %

2. Please describe the basic profile of 2 (or 3) most important R&D centers in China. (Center #1 is your center). Please use most recent figures.

Name of center	Location City name	Established date	Investment (US$)	Total R&D Employees	% of Foreign Employees	Employees with Ph.D/Master degree
Center #1	_____,	_____,	_____,	_____	_____	_____% _____%
Center #2	_____,	_____,	_____,	_____	_____	_____% _____%
Center #3	_____,	_____,	_____,	_____	_____	_____% _____%

3. What are the durations of each R&D project before they turn into final products? Example: basic research projects might take more than 3 years, while product development or product localization projects might take less than 1 year. Please name three most important R&D projects, and select their duration.

	Less than 1 year	1-3 years	3-5 years	5-8 years	More than 8 years
Center #1 (Overall)_____	☐	☐	☐	☐	☐
Name of R&D Project #1_____	☐	☐	☐	☐	☐
Name of R&D Project #2_____	☐	☐	☐	☐	☐
Name of R&D Project #3_____	☐	☐	☐	☐	☐

4. What are the main R&D projects and technologies involved? Please compare their level of technical difficulty in comparison to the R&D center in the HOME country. Please name your main R&D projects, and circle your choice.

	Type	Less Advance	Same	More advance
R&D Project #1_____	Product or Process	Less	Same	More
R&D Project #2_____	Product or Process	Less	Same	More

R&D Project #3_____	Product or Process	Less	Same	More
OVERALL for Center #1		Less	Same	More

*NOTE: **PRODUCT** R&D : R&D on ***new product*** or ***new technology*** that is not yet in the market
PROCESS R&D : R&D on improving ***existing product*** or ***existing technology***.

5. Please indicate roughly the relative importance of the following <u>motives and driving forces</u> behind the setting up of R&D centers in Beijing, (as compared to Shanghai, for example)

	Of no importance (= 0)				**Of major importance (= 4)**	**Future tendency**		
Supporting local JV production plant	0	1	2	3	4	–	0	+
Supporting local OEM firms	0	1	2	3	4	–	0	+
Reducing product R&D cycle time	0	1	2	3	4	–	0	+
Reducing R&D cost (personnel)	0	1	2	3	4	–	0	+
Access to better R&D personnel with better **BASIC** research capability	0	1	2	3	4	–	0	+
Access to better R&D personnel with better **APPLIED** research capability	0	1	2	3	4	–	0	+
Better access to market information	0	1	2	3	4	–	0	+
Better access to new policy information	0	1	2	3	4	–	0	+
Better access to technology information	0	1	2	3	4	–	0	+
Better access to local universities & research institutes	0	1	2	3	4	–	0	+
Better access to CENTRAL government key agencies and key official	0	1	2	3	4	–	0	+
Better access to LOCAL government key agencies and key official	0	1	2	3	4	–	0	+
Better incentives by local government	0	1	2	3	4	–	0	+
Generating better public image	0	1	2	3	4	–	0	+
Other	0	1	2	3	4	–	0	+

6. The degree of your satisfaction (in relative to Shanghai, for example) with the following conditions of building R&D centers in China.

	Center #1_____					**Center #2_____**				
	Not satisfied				**Very satisfied**	**Not satisfied**				**Very satisfied**
Central Government policy	0	1	2	3	4	0	1	2	3	4
Local Government policy	0	1	2	3	4	0	1	2	3	4
Central Government Support and Service	0	1	2	3	4	0	1	2	3	4
Local Government Support and Service	0	1	2	3	4	0	1	2	3	4
Infrastructure of the city	0	1	2	3	4	0	1	2	3	4
The collaboration of local OEM or Suppliers	0	1	2	3	4	0	1	2	3	4
The collaboration of local partners	0	1	2	3	4	0	1	2	3	4
Availability of R&D labor	0	1	2	3	4	0	1	2	3	4
Quality of R&D labor	0	1	2	3	4	0	1	2	3	4
Wage level of R&D labor	0	1	2	3	4	0	1	2	3	4

Loyalty of R&D labor	0	1	2	3	4		0	1	2	3	4
Other (please name)_____	0	1	2	3	4		0	1	2	3	4

7. The strategic role of this R&D center in your company's Global Innovation Network.

	Of no importance (= 0)					**Of major importance (= 4)**		**Tendency**
Global Technical Support	0	1	2	3	4	–	0	+
Local Technical Support in China	0	1	2	3	4	–	0	+
Technical Support outside China (please name_____)	0	1	2	3	4	–	0	+
Focus on inventing ***new*** product & technology R&D	0	1	2	3	4	–	0	+
Focus on improving ***existing*** product & technology R&D	0	1	2	3	4	–	0	+
Gradually replace certain R&D units in the:								
Home country R&D center	0	1	2	3	4	–	0	+
Other centers (e.g. India) _____	0	1	2	3	4	–	0	+
LEADING certain global R&D project or team	0	1	2	3	4	–	0	+
FOLLOWING R&D team or project from other center	0	1	2	3	4	–	0	+
Support product localization	0	1	2	3	4	–	0	+
Support production localization	0	1	2	3	4	–	0	+
Better Public Relation Purpose	0	1	2	3	4	–	0	+
Other (please name _____)	0	1	2	3	4	–	0	+

8. Please indicate the performance and accomplishment of your R&D center since its establishment in China.

	This R&D Center	Total of all R&D centers in China
Number of patents applied in HOME Country	_____	_____
Number of patents applied in U.S.A.	_____	_____
Number of patents applied in China	_____	_____
Number of technical papers published	_____	_____
Number of technical conferences organized	_____	_____
Number of awards granted in Home country	_____	_____

Number of awards granted in China _____ _____

Number of press conferences on new product _____ _____

9. Please indicate the importance of Local Universities and Research Institutes to the operation of your R&D centers

	University in China
	NOT Important Major Importance Tendency
(1) It is important to have our company personal contacts with those who are doing the research in the university/research institutes	0 1 2 3 4 – 0 +
(2) It is important to locate the R&D center close to universities and/or research institutes.	0 1 2 3 4 – 0 +
(3) Industry funding of academic research is a useful vehicle for making that research more relevant to business and for gaining access.	0 1 2 3 4 – 0 +
(4) Industry funding of academic research is a useful vehicle for making that research more relevant to business and for gaining access.	0 1 2 3 4 – 0 +
(5) Hiring advanced-degree graduates of universities who are strong in a field of science or technology is an important way of learning about industrially relevant developments in that field.	0 1 2 3 4 – 0 +
(6) Universities in one's own country are more accessible than foreign universities.	0 1 2 3 4 – 0 +
(7) Having an R&D operation in a foreign country makes universities there more accessible	0 1 2 3 4 – 0 +

[i] That is, even the successful countries, such as Korea, based their catching up strategies on exploiting their laggard advantages and learning through reproducing (reverse engineering) what the industrialized world had already developed (Hobday, 1995).

[ii] The inclusion of the second type of actors represents a main difference from traditional cluster studies in developing countries. Universities and other knowledge providers are considered crucial in correcting or changing systemic failures in clusters which might prevent them from upgrading or engaging in radical innovations. Traditional industrial districts and clusters research is more concerned with the propensities in local systems that support incremental innovations, thus 'Schumpeterian' systems failures are not theorized.

[iii] For example, Intel's Speech Technology research group was most likely involved in product innovation, because it is the only research group among Intel's global R&D network that develops next-generation Human-Computer Interface.

[iv] This does not imply that the size of the market is not important per se, but that both size and technological sofistication matter.