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Reversing the International Flow of Innovation: How Does Chinese Market Trigger Reverse Innovation?

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Chapter 1: Introduction

1.1 Background and aims of the research

The common understanding of innovation often refers to its process as a complex and sophisticated one. Be it a product, process, or another kind of innovation, seldom it was reported in the literature, newspapers or books without being close to terms such as "high-tech", "scientific discovery", and similar. In other words, it has almost always been considered as a prerogative of the advanced world (commonly the TRIAD: United States, Europe, and Japan), leaving emerging economies as constant followers and imitators, being technological innovation one of the most important factors for economic development.

Of course this is only partly true. There is a rather rich debate on what exactly can be configured as an innovation (Fagerberg et al, 2009). Does it always have to entail a complex process? Does it always need a mature market whose high power of purchase can afford its often premium-priced novelty? This was the common view in the Sixties when Raymond Vernon (1966) developed his Product Life Cycle Theory, assessing an international cycle of innovation that starts from the United States of America (at that time the country with the most mature market, the most advanced technology and high availability of investment capital), passing through Europe and eventually finishing its life in emerging countries. Vernon's model was further revised by himself and other scholars who stepped aside from a purely demand driven innovation and extended the merit of locus of innovation to countries holding a technological leadership. Yet, advanced countries were still the only ones able to pursue systematic innovative activity. This was partly due to the fact that the most innovative companies were concentrated in those countries, maintaining their crucial R&D in the home country (Patel and Pavitt, 1991; Di Minin and Bianchi, 2011).

The globalization of markets has pushed "advanced companies" to localize production and R&D activities also in emerging economies. Some of these countries have benefited from spillover effects of foreign investments and have built on them promoting their own indigenous innovation capability, stepping into the global markets as active players for different reasons.

I identify at least four different conditions which currently make the topic of innovation *for and from* emerging economies crucial and worth to be further explored.

First, global GDP growth in the last years has been lead by the emerging world. The 2012 World Economic Outlook (International Monetary Fund - IMF, 2012) reported how while advanced economies pursued a GDP growth of 3,2% and 1,6% in 2010 and 2011, emerging economies grew by 7,3% and 6,2% respectively. According to IMF projections, despite a slight decline in GDP growth of both categories for the year 2012, it is clear how emerging economies will drive the global economic growth reaching a 5,4% and a 5,9% GDP growth in 2012 and 2013 (against the respective 1,2% and 1,9% of the advanced world).

Second, the fast technological catching up of emerging countries has allowed them to develop a relatively strong technological capability which is putting them in good conditions for competing on global markets against the traditional technological leaders headquartered in the advanced countries. Using Patent Cooperation Treaty (PCT) applications, I calculated that the share of world total applications filed by applicants located in emerging economies grew from less than 3% in 1985 to more than 8% in 2009.

Third, the shrinking power of purchase of consumers in advanced countries has made evident the need for a "consumer saving approach". Context conditions traceable in emerging economies have made local companies particularly efficient in serving low income markets to develop innovations accessible to the so called "bottom of the pyramid", the large part of a developing country commonly characterized by a low power of purchase. These innovations (e.g. cost innovation, frugal innovation, good enough products) might also be commercially valuable on specific segments of the advanced world (Zeng and Williamson, 2007; Hart and Christensen, 2002).

Fourth, companies born and headquartered in emerging economies are going global (Goldstein, 2009) and disrupting markets that originally were a prerogative of companies from the advanced world. Companies such as Huawei (China) or Tata Motors (India) leverage on, and learn from, their domestic market before going global challenging incumbent firms with new production processes, new business models, and heavy investments in R&D. For companies from the advanced world is imperative to find a way to respond to these critical challenges and potentially learn from their new competitors.

I believe the emergence of emerging economies challenges the management field of study with several questions to be addressed. At a macro-level, far behind the purpose of this work, some developing countries have shown impressively fast catching-up processes (e.g. China, Brazil, and India) leveraging on different dimensions of their economies and

using different policy instruments to foster their economic development. As we observed in the past for the Japanese Developmental State (Johnson, 1982), China is somehow replicating such a fast growth thanks to an efficient economic planning run by an effective bureaucracy (Breslin 1996). At a micro level, the implications are far more interesting from a managerial point of view. Companies from the advanced world are pushed to move R&D activities to emerging economies in order to be able to penetrate the local markets, often characterized by strong differences in consumer behavior, environmental constraints, and regulations (Ghemawat, 2001). At the same time they need to contrast companies from emerging economies that are gaining a foothold in global markets, often leveraging on economies of scale pursuable in their local markets.

In both "advanced" and "developing" companies cases, we can observe how innovation designed and developed for emerging economies can open brand new business opportunities at the global level. Scholars such as Hart and Christensen (2002) have started identifying a reversed product life cycle t. Immelt et al (2009) and Govindarajan and Trimble (2012) have coined the term Reverse Innovation and provided concrete examples.

The literature, mainly a practitioner oriented one, has so far provided a number of names for identifying innovation coming from emerging economies (e.g. cost innovation, frugal innovation, blow-back innovation), but it still lacks a more structured framework through which interpreting the phenomenon.

What factors trigger reverse innovation? In what does innovation from emerging economies differ from the one from advanced countries? What can "advanced companies" learn from "emerging companies"? What are, for "advanced companies", the consequences of bringing back to their home country innovations initially thought for emerging economies?

These are only a few of the many questions that I believe will fuel future research on this matter. In this work I tried to build the instruments for further investigation and to answer some of these questions with specific reference to the case of Italian companies in China.

1.2 Structure of the Dissertation

This dissertation is a collection of three papers (respectively Chapter 2, Chapter 3, Chapter 4) written during my years as a doctoral candidate at Scuola Superiore Sant'Anna di Pisa. Although different in structure and perspectives, they share the same aim of further

investigating the phenomenon of innovation *for* and *from* emerging countries, with specific focus on China. Their abstracts are reported in paragraphs 1.4.1, 1.4.2, 1.4.3.

The first step (Chapter 2) was to frame the investigated phenomenon, Reverse Innovation, within the Disruptive Innovation paradigm. An exercise that the coiners of the term Reverse Innovation (Immelt et al, 2009) advise not to pursue but that sounded to us as promising and worth to be further elaborated. Through a literature review on the topic of disruptive innovation and innovation *for* and *from* emerging economies, we reached a rationalization of concepts, often overlapping one another, and we proposed, by adding a geographical dimension to the already existing paradigm, a reinterpretation of Reverse Innovation, as defined by Immelt et al (2009) and Govindarajan and Trimble (2012) as a type of disruptive innovation.

Two reasons have brought us to develop the paper reported in Chapter 3:

- Disruptive Innovation was not the only type of Reverse Innovation we could detect from the literature and from the empirical evidence collected so far. This condition required in our opinion further work and elaboration on a taxonomy of reverse innovation.
- In the last ten years, management scholars have investigated patterns of innovation from emerging economies from several perspectives. In doing so, they have collected empirical evidence under different forms, but particuarly focusing on case studies. Despite the nature of the studies was still explorative, and sometimes only anecdotal, strong differences among them clearly appear. We thought a categorization of these patterns would have been useful for supporting and fostering research towards this direction.

Chapter 3 aims at providing such a categorization identifying a typology of Reverse Innovation. Building on an innovation process organized in four phases, where each one can alternatively take place either in an emerging economy or in an advanced one, we 'labeled' the sixteen resulting typologies identifying which ones, and to what extent, can be considered as Reverse Innovation.

With an average GDP annual growth of 10% for the last 30 years and its growing availability of indigenous technology and scientists, China represents the developing country *par excellence*. An increasingly important and already protagonist in the chessboard of the global economy. Chapter 4 analyzes the effects of the Chinese context on the R&D and innovative activities that foreign firms have localized there. The chapter

studies the cases of four Italian firms which have R&D laboratories localized in China and identify three dimensions that affect their innovative activities.

1.3 Theoretical Contributions

The contributions of each of the papers that compose this dissertation are listed below.

In the first paper:

- We support the idea that Disruptive Innovation - as defined by Christensen (1997) and intended for advanced economies – needs to be adapted and reinterpreted to be useful in analyzing new business that originates from emerging economies.
- We suggest that Reverse Innovation - as defined by Immelt et al (2009), and intended to explain a phenomenon originating from emerging countries – fits the definition and is hence a particular manifestation of Disruptive Innovation.

In the second paper:

- We provide a categorization of Reverse Innovation, setting it in a both temporal and spatial context, and lay the foundations for a more organized study of the phenomenon.
- We believe that the stage-organized process identified in the paper will help future researchers to better identifying and interpreting patterns of Reverse Innovation.

In the third paper:

- We confirm an evolution path from exploitative to a more explorative nature of R&D abroad and we contribute to the literature identifying a phase in which foreign R&D investments in China are not determined by the possibility to tap into local knowledge or technology pockets, but rather by the opportunity to absorb innovative inputs coming from local market peculiarities so that the combination of corporate knowledge and technology with these inputs can suggest technological paths to explore.
- In relation to the literature on subsidiary role evolution we contribute showing that the duty to explore technological paths gradually shifts from headquarters to subsidiary in accordance to the competence evolution path of the latter one.

1.4 Abstracts

1.4.1 Abstract Chapter 2: Disruptive Innovation…in Reverse: a Theoretical Framework to Look at New Product Development from Emerging Economies

Based on a literature review on disruptive innovation and innovation from emerging economies, we attempt a reinterpretation of the concept of Reverse Innovation as defined by Immelt et al (2009) as a type of disruptive innovation. We argue that the combination of these two theories provides a useful framework to look at emerging economies as sources of new products and technological solutions. Finally, we provide a new categorization of Disruptive Innovation considering a geographical dimension and future research directions.

This paper is co-authored with Dr Alberto Di Minin. Adapted versions of this chapter have been published as Working Paper (n° 4/2011) of the Institute of Management of Scuola Superiore Sant'Anna and presented at the 2nd Tilburg Conference on Innovation, June 15th-17th 2012, Tilburg, The Netherlands.

1.4.2 Abstract Chapter 3: Towards a Typology of Reverse Innovation

Reverse innovation commonly refers to the introduction of new products initially launched in emerging countries to markets in advanced countries. We expand the definition of reverse innovation beyond a purely market-introduction concept by identifying two additional reversals in the flow of innovation: development-based reverse innovation and ideation-based reverse innovation. We propose a typology of reverse innovation with sixteen different types of global innovation between advanced and emerging countries, ten of which are reverse innovation flows. These are further distinguished between weak and strong reverse innovation. This analytical framework provides a conceptual link between innovation research and international business. We discuss ethnocentricity in reverse innovation as well as merits and pitfalls of model simplicity.

This paper is co-authored with Dr. Maximilian von Zedtwitz (GLORAD - Research Center for Global R&D Management and Reverse Innovation,Tongji University), Peder Veng Søberg (Center for Industrial Production, Aalborg University), and Rome Frega

(United Nations World Food Programme). An adapted version of this chapter is currently "accepted with revisions" for a special issue of the *Journal of Product Innovation Management* titled "Innovation for and from emerging markets"

1.4.3 Abstract Chapter 4: Chinese Market as a Source of Global Innovation: Foreign MNCs' R&D activities in China

This paper studies the influence of host country peculiarities on R&D activities of foreign MNCs in China. Through case study approach, I analyzed four Italian companies that have R&D and innovative activities in China. I find that innovation activities of foreign MNCs in China are affected by host country characteristics on three dimensions: *state intervention*; *local competition*, and *local market peculiarities*. I show how Chinese competitive context can be a source of global innovation if stimuli are properly received at both local and corporate level and I derive a taxonomy of innovation that might originate from foreign MNCs' R&D activities in China. Our case studies confirm an evolution path of foreign R&D activities from an exploitative to an explorative nature. Finally, future research directions are suggested.

This paper is single-authored by Simone Corsi. An adapted version of this chapter has been presented at the 2012 Academy of Management Annual Meeting, August 3rd-7th, Boston: USA.

1.5 Other contributions during the PhD

- Appio F., Corsi S., Di Minin A., Lazzeri F. (2012). *ICT tools enabling collaborative creation and development with customers: the case of Ansaldo Energia*. ***ITAIS Conference***, September 28th-29th, Rome (Italy)
- Corsi S., Di Minin A. (2012). *Cina: da mercato emergente a nuovo hub di innovazione?* Forthcoming in ***Mondo Cinese***.
- Corsi S., Di Minin A., Piccaluga A., Sangalli I., Trenti S. (2012). *Verso una migliore comprensione dei percorsi di sviluppo e marketing relazionale delle imprese italiane high-tech in Giappone*. Submitted to ***Mercati e Competitività.***

- Corsi S., Di Minin A., Piccaluga A. (2012). *La base della piramide come nuova opportunità di crescita: il caso Esaote nel mercato cinese*. Submitted to ***Mercati e Competitività.***
- Corsi S., Di Minin A., Piccaluga A. (2012). *Internazionalizzazione come fonte di innovazione: il caso Carel Spa*. Working paper. Target Journal: ***Economia e Società Regionale***.
- Campanale, C., Cinquini, L., Corsi, S., Piccaluga, A. (2011). *Innovazione nella tecnologia biomedicale: un modello di valutazione dei costi del sistema EchoLaser in chirurgia mini-invasiva*. ***Mecosan – Management ed Economia Sanitaria***, N.77, Gennaio-Marzo.
- Corsi, S., Di Minin, A. 2011. Extending the Uppsala Model: Disruptive Innovation from a Chinese Evolved Subsidiary. ***2011 Academy of Management Annual Meeting***, August 12-16th. San Antonio, Texas: USA.

References

Breslin, S.G. 1996. China: developmental state or dysfunctional development?. ***Third World Quarterly,*** 17(4): 689-706.

Christensen, C. M. 1997. ***The innovator's dilemma: when new technologies cause great firms to fail***. Cambridge, MA: Harvard Business Press.

Di Minin, A., Bianchi, M. 2011. Safe nests in global nets: internationalization and appropriability of R&D in wireless telecom. ***Journal of International Business Studies*****,** 42(7): 910-934.

Fagerberg, J., Srholec, M., Verspagen, B. 2009. Innovation and economic development. ***United Nations University-MERIT,*** *Working Paper 032*.

Ghemawat, P. 2001. Distance still matters: the hard reality of global expansion. **Harvard Business Review**, 79(8): 137-147.

Goldstein, A. 2009. ***Multinational companies from emerging economies: composition, conceptualization and direction in the global economy***. Palgrave.

Govindarajan, V., Trimble, C. 2012. ***Reverse innovation: create far from home, win everywhere***. Cambridge, MA: Harvard Business Press.

Hart, S.L., Christensen, C.M 2002. The great leap. Driving innovation from the base of the pyramid. ***MIT Sloan Management Review***, 44(1): 51-56.

IMF 2012. **World economic outlook: growth resuming, dangers remain.** Washington, DC: International Monetary Fund.

Immelt, J.R., Govindarajan, V., Trimble, C. 2009. How GE is disrupting itself. ***Havard Business Review*****,** 87(10): 56-65.

Johnson, C. 1982. ***MITI and the Japanese miracle: the growth of industrial policy, 1925-1975*****.** Stanford University Press.

Patel, P., Pavitt, K. 1991. Large firms in the production of the world's technology – An important case of non-globalization. ***Journal of International Business Studies***, 22 (1): 1-21.

Vernon, R. 1966. International Investment and International Trade in the Product Cycle. ***Quarterly Journal of Economics***, 80(2): 190-207.

Zeng, M., Williamson P.J. 2007. ***Dragons at your door: how Chinese cost innovation is disrupting the rules of global competition.*** Boston, MA: Harvard Business School Press.

Chapter 2: Disruptive Innovation…in Reverse: A Theoretical Framework to Look at New Product Development from Emerging Economies[1]

2.1 Introduction

What role do emerging economies play in the global innovation system? This paper attempts a reinterpretation of the concept of Reverse Innovation (Immelt et al, 2009), defined as a type of disruptive innovation (Christensen, 1997).

In our literature review, we argue that the combination of these two theories provides a useful framework to look at emerging economies as sources of new products and technological solutions.

It is now clear that emerging economies are gaining increasing importance in the global innovation system. Their actual role is perhaps the central question driving the growing interest in this topic and to which this paper attempts to respond.

Several authors are investigating - on a limited empirical basis for the time being – in what way these countries are not only recipients (Vernon, 1966) but also sources of innovation (Hart and Christensen, 2002; Immelt et al, 2009; Kenney et al, 2009).

Although several authors have identified and discussed the process of innovation from emerging economies, it remains under-explored. Managerial literature is still lacking both a clear and solid theoretical position and a strong theoretical framework within which a new innovation trend from emerging economies can be read and interpreted. Indeed, despite a certain shared view on framing it in the *disruptive innovation* paradigm, there seems to be some confusion and overlap of the concepts that are used to describe such a reverse process of innovation. Scholars refer to this trend in different ways, depending on the aspects they focus on, such as *disruptive innovation from emerging economies, innovation at the bottom of the pyramid, cost-innovation, reverse innovation*.

Hence, the aim of this paper is to critically review the literature concerning innovation from emerging economies and contributing a rationalization of the related concepts. We then view the *disruptive innovation* and *reverse innovation* paradigms side by side: two

[1] This paper is co-authored with Dr. Alberto Di Minin. Adapted versions of this chapter have been published as Working Paper (n° 4/2011) of the Istituto di Management of Scuola Superiore Sant'Anna and presented at the 2nd Tilburg Conference on Innovation, June 15th-17th 2012, Tilburg, The Netherlands.

theories that we think offer interesting and complementary perspectives when we position emerging markets at the centre of the stage as a source of innovation.

A number of fields of study in international business, management and economics have considered the role that BRIC countries (Brazil, Russia, India, China) play in the current global economy configuration. Important studies have been produced sustaining the need for a better understanding of their institutional, environmental and social context. Although beyond the scope of this paper, the areas span intercultural management (Usunier and Lee, 2009; Jacob, 2003), negotiation (Cavusgil et al, 2002; George et al, 1998; Faure and Rubin, 1993), FDI (Frenkel et al, 2004; Meyer, 2004; Tan and Meyer, 2011), outsourcing (Javalgi et al, 2009; Nguyen, Lee, 2008), offshoring (Chakrabarti and Bhaumik, 2010; Engman, 2007), human resource management (Thite et al, 2011; Von Zedtwitz, 2004; Agrawal et al, 2011), monetary economics (Laxton, Pesenti, 2003; Perri, 2004), entry strategy (Cavusgil et al, 2002; Meyer et al, 2009; Demirbag et al, 2008), R&D internationalization (Qu et al, 2007; Li and Kozhikode, 2009; Chakrabarti, Bhaumik, 2010; Von Zedtwitz, 2004), multinational corporations from emerging economies (Chang et al, 2009; Di Minin and Zhang, 2010), and so forth.

The lower cost of production factors and the soaring market size of emerging economies have increasingly pushed foreign companies to consider these countries as the main recipients of their investments. At the same time, cultural and institutional differences, as well as environmental and regulatory constraints, have forced foreign companies to adapt their products in order to respond to local requirements and regulations. For several years now, scholars have referred to *glocalization* (the adaptation of global products to local needs) as a way of succeeding in peripheral markets. Developing innovations at the headquarters (HQ) of MNCs in developed economies (Europe, USA and Japan) and then adapting them to some extent to meet local requirements in emerging markets is still the most common way for foreign MNCs to commercialize their products in emerging economies.

In the last ten years, scholars have started to look at companies that serve those markets in a different way. *Glocalization* is in fact assumed to be partially "blind" or ineffective for the purpose of reaching emerging market needs. Innovations generated for developed economies, only partially adapted, and commercialized in emerging markets are able to reach only a small part of the population, the one that has benefited the most from the growing rate of these economies and that is comparable, in terms of power of purchase, to

the majority of customers in developed countries. The new challenge of the 21st century has been identified in the profitable development and sale of new products for the mass markets of less affluent populations of emerging economies that are currently not, or only partially, served by MNCs. Innovation management literature has produced a limited number of studies (Hart and Christensen, 2002; Prahalad, 2004; Immelt et al, 2009; Hang et al, 2010), largely based on anecdotal evidence, trying to identify new ways of pursuing innovation in emerging economies. Most of these studies build, more or less implicitly, their argument on the well-known *disruptive innovation* paradigm as defined by Christensen (1997) and Christensen and Raynor (2003). Christensen was one of the first authors to propose a link between *disruptive innovation* and an innovation process that stems from serving developing economies (Hart and Christensen, 2002). *Disruptive innovation* in emerging economies seems to be applied also in Prahalad's seminal work on innovation for *the bottom of the pyramid* (BOP) (Prahalad, 2004), discussing how to make profit by serving the poorest people in the world with the adoption of revolutionary business models and product/service configurations. This produces benefits for both consumers - who would otherwise not have had access to that type of product and technology - and companies - especially domestic enterprises that gain access to new and large market segments.

Given the specificity of the context for and in which these innovations need to be developed domestic companies seem to be best placed to pursue them. By virtue of their embeddedness, local market knowledge and low cost approach, they develop new product solutions for emerging markets that challenge the activities of foreign MNCs. This phenomenon has mostly been referred to as *cost innovation* (Zeng and Williamson, 2007). Scholars caution foreign MNCs on the risk of being overtaken by these disruptive companies not only in emerging but also in developed economies (Zeng and Williamson, 2007; Seely-Brown and Hamel, 2005). Indeed, growing attention has been paid to companies from emerging economies and how in going global they threaten western MNCs in the home markets that they have dominated for decades. Testing their new products/services, business model solutions and pursuing economies of scales in their local markets, "emerging" companies learn how to innovate and disrupt global competition by leveraging on their high-tech low-cost ability to reach the market (Williamson and Zeng, 2004; Williamson, 2005; Williamson and Zeng, 2008; Williamson, 2010). Responding to this threat is a new challenge for incumbent MNCs and, in our opinion, *disruptive*

innovation is in some way useful to describe the new trend that has recently been defined as *reverse innovation* (Immelt et al, 2009). According to Immelt et al (2009), since most current and future global economic growth is likely to take place in emerging economies, innovation specifically aimed at responding to these markets is crucial. In order to do this, subsidiaries in emerging economies have to be granted full decision-making authority in the markets they serve. The success of such a strategy would not only be in anticipating or challenging "emerging" MNCs, but also in granting new growth opportunities to "developed" MNCs in their home markets with technologies and products that would not have been developed without emerging market inputs (Kenney et al, 2009[2]). Indeed, new products developed entirely in emerging markets *for* emerging markets are likely to disrupt developed markets and open new business opportunities. This phenomenon thus configures a process of innovation that no longer sees developed economies as the locus where new products are conceived, designed and commercialized but instead take on the role of the last recipient of innovations developed *in* and *for* emerging economies.

This paper builds on the *disruptive innovation* literature and contrasts its analysis with the concept of *reverse innovation*. We believe we bring two theoretical contributions:

- We support the idea that *disruptive innovation* - as defined by Christensen (1997) and intended for advanced economies – needs to be adapted and reinterpreted to be useful in analyzing new business that originates from emerging economies.
- We suggest that *reverse innovation* - as defined by Immelt et al (2009), and intended to explain a phenomenon originating from emerging countries – fits the definition and is hence a particular manifestation of *disruptive innovation*.

The paper is organized as follows. In the next section, we lay the foundations of our analysis by reviewing Disruptive Innovation Theory. This will be used as our framework to interpret the other sections that take into account disruptive innovation as considered in the different streams of literature related to innovation in emerging economies. Section 3 explores the dynamics of innovation at the Bottom of the Pyramid (BOP), section 4 investigates the conceptualization of disruptive innovation from emerging economies,

[2] This is the introductory article to the JIBS Special Issue on "Offshoring Administrative and Technical Services". By discussing the related articles, the authors suggest possible evolutionary patterns for International Business and R&D Management. They identify the role of emerging economies as a potential location to give *"…rise to born-global innovations that could never have taken place at home"* (p. 8). For a further analysis with a focus on India see Dossani & Kenney (2009).

while section 5 considers cost-driven innovation. Section 6 introduces the dynamics of Reverse Innovation and section 7 interprets this within the Disruptive Innovation framework. Section 8 provides a new categorization of Disruptive Innovation considering a geographical dimension. Finally, conclusions and future research directions are provided in section 9.

2.2 Disruptive Innovation

Originally, the term *disruptive* was introduced by Bower and Christensen (1995) to indicate a new technology that responds to unserved needs by improving existing technologies on product attributes not valued by mainstream customers.
Christensen refined the concept in 1997 with his "Innovator's Dilemma", asking why great companies pursuing innovation in mainstream markets suffer from market myopia and are overtaken by entrant firms introducing products based on new-disruptive technologies.

To explain these phenomena, the author distinguishes between sustaining and disruptive technologies. The former are technologies that respond to an improvement, radical or incremental, of "established products, along the dimensions of performance that mainstream customers in major markets have historically valued" (Christensen, 1997, p. XV). Disruptive technologies instead are innovations for existing products but on attributes that differ from those that are mainly valued by mainstream customers. These innovations, which initially underperform with respect to the main attributes of sustaining technologies, become disruptive when they reach the same performance as the sustaining innovations on the attributes valued by mainstream customers. At this point, they displace existing technologies and cause, in most cases, the failure of incumbent firms. These companies have different options to respond to this type of challenging innovation that include both disruptive and traditional business models, as showed by Charitou and Markides (2003).

In earlier works, Christensen (Bower and Christensen, 1995; Christensen, 1997) refers to disruptive technology only as an "innovation that results in worse product performance in mainstream markets". It is also described as a "typically cheaper, simpler, smaller and frequently more convenient to use" version of an existing product.

In an updated version of the concept, Christensen and Raynor (2003) distinguish between *low-end disruptions* and *(new-market) high-end disruptions*. The former are those offering lower performance at a cheaper price but no other performance improvements,

while the latter are described as products and services that offer better performance on attributes that differ from those valued by mainstream customers.

Christensen also asserts that disruptive technologies should be framed as a marketing, and not a technological, challenge. Firms succeeding in disruptive innovations have a strong attitude in interpreting and addressing needs expressed by a market niche or a new market segment. Thus, the challenge that incumbent firms should overcome in developing and responding to disruptive innovations relates to the development of capabilities to forecast market trends and attitudes as well as "riding" new technological trajectories (Suzuki and Kodama, 2004).

The main research question that guided Christensen and other scholars through their research on disruptiveness is *"how can big incumbent firms prevent or face disruptive technologies?"* Therefore, disruptive innovation has been used from the very beginning to discuss innovation dynamics taking place with the entry of new companies in established and developed markets (Chesbrough, 2002). One of the most convincing responses provided by researchers, albeit widely discussed and doubted (Danneels, 2004), is that these companies should promote the creation of spin-off enterprises in order to better serve and interpret emerging markets. The creation of a separate organization of a smaller dimension with large autonomy allows overcoming the problem of resource allocation that is too mainstream-customer oriented. Matching the initially small market size to the size of the investment potentially enables the new company to be profitable (Cefis and Marsili, 2006[3]).

Since its coinage, the concept of disruptive innovation has been widely discussed from different perspectives (Danneels, 2004; Henderson, 2006). The disruptive innovation paradigm has been analyzed in relation to different industries (Christensen et al, 2000; Gilbert and Bower, 2002; Myers et al, 2002; Pilkington and Dyerson, 2004; Christensen et al, 2006; Sull et al), technological trajectories (Myers et al, 2002), disruptiveness evaluation and predictability (Linton, 2002; Bucher et al, 2003; Husig et al, 2005), firms characteristics for potential disruptiveness (Walsh et al, 2002; Kassicieh et al, 2002), market characteristics (Adner, 2002), financial market influences (Benner, 2007). Christensen himself called for a clarification of disruptive theory (Christensen, 2006).

[3] The authors analyze the relationship between innovation and survival probability of manufacturing firms in the Netherlands and they find that the "innovation premium is the highest for small and young firms" (p. 637).

In particular, Govindarajan and Kopalle (2005; 2006) make a clear distinction between low-end and high-end disruptions based on the level of radicalness of disruptive innovations (technologically more radical in high-end disruptions, technologically less radical in low-end disruptions). The authors also make a clear distinction between innovations that are radical and disruptive and merely radical, stating that radicalness is a technology-based concept while disruptiveness is a market-based concept. Analogously, Markides (2006) draws a clear distinction between different kinds of disruptive innovations: technological, business model and new-to-the-world product innovations. From this distinction and from the work of Utterback (2004), Acee's (2001), and Utterback and Acee (2005), who recognized the importance of disruptive technologies not in the fact that they displace existing products but in their ability to enlarge existing markets and provide new functionalities, Govindarajan and Kopalle add rigor to an expanded view of disruptive innovation including both high-end and low-end disruptions and defining the concept as follow (2006, p.15):

"A disruptive innovation introduces a different set of features, performance and price attributes relative to the existing product, an unattractive combination for mainstream customers at the time of product introduction because of inferior performance on the attributes these customers value and/or a high price - although a different customer segment may value the new attributes. Subsequent developments over time, however, raise the new product's attributes to a level sufficient to satisfy mainstream customers, thus attracting more of the mainstream market".

The most noted example of disruptive innovation provided by Bower and Christensen (1995) and Christensen (1997) refers to the hard disk drive industry between 1976 and 1992. In this market, mainstream customers constantly required improvements in two attributes, total capacity and recording density. The industry and incumbent firms were led by this trend until an emerging segment asked for improvements on different attributes, in particular, the size of drivers. At the beginning, this segment remained marginal and was mainly covered by small entrant firms that could afford to do so by virtue of their relatively limited cost structure, but while the products offered gained improved performance, including the mainstream segment attributes, the market based on sustaining technologies was progressively displaced, causing the failure of incumbents.

In this case, as in the other industry examples provided by Christensen (1997) and Christensen and Raynor (2003), the new segment belongs to the same market where incumbent companies operate. The emergence of new technologies triggers interest within the mainstream segment where these incumbents operate, hence rendering access to the disruptive offering (initially not desired) also possible to mainstream customers.

In conclusion, we can argue that *disruptive innovation* is a theory that seeks to explain changes and new entries in established markets. The result of *disruptive innovation* is visible when mainstream customers switch to the new disruptive product that is gaining market share on established markets.

What if the new disruptive solution has been brought to maturity and has triggered interest in markets that are geographically distant and disconnected from established markets? Disruptive innovation theory was not developed, and is as yet too unrefined, to explain this phenomenon.

2.3 Innovation at the Bottom of the Pyramid (BOP)

While the disruptive innovation paradigm explores the dynamics originating within the hub of an industry, a new approach was developed to understand what was taking place in emerging economies and their markets. This orientation brought scholars to thinking of emerging economies as focal markets to which companies should pay increasing attention and develop a new R&D orientation (Prahalad and Hart, 2002).

Traditionally, MNCs delocalized their R&D oriented FDI in emerging economies for two main reasons (Gassman and Han, 2004; Von Zedtwitz, 2004):

- Access to local markets
- Access to high-skilled research personnel at a lower cost

Following these two drivers, most R&D carried out by foreign MNCs in emerging countries consisted in the adaptation of global products to the specific needs of the local market. R&D, crucial for the development of new products, has traditionally been undisclosed by headquarters (Patel and Pavitt, 1991; Di Minin and Bianchi, 2011), and this is particularly true of R&D internationalization in emerging economies.

The new perspective in the early 2000s was that emerging market potential was not exploited with the previous approach and that a new type of innovation management had to

be developed. According to emerging studies in this period, two main motivations lay behind the evolution of a new approach to emerging markets:

1. the high growth rates of developing countries that pushed foreign investors to focus on those markets that lead global growth
2. the emergence of business ethics that pushed companies and Non Governmental Organizations (NGOs) to strengthen their efforts in order to serve poor people

Companies noted that responding to local market needs with a simple local adaptation of global products developed in their (mainly) western headquarters (*glocalization*) was ineffective in exploiting the entire potential of these growing markets (London and Hart, 2004). From an NGO's perspective, the aim of improving the lives of poor people by serving them with the technology developed and available in developed markets was unsuccessful because not only could poor people not afford this technology but also because it was only partially exploitable due to environmental constraints.

Prahalad and Hart (2002), and later on Prahalad (2004), introduced the new approach to emerging economies as a source of significant profit generation through the development and commercialization of ad-hoc products and services for the markets of the poor.
Prahalad's approach is expressed in the title of his famous 2004 book *"The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits"*. The author identifies a large opportunity for MNCs operating in emerging economies. Most foreign MNCs that internationalize in developing countries adopt a *glocalized* approach. They design and develop global and technologically sophisticated products in their R&D labs in developed countries and later adapt them to local needs for other countries including the developing. Hence, MNCs can only serve a small part of the world population, those with the highest income who can afford to pay a premium price for the high R&D and manufacturing costs sustained by MNCs in developing and distributing these products.

This strategy allows foreign companies to serve only approximately one third of the world population, ignoring the poorest comprising almost 4 billion people (Prahalad and Hart, 2002; Simanis and Hart, 2006).

According to Prahalad's perspective, MNCs serving only the top of the pyramid in emerging economies suffer from business myopia in a way that closely recalls the marketing challenge that Christensen's incumbent firms faced in developing disruptive innovation for new or emerging market niches.

Serving the BOP would imply reconsidering some of the main assumption (Prahalad and Hart – 2002 - identifying 6 of them[4]) of MNCs operating in emerging economies (London and Hart, 2004), since they believe they are unable to make profit by serving customers who cannot afford, nor appreciate, costly sophisticated technology (London, 2007). Although Helling (2009) describes some major barriers in the application of this strategy, Anderson and Billou (2007) list four challenges to overcome (Availability, Affordability, Acceptability, Awareness) that would enable a firm to serve the BOP efficiently.

In order to do so companies have to rethink their strategies. Their business models have to be forged according to the new and stronger environmental constraints that characterize these markets and reach a large part of the world population that has never had access to up-to-date technologies (and sometimes have difficulty in accessing even simple products).

What is of great interest to us is that, although there is no direct and explicit link between these theories, the BOP concept shares some similarities with the disruptive innovation paradigm (Hart and Christensen, 2002). It suggests developing products and services for a market segment requesting different attributes than those of mainstream customers and, in particular, access to the same technology at a much lower price. In reality, it addresses a market that does not yet exist, seemingly configuring what Govindarajan and Kopalle (2005, 2006) identify as disruptive innovation that creates a new market. In our opinion, innovation at the BOP cannot be easily, or entirely, assimilated with disruptive innovation theory. We will explain why in the next section, explicitly linking the BOP to the disruptive innovation paradigm.

2.4 Disruptive Innovations from Emerging Economies

Parallel to the work on "Serving the Bottom of the Pyramid", a further wave of exploration was initiated by scholars linking the disruptive innovation paradigm and Prahalad's non-served markets of the poorest in emerging economies (Hart and Christensen, 2002; London and Hart, 2004).

The argument of scholars applying disruptive innovation to explain the success of new products originating from emerging economies is as follows: foreign MNCs develop

[4] 1- Rethinking the price/performance equation; 2- Rethinking brand management; 3- Rethinking the costs of market building; 4- Rethinking product design; 5- Rethinking packaging; 6- Rethinking capital efficiency.

products for emerging markets and later use them to penetrate the low-end segment of developed markets in the US and Europe, and domestic firms leverage on their cost structure and knowledge of the domestic context to serve local, and later developed, markets.

To the best of our knowledge, Hart and Christensen (2002) for the first time introduced the link between the disruptive innovation framework and emerging economies. Their argument is clearly in line with Prahalad's work referring to "innovation from the base of the pyramid". The authors propose examples of Asian companies that succeeded in introducing disruptive innovations in low-income countries, enabling poor people to afford certain types of technological products and generating profits for themselves. In particular, they explain how Grameen Telecom (a firm that is part of the Grameen family) started to serve Bangladesh's rural market with a wireless telecommunication service. The extremely low income that characterizes potential customers in this market made it unattractive to incumbent firms, but Grameen Telecom, leveraging on Grameen's experience on micro-credit, set up a business model that allowed creating a new class of small entrepreneurs who, properly financed, equipped and trained, "sell phone usage on a per-call basis at an affordable price to others in their villages" (Hart and Christensen, 2002; p. 54).

Recently, Hang et al (2010), demonstrated four cases of Asian companies that, starting from their low-income markets (China and India), developed disruptive products. The success pursued in these markets brought them performance improvements on attributes that had at first been neglected and valued by mainstream customers in developed economies. This pushed them to invest globally and to steadily grow in developed economies. Thus, products developed in emerging economies for their domestic markets are also finding more and more market response in developed countries.

We believe that in both works cited above, the disruptive innovation concept is used in a way that differs from the traditional application of the concept within established markets in developed economies. The traditionally defined disruptive innovation paradigm (Bower and Christensen, 1995; Christensen, 1997) claims that new products (or services) are considered disruptive when they respond to an ignored and new market segment that is usually small, unprofitable for incumbents and has differentiated needs in terms of product attributes.

Could we say that the two cases of innovations originating in emerging markets presented by Hart and Christensen (2002) are indeed disruptive innovations?

We think this is true only in part, and that three limitations need to be considered in relation to the characteristics of disruptiveness mentioned above. In particular, we need to consider 1) the categorization of mainstream and non-mainstream customers 2) market size and 3) disruptive innovators (see Table 1):

1. Foreign MNCs operating in emerging economies have traditionally served those markets adopting a glocalization approach to market segmentation. Thus, they adapted global products to the local needs serving customers that correspond and share similar characteristics to those segments served back in their country of origin or in developed markets. These are their mainstream customers, who might represent the great majority at home but in emerging economies represent only the top of the pyramid. Adopting a marketing perspective instead, as the disruptive challenge requires us to (Christensen, 1997; Danneels, 2006), mainstream customers in emerging markets should be defined as the large part of the population (be it individuals or companies) that cannot afford expensive state of the art technology and that are partly served by local companies that can interpret their needs and respond to them thanks to their cost-structure.
2. One of the main challenges that incumbent firms face when developing or responding to disruptive innovations in their markets is that the size of the emerging market with different requirements is too small to cover the development costs of new products (Christensen, 1997; Christensen and Raynor, 2003). Indeed, the size of the market does not match the size of the company and its related cost structure as it does in the case of small entrants or spin-off companies. This is not true in emerging economies where the market served by innovations, as in the cases presented in Hart and Christensen (2002) and Hang et al (2010), is much bigger than that served by *glocal* products so that the market size is potentially huge, assuming that access to these market segments is feasible.
3. Disruptive innovations in developed economies generally come from a small entrant firm (e.g., a start-up company) that is generated by either a new entrepreneurial activity or a spin-off company from an incumbent firm (Bower and Christensen, 1995; Christensen, 1997; Christensen and Raynor, 2003; Walsh et al, 2002). The generation of disruptive innovations in emerging economies could be developed by domestic companies that naturally have a cost structure and a market

orientation that fits the local environment and by subsidiaries of MNCs that have evolved and gained enough autonomy to develop new products.

2.5 Cost Innovation

The growing tendency of innovation likely to be thought of first in and for the developing world is often referred as cost innovation. In particular, Zeng and Williamson (2007) wrote a book (*Dragons at your Door: How Chinese Cost Innovation is Disrupting Global Competition*), reporting how innovations developed by Chinese companies are disrupting global markets by primarily leveraging on new, low-cost based, business models.

As the authors state in their book, the main assumption is that companies wanting to serve the huge and constantly growing Chinese market (or any other emerging economies) have to undertake a radical change in their business models, pursuing the ability to provide what the authors describe in three points:

1. High-technology at low-cost
2. Variety and customization at low-cost
3. Specialty products at low-cost

Because of the strong focus on low-cost, the innovating process is here defined "cost innovation", resulting in "products or services that initially look inferior to existing ones in the eyes of established players" (Zeng and Williamson, 2007; p.55).

In stating this, innovation considered to be disruptive by the authors is low-end innovation where the same functionalities of products and services are provided but at a dramatically lower price. The point of departure that allows these companies to pursue such low-cost innovation does not rely on low-cost labour force. At least not only and not even primarily. Even if the lower cost of skilled employees plays a role in competitive advantage, the main issue regarding disruptive innovations concerns the way companies pursue such a cost reduction through the different organization of development and production activities and completely original business models that change the way profits are made.

We should rather speak of business model innovation pursued through a series of process innovations that allow companies to serve large markets with low margins instead of competing with the incumbents serving high-end markets with higher margin. The competition is thus on volume rather than on margins, and foreign MNCs have to respond

to the threat from developing countries by "learning the tricks of cost innovation" (Williamson and Zeng, 2008; p.3) (Williamson and Zeng, 2004; Williamson, 2005).

2.6 Reverse Innovation

In the previous sections, we showed how the disruptive innovation paradigm does not adequately fit the description of innovations developed for emerging economies and afterwards "exported" back to developed economies. *Reverse Innovation* (Immelt et al, 2009; Seely Brown and Hagel, 2005) is a more suitable concept that helps us understand this trend. Indeed, this is a new conceptualization that has been developed to explore innovation from emerging economies. This new line of research argues that innovation is less likely to come from, and is adopted in, developed countries first, but is conceived and adopted in emerging economies first to then be introduced to developed markets. It is then "exported" to the developed economies. These dynamics reverse the innovation process as intended in past literature and managerial practice. The reasons that support such an inverted process lie in the market growth of the developing countries that are supporting and leading the global economy.

The trend of innovation from developing countries, thus reversing the innovation process as generally intended from developed to developing economies, is partly anticipated by the concept of disruptive innovation from emerging economies that we described above. Seely-Brown and Hagel (2005) delve into the theme and call it "innovation blowback", introducing the risk of Western companies being displaced by MNCs from emerging economies that are going global and disrupting the markets of developed economies (Zeng and Williamson, 2007). Seely-Brown and Hagel (2005) stress the importance of learning by operating in emerging economies; serving the low-income segments of these markets to gain a competitive advantage that will foster their growth on a global basis. They explain how western MNCs cannot simply adapt global products to local needs by cutting costs thanks to the local low-cost labour force. They have to reshape their business and management practices in order to gain access to these promising markets and build their future global competitive advantage on this experience.

A step further is made by Immelt, Govindarajan and Trimble in their Harvard Business Review Article, *"How GE is disrupting itself"* (2009). In this work, they show how GE is benefiting from its presence in the markets of emerging economies, specifically China and

India, to develop breakthrough innovations that are introduced and successfully commercialized first in developing countries and later, when performance improvements are acceptable, in developed countries. They provide a clear example in the Chinese health-care sector. In the 90s, GE implemented *glocalization* in China. Leveraging on the experience of its US and Japanese research centres, GE developed an ultrasound machine that was mainly sold to sophisticated high-end hospitals around the world. The machine sold poorly in China due to the high price of around US $100.000 and the different health-care infrastructure largely characterized by low-end hospitals and rural clinics. In 2002, a portable machine (combining a laptop and sophisticated software), providing similar functions, was developed by a GE local team in China and was sold for US $30-40.000 to Chinese rural clinics and US ambulance squads. In 2007, the same machine benefited from a further price reduction, expanding the market for portable ultrasound machines. Furthermore, "thanks to technology advances, higher-priced PC-based models can now perform radiology and obstetrics functions that once required a conventional machine" (Immelt et al, 2009; p. 7).

A product perfected in and for the emerging market was first sold also in developed economies for different uses and later disrupted existing products in some markets as a result of performance improvements on the attributes most valued by mainstream customers.

The authors stress the importance of Local Growth Teams (LGTs) as new units, independent from their MNC HQ, built from scratch in emerging economies. They are responsible for the complete development and commercialization of products leveraging headquarter technology but developing completely new offerings that match the market they operate in.

The authors astutely set *reverse innovation* against *glocalization* in a way that challenges the conventional wisdom of foreign firms operating in emerging economies. They explain how in order to compete in emerging economies, foreign MNCs have to rely on LGTs in order to develop innovations that fit local needs and overcome local constraints. At the same time, they do not neglect the *glocalization* paradigm in line with which MNCs have to continue to operate to serve high-end markets and build part of the technological knowledge that is essential for the activities of LGTs in emerging economies.

2.7 Overlapping Areas Between Disruptive and Reverse Innovation

Despite the above considerations, the innovation concept that the authors define as reverse innovation is, in our opinion, a form of disruptive innovation. The characteristics that Immelt et al (2009) list and illustrate to describe reverse innovation match those described in the previous sections of this paper recalling the disruptive innovation theory as illustrated by Christensen and Bower (1995), Christensen (1997), Christensen & Raynor (2003), Acee (2001), Utterback and Acee (2004), Govindarajan and Kopalle (2005, 2006). In particular, reverse innovation shares great similarities with the concept of disruptive innovation from emerging economies as illustrated by Hart and Christensen (2002), Zeng and Williamson (2007) and Hang et al (2010).

Govindarajan and Trimble responded to this parallelism themselves following the requests of some readers of their paper who asked for clarification between disruptive innovation and reverse innovation. They did so on Govindarajan's blog in a specific post entitled *"Is reverse innovation like disruptive innovation?"* (September 30, 2009[5]). The post directly refers to the 2009 HBR article to distinguish between disruptive and reverse innovation. The authors state that there is an overlap between the two concepts but only some cases of reverse innovation are also disruptive innovations. They go on to explain, "A reverse innovation, very simply, is any innovation likely to be adopted first in the developing world" and list three primary situations, or gaps, that open the opportunity for reverse innovation:

1. Income gap
2. Infrastructure gap
3. Sustainability gap

These three gaps represent the differences between developed and developing countries that are likely to be the basis for reverse innovation. Govindarajan and Trimble argue that only in the first case innovation would take the shape of disruptive innovation. They thus consider disruptive innovation only from a price/performance point of view, and not as a market widener or a provider of new functionalities, implicitly stating that disruptive innovation can only have a lower price.

[5] Due to the novelty of the topic, relying on the blog of the scholar who coined the term is crucial in understanding the concept.

We do not believe this is completely true. Referring back to Govindarajan's works on disruptive innovation, we note that Govindarajan and Kopalle (2005) define disruptive innovation as *"a powerful means for broadening and developing new markets and providing new functionality, which, in turn, disrupt existing market linkages"*

In 2006, the same authors provided a different definition of disruptive innovation that does not merely focus on lower price/lower performance. As previously stated by Christensen and Raynor (2003), disruptive innovation can thus generate a new market by leveraging on non-served segments or respond to the most price sensitive segment of mainstream customers by lowering product price.

Therefore, the focus now lies in the alternative attributes that are offered by the innovation in relation to an existing product. These new products are able to penetrate the market starting from early adopters and improve performance in the "mainstream" thanks to the experience accumulated in serving the new segment. In line with Christensen and Raynor (2003) and Utterback and Acee (2005), Govindarajan and Kopalle (2006) define disruptive innovation in the way presented in the second section of this paper and include both new, low-end and high-end attributes to existing products that initially are tempting only to new customers (thus not necessarily price-focused) or the most price sensitive mainstream customers, but in developing over time they also gain the attention of mainstream customers and the market.

The case of the ultrasound machine is thus a clear example of both reverse innovation and disruptive innovation. Govindarajan himself reinforced this insight in his blog post entitled *"What is reverse innovation?"* published on October 15, 2009. Following a definition of reverse innovation as reported previously, he stated that the fundamental driver of reverse innovation is the income gap between developing and developed economies.

Furthermore, in their HBR article they seem to be rather focused on low-cost, configuring what in literature has been defined as low-end disruptive innovation from emerging economies (Hart et al, 2002; Hang et al, 2010). They also mention lack of infrastructure and sustainability problems as drivers for reverse innovation but reference seems nevertheless to be made to low-cost solutions, "a 50% solution at a 15% price... these products can create brand-new markets in the developed world – by establishing dramatically lower price points or pioneering new applications" (Immelt et al, 2009; p.5). The trend is also confirmed by several other posts that Govindarajan published in his blog on reverse innovation examples.

In summary, Govindarajan and Trimble state that reverse innovation has three drivers (although Govindarajan stresses the fundamentality of the income gap) but they do not provide any example of reverse innovation that is not linked to the income gap and thus that is not in the shape of disruptive innovation. Based only on this argument, we cannot exclude a complete overlap between the two concepts. Indeed, even if we consider the other two situations (infrastructure and sustainability gap) where reverse innovation can occur, they can certainly give origin to both low-end and high-end disruptive innovations as intended by Govindarajan and Kopalle (2006).

Beyond the conceptual similarities we have discussed up to now, reverse innovation and disruptive innovation from emerging economies (developed by foreign MNCs) have some other common points:

- the same risks of cannibalizations for companies that have previously invested in the same industries for mainstream customers (Immelt et al, 2009; Govindarajan and Kopalle, 2005, 2006), which is also a tool for measuring the potentiality of firms to develop disruptive innovations (Govindarajan and Kopalle, 2005).
- as anticipated by Seely Brown and Hamel (2005), Williamson and Zeng (2004), Williamson (2005), Zeng and Williamson (2007) and Williamson (2010) with reference to business models, disruptive innovations are a tool to pre-empt giants from emerging economies that are going global with a new price-performance offering, which is exactly the same purpose of reverse innovation (Immelt et al, 2009).
- LGTs that Immelt et al (2009) explain as crucial for the development of innovations for emerging economies mirror the spin-off companies described by Christensen and Overdorf (2000), Christensen et al (2000), Christensen and Raynor (2003), Danneels (2004; 2006), as the best solution for incumbents that want to compete with or develop disruptive innovations.

We therefore believe the main contribution of reverse innovation as described by Immelt et al (2009) is to be interpreted within the disruptive innovation paradigm, particularly with reference to innovations developed thanks to the market inputs of emerging countries.

We believe that Immelt et al (2009) make an important contribution, enriching the disruptive innovation paradigm from the emerging countries perspective by stressing the importance of LGTs in developing new products for local markets.

2.8 Geographic Dimension of Disruptive Innovation

As discussed in the previous section, it is possible to see reverse innovation as a particular manifestation of disruptive innovation, can we thus simply generalize the findings and implications of disruptive innovation originating from developed countries to situations of reverse innovation?

The answer is no. Such a generalization does not work, since success stories of disruptive innovation originating from developed markets differ substantially from success stories that export successful products back to developed markets that were first introduced in emerging economies.

Table 1 summarizes the main differences discussed below:

- *Early market*: in disruptive innovation theory, the market segment served by the new technology is characterized by early adopters: innovation oriented customers who seek new attributes in existent products and are willing to experience and experiment first, as they are eager for change. New customers represent only a small niche or segment of the established market. In reverse innovation, the early market is instead represented by the large part of the population, or BOP, that has no access to the established technology because it is either too expensive or too complex. This is hardly the case with early adopters and developed markets. These differences should lead to completely different marketing strategies.
- *Actors*: the small size of the early market in disruptive innovation theory makes spin-off companies or small new entrants the only actors able to serve this market profitably. On the other side, the vast size of the new market segment to be served in emerging economies allows foreign MNCs subsidiaries and large local companies to make profit from it by exploiting economies of scale.
- *Expansion*: the evolution of disruptive products conceived *in* and *for* developed markets brings innovative technologies to commercialization in the same markets as the established ones, while disruptive products introduced *in* and *for* developing economies allow foreign MNCs and domestic companies to export their evolved

disruptions to mainstream markets in developed countries, configuring a process of reverse innovation

- *Maturation of technology*: the technological evolution of disruptive innovations is the same in both cases, but while in disruptive innovation theory this occurs in the same country market, in reverse innovation we see it happening in developing economies and brought to developed economies once the technology has evolved
- *Challenges*: the development of a technology on a new trajectory puts new entrants in established markets in competition to reach new technological standards. In emerging economies, the main challenge is the difficulty of reaching a vast market that often lacks adequate complementary assets (such as distribution and logistics infrastructures). Furthermore, cultural and institutional differences make it difficult for foreign firms to understand and properly respond to market needs.
- *Competition/success is based on*: in traditional disruptive innovation theory, the "battle" is won by the company that develops the new technology better and faster, satisfying at first the request for new attributes and, along within technological evolution, catching up on the mainstream attributes. In reverse innovation, competition is instead based on the ability to develop a new business model that allows companies to serve a large portion of the market in order to achieve large sales volumes and economies of scale.

2.9 Disruptive Innovation in Reverse: Towards a Research Agenda

In light of the discussion presented in this paper, we can conclude that reverse innovation can be defined as a form of disruptive innovation that originates not from the same geographical market that incumbent companies dominate, but rather from the markets of emerging economies, where a technology/product has been commercialized to fit the characteristics of those markets, particularly serving the vast bottom of the pyramid.

The disruptive innovation framework provides us with the dynamics to look at innovation that originates for emerging economies. However, the challenges, evolution and factors leading to success or failure of reverse innovation are different from those that are relevant when disruptive innovation originates from a developed market.

We therefore argue that instead of simply generalizing the findings of disruptive innovation to emerging economies, future studies should take into consideration innovations that originate for those markets.

Innovating in foreign countries requires a deep understanding of the local culture and business environment. This is particularly true for emerging economies with crucial differences in management and business practices as well as in general social interactions. Research in this area should therefore include a cultural and anthropological perspective. Several works have considered culture as a major determinant in different business areas: human resources (Hofstede, 1980, 1988, 1991; Hampden-Turner and Trompenaars, 1997), entry strategies (Kogut and Singh, 1988; Nakino and Neupert, 2000), negotiation (Lin and Miller, 2003; Faure and Rubin, 1993), marketing (Usunier and Lee, 2005; Nevins and Money, 2008; Nes et al, 2007). We think in-depth studies that focus on low-income growing markets such as China and India are needed for the future.

In particular, contributions should link global innovations deriving from MNC activities in emerging economies and Open Innovation (OI) dynamics. As reported by Seely-Brown and Hamel (2005), Zeng and Williamson (2007) and Williamson (2010), organizational structure and business models are key areas to learn how to serve low-income countries and how to develop innovations from those market inputs. In their contributions, several similarities with the OI model can be identified. Innovation is derived from strong local market inputs and therefore developed thanks to (potential) customer cooperation rather than a technological push. Cultural and institutional differences push foreign MNCs to observe and interact with local suppliers and competitors for a reciprocal exchange of information on markets and technologies.

Chesbrough, in his "Open Services Innovation: Rethinking Your Business to Growth and Compete in a New Era" (2011), dedicates a chapter to emerging economies showing how OI can be a fruitful way to reach those markets and learn from them.

Strong intellectual property regimes are required to implement an innovation strategy that is based on an open model. This may be a problem in developing countries since they are shown to have weak intellectual property regimes (IPR) (Zhao, 2006). Despite this, recent contributions show how to overcome this problem in developing economies (Keupp et al, 2010) such as China (Keupp et al, 2009; Quan and Chesbrough, 2010), presenting successful cases of foreign companies that implement R&D activities in China, providing useful tools for overcoming the IP violation risk.

A second research stream that we would like to see addressed is the one on subsidiary evolution. As stated before, adopting a disruptive innovation view, foreign subsidiaries in emerging economies can be read as spin-off companies (Christensen and Raynor, 2003) created for interpreting emerging market segments. So far, literature on subsidiary evolution and role have mainly focused on developed countries (usually the TRIAD plus Canada). To this respect, distance between country of origin and country of destination, on both cultural and institutional side, in the case of emerging economies would be of special usefulness for understanding the dynamics of learning in relation to subsidiary role and autonomy. So far several researchers have focused on human resource management (Hofstede, 1980; Hofstede and Bond, 1988; Gassman and Han, 2004), the evolution of R&D activities (von Zedtwitz, 2004), strategy (Gassman and Keupp, 2008; Sun et al, 2008) but a clear understanding on evolution processes and drivers of subsidiary still lacks.

As reverse innovation dynamics unfold, we expect to see new business models evolve, new forms of interaction between MNCs and local partners, as well as new opportunities for entrepreneurs trying to adapt technologies across distant markets.

Characteristics / Location	***Early Market***	***Actors***	***Expansion***	***Maturation of Technology***	***Challenges***	***Compete/Succeed based on***
Disruptive Innovation in Developed Countries	• Advanced/Innovative early adopters seeking to be "educated" and to try the new technology. • Typically small, advanced niche	Spin offs or new entrants able to be flexible enough to serve the niche	Into mainstream market of the same country through a process of upgrading "mainstream technological attributes"	Profits from early markets are invested (driven by early market requests) into the development of technology that is improved with respect to that from incumbents through path dependence	Standard battle amongst start-ups	• Speed of development • High margins once the incumbents have been disrupted
Disruptive Innovation in and from Emerging Economies	• Large majority of population with no means to get to established technologies • Typically large BOP	Subsidiaries of MNCs and large local companies that are able to exploit economies of scale	Into mainstream market of emerged countries through a process of reverse innovation	Same process of maturation	• Distribution in vast markets • Requirement to access market needs • Requirement to understand and respond to market needs	• Volume • Costs and reorganization of products/services

Table 1 Differences between disruptive innovation in emerging and developed economies

References

Acee, Happy J. 2001. *Disruptive Technologies: an Extended View*, SM Thesis, Management of Technology, Massachusetts Institute of Technology.

Adner, Ron 2002. When are technologies disruptive? A demand-based view of the emergence of competition. ***Strategic Management Journal***. 23 (8): 667-688.

Agrawal, Narendra M., Khatri, Naresh, Srinivasan, R. 2011. Managing growth: human resource management challenges facing the software industry. ***Journal of World Business***. 47(2): 159-166.

Anderson, Jamie, Billou, Niels 2007. Serving the world's poor: innovation at the base of the economic pyramid. ***Journal of Business Strategy***. 28 (2): 14-21.

Benner, Mary J. 2007. Financial market reactions following technological discontinuities: a non-event study in two industries. ***Industrial and Corporate Change***. 17 (1): 109-154.

Bower, Joseph L., Christensen, Clayton M. 1995. Disruptive technologies: catching the wave. ***Harvard Business Review***. 73 (1): 43-53.

Brusoni, Stefano, Prencipe, Andrea, Pavitt, Keith 2001. Knowledge specialization, organizational coupling, and the boundaries of the firm: why do firms know more than they make?. ***Administrative Science Quarterly***. 46 (4): 597-621.

Bucher, Philip, Birkenmeier, Beat, Brodbeck, Harald, Escher, Jean-Philippe 2003. Management principles for evaluating and introducing disruptive technologies: the case of nanotechnology in Switzerland. ***R&D Management.*** 33 (2): 149-163.

Cavusgil, S. Tamer, Ghauri, Pervez N., Agarwall, Milind R. 2002. *Doing business in emerging markets: entry and negotiation strategy*, Thousand Oak: Sage.

Cefis, Elena, Marsili, Orietta 2006. Survivor: the role of innovation in firms' survival. ***Research Policy***. 35 (5): 626-641.

Chakrabarti, Alok K., Bhaumik, Pradip K. 2010. Globalisation of technology development: offshoring of R&D to China, India, and Brazil. ***International Journal of Engineering Management and Economics*.** 1 (1): 68-79.

Chang, Yi Y., Mellahi, Kamel, Wilkinson, Adrian 2009. Control of subsidiaries of MNCs from emerging economies: the case of Taiwanese MNCs in the UK. ***International Journal of Human Resource Management*.** 26 (1): 76-95.

Charitou, Costantinos D., Markides, Costantinos C. 2003. Responses to disruptive strategic innovation. ***MIT Sloan Management Review***. 44 (2): 55-63.

Chesbrough, Henry W. 2002. Environmental influences upon firm entry into new sub-markets: evidence from the worldwide hard disk drive industry conditionally. ***Research Policy***. 32 (4): 659-678.

Chesbrough, Henry 2011. *Open Services Innovation. Rethinking your business to growth and compete in a new area*. Jossey Bass.

Chiesa, Vittorio. 1994. International technology development organisation: a framework, *In*: Bertelé U., Chiesa V. (eds.), *La globalizzazione delle attività di ricerca e sviluppo*, Consorzio Mip-Politecnico di Milano, October, vol. 3.

Christensen, Clayton M. 2006. The ongoing process of building a theory of disruption. ***Journal of Product Innovation Management.*** 23 (1): 39-55.

Christensen, Clayton M., Baumann, Heiner, Ruggles, Rudy, Sadtler, Thomas M. 2006. Disruptive innovation for social change. ***Harvard Business Review.*** December, pp. 94-101.

Christensen, Clayton M., Overdorf, Michael 2000. Meeting the challenge of disruptive change. ***Harvard Business Review***. March-April, pp. 66-76.

Christensen, Clayton. M. 1997. *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Press.

Christensen, Clayton M., Raynor, E. Michael 2003. T*he innovator's solution: creating and sustaining successful growt.,* Harvard Business Press.

Danneels, Erwin 2004. Disruptive technology reconsidered: a critique and research agenda. ***The Journal of Product Innovation Management.*** 21 (4): 246-258.

Demirbag, Mehmet, Tatoglu, Ekrem, Glaister, Keith W. 2008. Factors Affecting Perceptions of the Choice between Acquisition and Greenfield Entry: The Case of Western FDI in an Emerging Market. ***Management International Review***. 48 (1): 5-37.

Di Minin, Alberto, Bianchi, Mattia 2011. Safe nests in global nets: internationalization and appropriability of R&D in wireless telecom. ***Journal of International Business Studies.*** 42: 910-934.

Di Minin, Alberto, Zhang, Jieyin 2010. An exploratory strategy on international R&D strategies of Chinese companies in Europe. ***Review of Policy Research.*** 27 (4): 433-455.

Dossani, Rafiq, Kenney, Martin 2009. Service provision for the global economy: the evolving Indian experience. ***Review of Policy Research.*** 26 (1-2): 77-104.

Engman, Michael 2007. Expanding International Supply Chains: The Role of Emerging Economies in Providing it and Business Process Services. ***OECD Trade Policy Working Papers*****,** No. 52, OECD Publishing.

Faure, Guy O., Rubin, Jeffrey Z. 1993. *Culture and negotiation*, Newbury Park, California: Sage Publications.

Frenkel, Michael, Funke, Katia, Stadtmann Georg 2004. A panel analysis of bilateral FDI flows to emerging economies. ***Economic Systems*****.** 28 (3): 281-300.

Gassmann, Oliver, Han, Zheng 2004. Motivations and barriers of foreign R&D activities in China. ***R&D Management*****.** 34 (4): 423-437.

George, Jennifer M., Jones, Gareth R., Gonzales, Jorge A. 1998. The role of affect in cross-cultural negotiations. ***Journal of International Business Studies***. 29 (4): 749-772.

Gilbert, Clark., Bower, Joseph L. 2002. Disruptive change. When trying harder is part of the problem. ***Harvard Business Review***. 80 (5): 94-101.

Govindarajan, Vijay, Kopalle, Praveen K. 2006. Disruptiveness of innovations: measurement and an assessment of reliability and validity. ***Strategic Management Journal*****.** 27 (2): 189-199.

Govindarajan, Vijay, Kopalle, Praveen K. 2006. The usefulness of measuring disruptiveness of innovations. Ex post in making ex ante predictions. ***Journal of Product Innovation Management*****.** 23 (1): 12-18.

Govindarajan, Vijay 2010. The case of 'reverse innovation' now. ***BusinessWeek Online***, 10/27/2009, p. 13.

Hakanson, Lars, Nobel, Robert 1993. Determinants of foreign R&D in Swedish multinationals, ***Research Policy***. 22 (5/6): 397-411.

Hampden-Turner, Charles, Trompenaars, Fons 1998. *Riding the waves of culture: understanding diversity in global business*. McGraw Hill.

Hang, Chang-Chieh, Chen, Jin, Subramian, Annapoornima M. 2010. Developing disruptive products for emerging economies: lessons from Asian cases. ***Research Technology Management***. 53 (4): 21-26.

Hart, Stuart L., Christensen, Clayton M 2002. The great leap. Driving innovation from the base of the pyramid. ***MIT Sloan Management Review***. 44 (1): 51-56.

Helling, Tom 2009. Barriers at the bottom of the pyramid, ***Urban Canopy Working Papers*****.**

Henderson, Rebecca 2006. The innovator's dilemma as a problem of organizational competence. ***Journal of Product Innovation Management***. 23 (1): 5-11.

Herbig, Paul A. (1998), *Handbook of cross-cultural marketing*, The International Business Press.

Hofstede, Geert 1980. *Culture's consequences: international differences in work-related values*. Newbury Park, CA: Sage.

Hofstede, Geert 1991. *Cultures and organizations: software of the mind*. New York, McGraw-Hill.

Hofstede, Geert, Bond, Michael H. 1988. Confucius and economic growth: new trends into culture's consequences. ***Organizational Dynamics.*** 16 (4): 4-21.

Husig, Stephane, Hipp, Christiane, Dowling, Michael 2005. Analysing disruptive potential: the case of wireless local area network and mobile communications network companies. ***R&D Management.*** 35 (1): 17-35.

Immelt, Jeffrey R., Govindarajan, Vijay, Trimble, Chris 2009. How GE is disrupting itself. ***Harvard Business Review.*** 87 (10): 56-65.

Jacob, Nina 2003. *Intercultural Management*, Kogan Page, UK.

Utterback, James M. 2004. The Dynamics of Innovation. ***Educause Review***, January-February, pp. 42-51.

Javalgi, Raj G., Dixit, Ashutosh, Scherer, Robert F. 2009. Outsourcing to emerging markets: theoretical perspectives and policy implications. ***Journal of International Management***. 15 (2): 156-168.

Kassicieh S.K., Walsh S.T., Cummings J.C., McWhorter P.J., Romig A.D., Williams W.D. 2002. Factor differentiating the commercialization of disruptive and sustaining technologies. ***IEEE Transactions of Engineering Management***. 49 (4): 375-387.

Kenney, Martin, Massini, Silvia., Murtha Thomas P. 2009. Offshoring administrative and technical work: new fields for understanding the global enterprise. ***Journal of International Business Studies.*** 40: 887-900.

Keupp, Marcus M., Beckenbauer, Angela, Gassmann, Oliver 2009. How managers protect intellectual property rights in China using de facto strategies. ***R&D Management.*** 39 (2): 211-223.

Keupp, Marcus M., Beckenbauer, Angela, Gassmann, Oliver 2010. Enforcing intellectual property rights in weak appropriability regimes: the case of de facto protection strategies in China. ***Management International Review***. 50 (1): 128-159.

Kogut, Bruce, Singh, Harbir 1988. The effect of national culture on the choice of entry mode. ***Journal of International Business Studies***. 19 (3): 411-432.

Kuemmerle, Walter 1997. Building effective R&D capabilities abroad. ***Harvard Business Review.*** 75 (2): 61-70.

Laxton, Douglas, Pesenti, Paolo 2003. Monetary rules for small, open, emerging economies. ***Journal of Monetary Economics***. 50 (5): 1109-1146.

Li, Jiatao, Kozhikode, Rajiv K. 2009. Developing new innovation models: shifts in the innovation landscapes in emerging economies and implications for global R&D management. ***Journal of International Management.*** 15 (3): 328-339.

Lin, Xiaohua, Miller, Stephen J. 2003. Negotiation approaches: direct and indirect effect of national culture. ***International Marketing Review***. 20 (3): 286-303.

Linton, Jonathan D. 2002. Forecasting the market diffusion of disruptive and discontinuous innovation. ***IEEE Transactions on Engineering Management.*** 49 (4): 365-374.

London, Ted 2007. A Base-of-the-Pyramid Perspective on Poverty Alleviation. ***Growing Inclusive Markets Working Paper Series***, Washington, DC: United Nations Development Program.

London, Ted, Hart, Stuart L. 2004. Reinventing strategies for emerging markets: beyond the transnational model. ***Journal of International Business Studies***. 35 (5): 350-370.

Makino, Shige, Neupert, Kent E. 2000. National culture, transaction costs and the choice between joint venture and wholly owned subsidiary. ***Journal of International Business Studies***. 31 (4): 705-713.

Markides, Constantinos 2006. Disruptive innovation: in need of better theory. ***Journal of Product Innovation Management***. 23 (1): 19-25.

Meyer, Klaus E., Estrin, Saul, Bhaumik, Sumon K., Peng Mike W. 2009. Institutions, resources and entry strategies in emerging economies. ***Strategic Management Journal***. 30 (1): 61-80.

Meyer, Klaus E. 2004. Perspectives on multinational enterprises in emerging economies. ***Journal of International Business Studies***. 35 (4): 259-276.

Myers D.R., Sumpter C.W., Walsh S.T., Kirchhoff B.A. 2002. A practitioner's view: evolutionary stages of disruptive technologies. ***IEEE Transactions on Engineering Management.*** 49 (4): 322-329.

Nes, Erik B., Solberg, Carl A., Silkoset, Ragnhild 2007. The impact of national culture and communication on exporter-distributor relations and on export performance. ***International Business Review.*** 16 (4): 405-424.

Neumeyer, P.A., Perri, F. 2004. Business cycles in emerging economies: the role of interest rates. **Federal Reserve Bank of Minneapolis**, Research Department Staff Report 335.

Nevins, Jennifer L., Money, R. Bruce 2008. Performance implications of distributor effectiveness, trust and culture in import channels of distribution. ***Industrial Marketing Management.*** 37 (1): 46-58.

Nguyen, Hien, Lee, Yu-Feng L. 2008. International outsourcing in emerging and developed economies: an empirical study. ***Journal of International Business Research***. 7 (3): 53-62.

Patel, Pari, Pavitt, Keith 1991. Large firms in the production of the worlds technology – An important case of non-globalization. ***Journal of International Business Studies.*** 22 (1): 1-21.

Pearce, Robert D. 1989. *The internationalization of research and development by multinational enterprises*. The McMillan Press Ltd, London.

Pilkington, Alan, Dyerson, Romano 2004. Incumbency and the disruptive regulator: the case of electric vehicles in California. ***International Journal of Innovation Management***. 8 (4): 339-354.

Prahalad, Coimbatore K., Hart, Stuart L. 2002. The fortune at the bottom of the pyramid, ***Strategy + Business.*** 26, First quarter.

Prahalad, Coimbatore K. 2004. *The fortune at the bottom of the pyramid. Eradicating poverty through profits*. Pearson Education.

Qu, Z., Huang, C., Zhang, M., Zhao, Y. 2007. R&D offshoring and technology learning in emerging economies: Firm-level evidence from the ICT industry. ***United Nations University Working Paper Series***, n. 23.

Quan, Xiaohong, Chesbrough, Henry W. 2010. Hierarchical segmentation of R&D process and intellectual property protection: evidence from multinational R&D laboratories in China. ***IEEE Transactions on Engineering Management.*** 57 (1): 9-21.

Seely Brown, John, Hagel, John III 2005. Innovation blowback: disruptive management practices from Asia. ***The Mckinsey Quarterly***. 1: 34-45.

Simanis, Erik, Hart, Stuart L. 2006. Expanding possibilities at the base of the pyramid, ***Innovations***. 1 (1): 43-51.

Sull, Donald N., Tedlow Richard S., Rosenbloom, Richard S. 1997. Managerial commitment and technological change in the US tyre industry. ***Industrial and Corporate Change***. 6 (2): 461-501.

Suzuki, Jun, Kodama, Fumio 2004. Technological diversity of persistent innovators in Japan: two case studies of large Japanese firms. ***Research Policy.*** 33 (3): 531-549.

Tan, Danchi, Meyer, Klaus E. 2011. Country-of-origin and industry FDI agglomeration of foreign investors in an emerging economy. ***Journal of International Business Studies***. 42: 504-520.

Thite, M., Wilkinson, A., Shah, D. 2011. Internationalization and HRM strategies across subsidiaries in multinational corporations from emerging economies – a conceptual framework. ***Journal of World Business.*** 47(2): 251-258.

Usunier, Jean-Claude, Lee Julie. A. 2005. *Marketing across cultures*. Prentice Hall, England.

Utterback, James M., Acee, Happy.J., 2005. Disruptive technologies: an expanded view. ***International Journal of Innovation Management.*** 9 (1): 1-17.

Vernon, Raymond 1966. International Investment and International Trade in the Product Cycle. ***Quarterly Journal of Economics.*** 80 (2): 190-207.

Von Zedtwitz, Maximilian 2004. Managing foreign R&D laboratories in China. ***R&D Management.*** 34 (4): 439-452.

Walsh, S.T., Kirchhoff, B.A., Newbert, S. 2002. Differentiating market strategies for disruptive technologies. ***IEEE Transaction on Engineering Management.*** 49 (4): 341-351.

Williamson, Peter J. 2005. Strategies for Asia's new competitive game. ***Journal of Business Strategy***. 26 (2): 37-43.

Williamson, Peter J., Zeng, Ming 2008. How to meet China's cost innovation challenge. ***Ivey Business Journal Online***. 27 (6).

Williamson, Peter J. 2010. Cost innovation: preparing for a 'value-for-money' revolution. ***Long Range Planning***. 43 (2-3): 343-353.

Williamson, Peter J., Zeng, Ming 2004. Strategies for competing in a changed China. ***MIT Sloan Management Review***. 45 (4): 85-91.

Zeng, Ming, Williamson, Peter J. 2007. *Dragons at your door: how Chinese cost innovation is disrupting the rules of global competition*. Boston, MA: Harvard Business School Press.

Zhao, M. 2006. Conducting R&D in countries with weak intellectual property rights protection. ***Management Science***. 52 (8): 1185-1199.

Chapter 3: Towards a Typology of Reverse Innovation[6]

3.1 Introduction

The term "reverse innovation" has become increasingly popular in both academic and managerial discussion describing some form of reverse flow of innovation or reversal of an expected direction of innovation activity. The general implication is that reverse innovation is part of the globalization of R&D and innovation, describing the introduction of new products first launched in developing countries to markets in industrially advanced countries. Despite the increasing practical and conceptual importance of global innovation, a reference framework for this phenomenon, however, is still missing.

For instance, Immelt et al (2009) describe reverse innovation as the opposite of the 'glocalization' process, which posits that multinationals first make products at home for the home market and subsequently localize them to other, usually less sophisticated markets. Building on this idea, Govindarajan and Ramamurti (2011) refer to reverse innovation as the case where an innovation is adopted first in poor (emerging) economies before 'trickling up' to rich countries. However, the idea of innovation coming from other than advanced countries is not new: for instance, Seely-Brown and Hagel (2005) use the term 'blowback innovation' to describe innovative solutions coming from emerging markets, and Hart and Christensen (2002) apply the disruptive innovation framework to new products coming from developing economies.

While the central idea of reverse innovation appears to be clear, much of what differentiates reverse innovation from other notions of innovation remains vague. Does it apply only to innovation processes controlled by firms from advanced countries? If so, what about products developed by local emerging market firms also sold in the US and Europe? Does it include concept development and R&D as part of the innovation process? If so, where do we draw the line for innovations clearly inspired through contact with so-called less-developed countries, such as the adoption of tea by the British or the introduction of gun powder from China to Europe? Does it apply only to market innovations in developing countries? If so, what about innovations carried out by e.g.

[6] This paper is co-authored with Dr. Maximilian von Zedtwitz (*GLORAD - Research Center for Global R&D Management and Reverse Innovation,*Tongji University), Peder Veng Søberg (Center for Industrial Production, Aalborg University), and Rome Frega (United Nations World Food Programme) and it is currently "accepted with revisions" for a special issue of the **Journal of Product Innovation Management** titled *"Innovation for and from emerging markets"*

Chinese or Indian firms in the US and Europe and then introduced back in their home countries?

It could be argued that this confusion derives from unclear definitions of what constitute 'advanced', 'developing', and 'emerging' markets, what is meant by 'the innovation process', and also what is implied by a 'reverse flow' of innovation. We agree with this terminological critique: It has always been central to the progress of empirical science to capture and define observations as accurately as possible to permit future research to improve knowledge of the phenomenon iteratively. The purpose of this paper is thus to clarify some of these definitions, identify implicit mental maps in the vocabulary of global innovation, and propose a typology of reverse innovation. To do so, we go back to Vernon's 1966 product life cycle model and explain how it may still be suitable to explain the global movement and adaptation of products in the world of global innovation almost fifty years later. We also present empirical evidence to balance the view that innovation is a prerogative of advanced countries and, more importantly, to dispel the notion that the flow of innovation is unidirectional from advanced countries to emerging markets. To accommodate different types of innovation, we use a simple definition of the innovation process and build a comprehensive innovation flow model in which we outline patterns of reverse innovation as a subset of global innovation. We conclude with a few pitfalls of the introduced typology and a discussion of ethnocentricity in global innovation.

3.2 The Development of the Notion of Reverse Innovation

3.2.1 Vernon's Product Life Cycle Hypothesis

In his seminal paper, Vernon (1966) outlines how factor conditions of advanced countries trigger innovation processes to develop new products aimed to satisfy the needs of local customers; the location of these innovation activities is in the advanced country not only because the entrepreneur has access to scientific knowledge and technology but also a greater likelihood and incentive to apply this knowledge, as entrepreneurs, technology, and consumers are geographically collocated. Production of the resulting new products initially takes place in the home country and eventually in other advanced countries, and only once labor-costs become a differentiating factor, usually at the end of the product life cycle, production and sales would migrate to less developed countries.

Note that Vernon's usage of the term "entrepreneur" would today not only apply to entrepreneurs but also to small and medium sized firms as well as large multinational firms. Note also that Vernon implicitly uses a linear model of innovation, starting with access to science and technology, new product development, introduction to a primary target market (in advanced countries) and eventually in secondary markets (at the end of the product life cycle). For innovation to succeed proximity between protagonists in adjacent innovation phases is important – this is one of his key arguments against innovation to emerge from less advanced countries.

Later, Vernon (1979) revised his original model based on observations that multinational companies increasingly operated a global network of production units, suggesting that local production would be more suited to serve their host country markets, and thus implying that the (advanced) home market may not be the only focal target market. Besides firms from the US also European firms were now reported to develop innovations targeting their home market, although in the case of European firms these innovations might be capital or material saving rather than labor saving (Tsurumi, 1972, 1977). Vernon (1979) does not neglect emerging countries, but their given role is still limited to that of being recipients of products at the end of their life cycles or perhaps as orchestrators of their own product life cycle towards even less developed economies.

Bartlett and Ghoshal (1990) were among the first to recognize how innovations developed by local subsidiaries targeting local markets were often subsequently commercialized globally as well. Analyzing US patents, Cantwell (1995) revised the product life cycle model by showing that the home country of a company is not anymore the only and most probable location for an innovation to occur; the product life cycle may start in whatever advanced country is leading in the given technological field. Actual development of an original idea into a product and its manufacturing are located wherever a company has an advanced center of know-how and production. These trends and underlying drivers have been well documented and explained by scholars in a number of supporting disciplines, e.g. Hedlund (1986), Ghoshal and Nohria (1989), or Gupta and Govindarajan (1991) for organizational structure, Håkanson and Nobel (1993) and Chiesa (2000) for international R&D, Frost (2001) and Frost et al. (2005) for geographic sources of innovation. Research on reverse knowledge and technology transfer (Buckley et al., 2003), defined as the transfer of knowledge or technology from a subsidiary to its headquarters, has given us insights on the importance of the level of national development (Ambos et al., 2006), the role of the subsidiary (Frost et al, 2002; Birkinshaw et al, 2004;

Mudambi et al, 2007; Bouquet and Birkinshaw, 2008; Phene and Almeida, 2008; Ambos et al., 2010), technology characteristics (Håkanson & Nobel, 2000), or a combination of these factors (Frost, 2001; Almeida and Phene, 2004).

In summary, research on global innovation has taken us to a much more refined understanding of how multinational companies conceive, develop and introduce new products. Although the role of local MNC subsidiaries and local host country factor conditions has been accentuated, the majority of this research is focused on MNCs from developed countries moving increasingly value-adding activities to emerging countries, following the traditional flow of innovation, thus reinforcing Vernon's product life cycle model. Reverse innovation, however, as understood by still sparse literature and anecdotal examples, suggests a more radical departure from our perception of the conventional role of emerging economy actors in innovation.

3.2.2 The Emergence of Emerging Economies

Emerging economies are often important as new markets, in particular because of their often above-average market growth rates. However, emerging economies have also become hosts for significant amounts of global production, and more recently also as targets for product development localization and innovation off-shoring. Last but not least, we see the emergence of indigenous innovation in emerging economies.

Given strong and sustained growth in many of their markets for extended periods of time, emerging economies have moved center-stage for many MNCs as equally important and sometimes prime markets to serve. Between 1960 and 2009, the share of advanced economies in world GDP dropped from 75% to 57% (Kose and Prasad, 2010), while the share of emerging economies in world GDP grew from 17% to almost 40%. For companies like Siemens and GM, China is now among the top-three markets in terms of revenue and profit generation, and India, Brazil and other emerging markets are following suit. A similar trend is observed in production: for example, over 90% of all photovoltaic products are manufactured in China and exported to the West (Franchini and Fink, 2011), while Indian software production powerhouses such as TCS, Wipro and Infosys have dominant positions worldwide. As markets and as production hosts, emerging economies are not emerging anymore, they are very much established now.

Since the turn of the millennium, MNCs have dramatically expanded their R&D presence in emerging economies, in particular China and India. The Chinese Ministry of Commerce reported the country to have more than 1,200 foreign R&D centers be the end of 2009 (People's Daily Online, 2010). India is estimated to host several hundred foreign R&D centers as well and expands further (Reddy, 2005). Similar trends are observed for other countries (e.g., Brazil, see Costa, 2005) or emerging economies in general (von Zedtwitz, 2005). Access to the new market (Håkanson and Nobel, 1993; Kuemmerle, 1997), better communication or integration with other firm processes already located in the same area (Quan and Chesbrough, 2010), access to low-cost skilled human capital (Brusoni et al, 2001), or combinations of these and additional reasons (e.g., Boutellier et al, 2008) explain why MNCs move R&D into countries with relatively low shares of tertiary education and small portions of the population with high dispensable income. In China, invention patent applications by foreign firms or individuals exceeded 100,000 for most years since 1998, reaching a share of approximately 71% of all domestically filed invention patent applications. India reached similar numbers in 1972 with a share of foreign applicants of approximately 64%, and almost 79% in 2009.

Clearly, foreign R&D in emerging economies is gaining a foothold and starts being productive. In Vernon's original model, emerging economies are now not only taking over as primary target markets at the expense of some home countries of MNCs from advanced economies, they also assume an increasingly important role in the development of products for local markets, as indicated by the rise in local R&D centers, as well as an emerging role as sources of new technology and product concepts, as suggested by the large number of patent filings as an output of pre-competitive R&D. More and more of the value chain activities that traditionally were conducted in advanced home countries as per Vernon's original product life cycle, are now being conducted in emerging economies directly.

3.2.3 What is New in Emerging Economies Innovation?

Given the might and momentum of the Western industrial R&D machinery, it is easy to overlook the blossoming of innovation in emerging economies. MNCs from advanced countries still outspend those from emerging countries by far despite a high R&D growth rate observed in the past few years for companies based in emerging economies such as China, India, and South Korea (2011 EU Industrial R&D Investment Scoreboard, see

European Commission, 2011). The same report identifies US, Europe, and Japan as the main source of top companies for R&D investment (with 35.1%, 29.0%, and 21.7%, respectively, of the world total) while emerging economies such as Korea and China are still trailing with 3.0% and 1.7%. The still predominant position of advanced countries in innovation is mirrored in the Global Innovation Index (Dutta, 2011) which shows how the traditional industry centers – the US, Europe, and Japan – are still leading the ranking. Even though China becomes more respected as a place to do science (Zhou and Leydesdorff, 2006), advanced countries also outnumber emerging countries as hosts of leading scientific institutions: 99 of the top-100 universities are located in advanced countries (mainly US and UK), only 1 in emerging countries, as per the 2011 Shanghai Jiaotong ranking (ARWU, 2011). Modern R&D is an accomplishment of Western-led industrialization.

Still, emerging economies MNCs are gaining ground with respect to global R&D. These includes well-researched firms such as Huawei, who have 29 R&D centers in countries such as the US, Germany, UK, India, Thailand and Russia, but also lesser known firms such as Goodbaby, who has set up R&D and design centers in Boston, Utrecht, Tokyo and Hong Kong – all of that besides having substantial R&D organizations inside China, of course. Satyam, an Indian firm, has R&D also in other emerging or less developed countries such as Egypt, Brazil and Malaysia (as well as other advanced countries). Sasol, a South African MNC, has global R&D in Germany, the US, UK, the Netherlands and Italy. Many of these R&D centers may be small in comparison to their home bases, but they indicate an emergence of global R&D organizations that so far were the hallmark of Western and Japanese MNCs only.

Although often questioned, patents represent the strongest proxy for measuring innovation activity (Watanabe et al, 2001). Patent statistics sometimes suggest a comparability of national innovation performance that is misleading in reality. For instance, differences in national invention subsidies, definition of acceptable novelty, or presence of alternative forms of patents (such as utility patents) can significantly distort the picture. Statistics on patents filed under the PCT agreement have a twofold function: (1) they are more suitable proxies for international comparison, as PCT patents are subject to a worldwide standardized recognition and approval process, and (2) they provide a useful proxy for global innovation. Even in this domain, emerging economies have largely increased their share of global patent applications between 1985 and 2009, although their worldwide share is still relatively small with 8.05%. Still, over the period of 25 years since

1985, with 19.76% the annual growth rate for emerging economies was much higher than that of developed countries at 13.7%. In absolute terms advanced countries are still far ahead; however, according to 2011 WIPO data, China is already the fifth largest PCT filer in the world, closely behind Korea but ahead of France and the United Kingdom.

The rise of emerging countries is not only a matter of scale, as one might estimate given the size of the two most populous countries, India and China, but also a matter of scope. WIPO data allows PCT patent applicants to be identified by organization. The top-10 PCT applicants were, well into the 2000s, either US or European multinationals. 2007 marked the first time that Japan fielded the most companies in the top-10 (Panasonic, Fujitsu, Sony), and by 2010 there were only 4 Western firms left – the rest came from Japan (3), China (2), and Korea. China had its first top-10 representative in 2001 when Biowindow Gene Development became the first top-10 PCT filer of any emerging economy, and first topped the list when Huawei was the largest filer of PCT patents in 2008.

Emerging economies MNCs have been capitalizing on their innovation performance and gaining global market share in their respective industries. The Financial Times, which ranks firms according to their market capitalization, had 112 companies from emerging economies in their top-500, three of them in the top-5, in their 2011 ranking (Financial Times, 2011). Fortune, which ranks by the amount of revenues, had 107 in the top-500 (Fortune, 2011). In 2005, those numbers were 43 and 44, respectively. China, Brazil, Russia are leading the way for other emerging economies.

3.2.4 Framing Global Innovation Flows With Emerging Economies in Mind

We are now very far from the premises of Vernon and from revised versions of the product life cycle. First, companies do not necessarily target their home country as their primary market. MNCs from smaller countries have long abandoned this practice by aiming at other large advanced market economies first (Buckley and Ghauri, 2004; Narula and Dunning, 2000). Now, however, even MNCs from large advanced countries are targeting emerging markets in countries such as China because these markets have become more important than their home markets. As a consequence, product development is not just localizing for emerging markets but often develops specifically for emerging markets as primary launch markets. Second, product development and R&D is not carried out exclusively in advanced countries but increasingly in these emerging economies directly,

to benefit from local factor conditions, and to enhance innovation for local markets. Third, products developed in and for emerging economies occasionally prove superior to competing products elsewhere, including advanced home markets, and are being reintroduced in these home markets subsequently, again in a departure from Vernon's original premise. Fourth, entrepreneurs and firms in emerging economies not only develop but also conceive product ideas based on technologies and scientific insights before MNCs from advanced countries understand and acquire them for themselves. This is the last fundamental departure from Vernon's proposition; namely that firms in advanced countries have preferential access to fundamental know-how that gave them an edge in global competition and thus led to innovation mostly in the (advanced) home country.

It is our assumption that these four departures from Vernon's premises of the global flow of innovation as captured in the product life cycle constitute the ingredients for what the literature and management practice calls "reverse". In the following chapter, we incorporate these four notions into a unified model that allows us to determine and describe what constitutes a reversal of the flow in global innovation.

3.3 A Global Model of Reverse Innovation

3.3.1 Expanding on the Notion of Reverse Innovation

The debate on reverse innovation has so far focused on the introduction of innovations from a market point of view. Govindarajan and Ramamurti (2011; p. 191) define reverse innovation as "an innovation that is adopted first in a poor country before being adopted in rich countries," and Immelt et al (2009; p. 3) explain that "...it's the opposite of the glocalization approach that many industrial goods manufacturers based in rich countries have employed for decades." In this *market-introduction based definition* of the reversal of innovation the authors justly imply that an innovation can be new to the market without necessarily being new to the world, and that it is in the perception of the customer whether an innovation is 'reverse' in the sense of having been introduced in an emerging market first before subsequently introduced in an advanced country. The successful transition of an innovation from a primary market in an emerging economy to a secondary market in an advanced country is a defining property of what the literature considers to be a reversal of the global flow of innovation.

Does the origin of an innovation matter? Thousands of R&D and innovation centers established in emerging economies over the past decade, many of which are owned and operated by MNCs from advanced countries, suggest it does (UNCTAD, 2005; Jaruzelski and Dehoff, 2008). In this *development-based definition* of the reversal of innovation, an innovation reversal is denoted by a product or service developed in an emerging economy and, at a later point of time or immediately at product launch, introduced to an advanced country. It is during the development phase of an innovation that the core architecture of a product is designed and key performance-defining features are added. In expanding the former understanding of reverse innovation with this development-based definition, we recognize the locus and the contributions of innovators in emerging economies in the crucial step in the value chain of a product, especially of products that are the result of significant investments of time, risk and effort in R&D.

By introducing a development-based interpretation of reverse innovation, we implicitly suggest the notion of a flow of innovation across different locations. That such a flow should exist is not necessarily evident but firmly established in the literature (Rogers, 1962; Vernon, 1966 and 1979). In the most simple form the flow of innovation posits that the principal locus of the innovation shifts during the innovation process while the core idea of the innovation remains essentially unchanged. We know much about the benefits and challenges of moving R&D and innovation activities apart (Allen, 1977; Leifer and Triscari, 1987; Gassmann and von Zedtwitz, 1999; Chiesa, 2000; Birkinshaw, 2002), while our understanding of the specific factors of such moves towards emerging economies is still developing (Li and Kozhikode, 2009; Christensen et al, 2010). Subsequent dispersion of a new product to usually non-collocated customers is a central economic tenet of commercial activity.

The early stages of the innovation process are commonly distinguished by the two phases of idea / concept generation and product development. The first phase is often called “Fuzzy Front End” (Smith and Reinertsen, 1991; Reinertsen, 1999) or “Front End of Innovation” (Koen et al, 2001) and includes the generation of one or more new ideas based on an opportunity or technology analysis (research), and the creation of a basic plan or concept of a product based on these ideas and an existing stock of technical and customer knowledge. This early phase is characterized by tacit (Polanyi, 1967; Nonaka and Takeuchi, 1995) and thus sticky (Szulanski, 2003; Asheim and Isaksen, 2002) knowledge, which make locational shifts costly and time intensive (Subramanian and Venkatraman, 2001). This is less the case for the subsequent development phase, which under suitable

conditions can be dispersed to take advantage of parallelization and capacity benefits (Gassmann and Zedtwitz, 2003). This second phase is concerned with transforming the product or technological concept into a product or service, and includes prototyping, system and module testing, performance tests, engineering and industrialization of the new product (Cooper, 1994; Brown and Eisenhardt, 1995).

In the context of global innovation we thus propose an *ideation-based definition* of reversal of innovation which suggests the creation of the original idea or concept in an emerging economy and its subsequent transfer to an advanced country where this concept is innovated further. The critical element in this definition is the term "subsequent" because the time lag between ideation and development can be significant and the two innovation phases would hence, by most standards, not be considered part of the same flow of innovation. Nevertheless, the possibility exists and the potential for such emerging economy originated innovations is real.

These three definitions imply, like Vernon (1966) before, four value-adding steps or innovation phases in the global flow of innovation: ideation, development, primary market introduction, secondary market introduction. Denoting "A" for advanced or developed countries (see Appendix 1) and "D" for developing or emerging economies, we have thus 16 possible global flows of innovation. Table 2 summarizes the three different definitions of reverse innovation along the flow of innovation.

	Flow of Innovation: Ideation → Development → Market(s)		
Innovation Activity	**Ideation**	**Development**	**Market-Introduction**
Prerequisite of a Reverse Innovation	Original idea of product concept or technology originated in an emerging country	Main locus of product development is an R&D unit in an emerging country	Product designed for and primary target market is an emerging country
Determinants of a Reverse Innovation	Product subsequently developed, launched or introduced in an advanced country	Product subsequently launched or introduced in an advanced country	Product subsequently introduced in an advanced country
Shorthand Notation	DAxx or DxAx or DxxA	xDAx or xDxA	xxDA

Table 2 Three types of reversals in the global flow of innovation and their associated reverse innovation.

3.3.2 A Model of Global Innovation Flows

A binary scheme maps out all 16 possible global flows of innovation, using one temporal and one spatial dimension by specifying each one of the four key innovation phases to take place primarily in either an advanced ("A") or an emerging ("D") country. This "map of global innovation flows" (see Figure 1, Table 3) also permits the conceptualization of reverse innovation as a subset of global innovation flows.

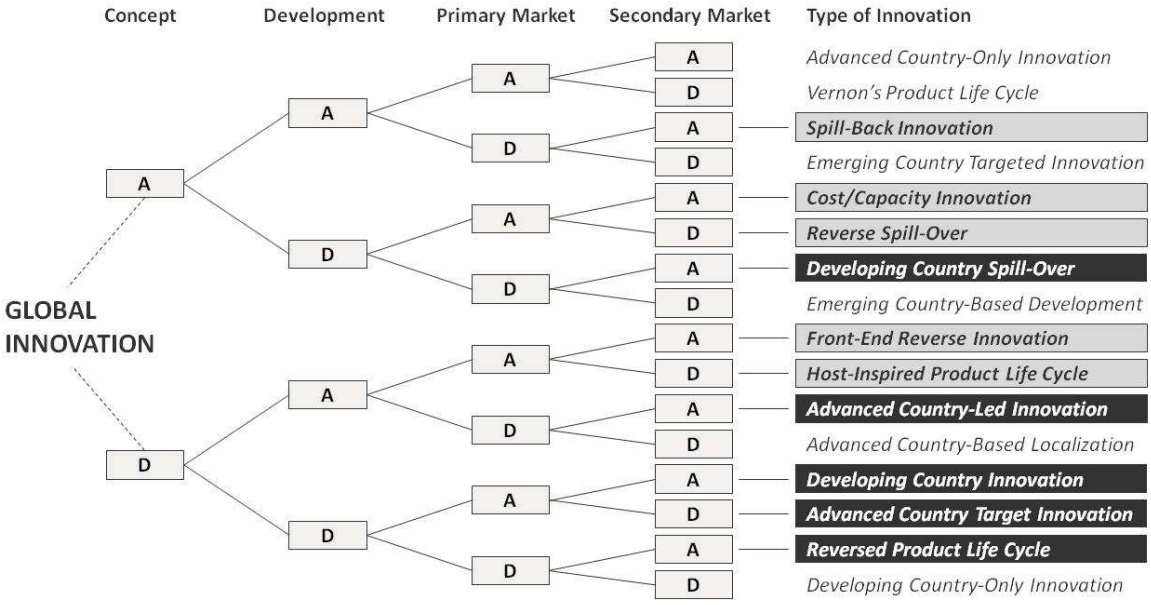

Figure 1 A map of global innovation flows. Grey-shaded innovations are reverse innovations in a weak sense, black-shaded innovations are reverse innovations in a strong sense.

We define as a *reverse innovation* any type of global innovation that, at some stage during the innovation, is characterized by a reversal of the flow of innovation from an emerging to an advanced country, and that is eventually introduced to an advanced country market. This eliminates six types of innovation from the global scheme as cases of non-reverse innovation that can be characterized as follows:

1. AAAA: This is best described as an advanced-country-only innovation without involvement of an emerging country at any stage.
2. AAAD: Like AAAA, but with the additional notion that the advanced-country-only innovation is introduced to an emerging or developing country late in its product life cycle. This is Vernon's product life cycle hypothesis.

3. AADD: An innovation entirely conceived and developed in an advanced country but targeted exclusively at developing countries. For instance, Vestergard Frandsen, a Switzerland-based company specializing in complex emergency response and disease control products aimed at helping developing world in health issues. In 2005 it developed LifeStraw®, a water filter that purifies water while drinking, for developing economies and countries hit by humanitarian and natural crisis. The ”One Laptop Per Child” project represents a similar case. Headed by MIT Professor Nicholas Negroponte, the ”One Laptop Per Child” foundation developed a low cost, low power and connected laptop to be distributed in least developed economies so that children can learn and be connected with the world.
4. ADDD: This innovation is perhaps best described as host-based localization of an advanced-country concept. For example, French carmaker PSA generated a format concept for a new luxurious car – Metropolis – whose design and industrialization was later developed in PSA's R&D facilities in China, spotted by a new local joint venture with Chang An Automotive Group. PSA's intent was to penetrate the Chinese market in its highest end-segment, leveraging on Chinese cultural peculiarities and habits and even paying attention to style differences within the country.
5. DADD: Similar to the previous type of innovation, but with the idea coming from an emerging country and the development being carried out in an advanced country before being brought back to an emerging country. This innovation covers, for instance, country-specialized products with critical technology components that so far can only be designed and developed in very few laboratories worldwide – and those labs are still in advanced couuntries. Examples are high-performance engines for China's J-20 fighter, or key technologies for India's space program.
6. DDDD: This is best described as a developing or emerging country-only innovation, without involvement of an advanced country at any stage, not even as a potential market.

We further define as *reverse innovation in the strong sense* a global innovation that is either developed in an emerging country or launched in an emerging country, and subsequently further developed or introduced in an advanced country respectively; it also has to have at least two of its innovation phases taking place in an emerging country. The

following five types of reverse innovation flows are cases of *reverse innovation in the weak sense*:

1. AADA: This case describes innovations created and developed in advanced countries targeting developing markets, but eventually reintroduced in advanced countries. Defeaturing ("reduction of number of product features") may be part of this process as long as it takes place during the product definition stage. In 1990, for instance, following its increasing presence in developing economies such as Brazil, China, Venezuela, Colombia and Hungary, Parmalat developed a new milk packaging ("Milk in a pouch") for responding to the lower power of purchase characterizing those countries. The same packaging was later introduced in advanced countries (e.g., Canada) as an environmental friendly solution. Note also that this type of innovation is included in the one used by Immelt et al (2009) and Govindarajan and Ramamurti (2011).
2. ADAA: Cost-saving factors or capacity-constraints may persuade companies to move product development to an emerging country even though the innovation is targeted at advanced country markets only. If only subsidiary features or components are developed outside the home-based R&D centers we do not speak of reverse innovation, but if the majority of the R&D effort is carried out in an emerging country and the novel product is then commercialized in an advanced country, this is clearly the sign of a reversal of the traditional innovation flow. The Chinese contract research organization Wuxi AppTech provides service to global companies in the pharmaceutical industry. Based on inputs coming from its customers, mainly located in the US, Wuxi AppTech develops technological solutions that help its customers to "shorten the time and lower the cost of drug and medical device R&D through cost-effective and efficient outsourcing solutions."
3. ADAD: This case is not unlike the ADAA innovation flow, but if the innovation is disruptive enough to be valuable and introducible also in an emerging country, it is best described as a reverse spill-over innovation. SAP provides an example of ADAD when it carries out prespecified software development in India. This software is often targeted for advanced countries, but eventually the software is also implemented in developing countries. ADAD, from a market perspective, is an example of the traditional product lifecycle; however, much of the value-added work related to the product has been carried out in developing countries, which was

the reason to expand our notion of reverse innovation by not only focusing on the flow between markets but also the flow of innovation in R&D.

4. DAAA: An innovation that has its origins in a developing country but was mostly matured and commercialized in an advanced country is hardly distinguishable from more traditional types of innovation. Because the reversal of the flow happened early in the innovation, we call it a front-end reverse innovation. If time lag did not matter, many of the old Chinese inventions could be considered for this type. Modern examples include telecom solutions by Huawei that are based on China-invented architectures but developed in overseas R&D units for overseas telecom service providers only.
5. DAAD: This emerging-country-inspired product life cycle innovation is similar to the preceding type DAAD except that ultimately the innovation is introduced back to an emerging country.

The five remaining strong reverse innovation types are:

1. ADDA: In what can be described as a developing-country spill-over innovation, products are inspired in advanced countries, but developed and initially commercialized in developing countries, and then ultimately introduced in advanced countries. An example of the pattern ADDA is represented by Nokia's development of cell phone ring tones for developing markets, which were subsequently utilized also in advanced countries. Beijing used the most mature technology platforms for the development of so-called "mass-market entry" phones, with half of Nokia's phones being designed in Beijing already. Even if those terminals were primarily targeted for the lower price segment (such as "first-timer" terminals including only voice and short messaging), they were later reintroduced in advanced markets, where some of these terminals have become absolute blockbusters, one of them even becoming the number one selling phone all over Asia and Europe.
2. DADA: This category describes a class of advanced-country-led innovations inspired in developing countries, developed in advanced countries, commercialized first in developing countries, and later in advanced countries. For example, Carel combined its learning of Chinese market stimuli with prior existing know-how and developed two new products initially targeted to Chinese market: a room terminal for humidity and temperature control and an electronic controller for bottle coolers.

#	Flow Type	Reverse Innovation in the Strong Sense	Description
1	ADDA	Developing-Country Spill-Over Innovation	Products inspired in advanced countries, developed and initially commercialized in developing countries, and then commercialized in advanced countries
2	DADA	Advanced-Country-Led Innovation	Products inspired in developing countries, developed in advanced countries, commercialized first in developing countries, and then in advanced countries
3	DDAD	Advanced-Country Target Innovation	Products inspired and developed in developing countries, commercialized first in advanced countries, and then in developing countries
4	DDAA	Developing-Country Innovation	Products inspired and developed in developing countries, and commercialized in advanced countries
5	DDDA	Reversed Product Life Cycle	Products inspired and developed in developing countries, and commercialized in advanced countries
#	Flow Type	Reverse Innovation in the Weak Sense	Description
1	AADA	Spill-Back Innovation	Products inspired and developed in advanced countries, but specifically targeting developing markets, but eventually commercialized also in advanced countries
2	ADAA	Cost/Capacity Innovation	Products inspired in advanced countries, developed in developing countries, and commercialized in advanced countries
3	ADAD	Reverse Spill-Over Innovation	Products inspired in advanced countries, developed in developing countries, initially commercialized in advanced countries, and then in developing countries
4	DAAA	Front-End Reverse Innovation	Products inspired in developing countries, but developed and commercialized in advanced countries
5	DAAD	Emerging-Country-Inspired Product Life Cycle	Products inspired in developing countries, developed and commercialized in advanced countries, and then sold in developing countries
#	Flow Type	Traditional Global Innovation Flows	Description
1	AAAA	Advanced-Country-Only Innovation	Products inspired, developed and commercialized in advanced countries
2	AAAD	Vernon's Product Life Cycle	Products inspired, developed, and initially sold in advanced countries, then sold in developing countries
3	AADD	Emerging-Country-Targeted Innovation	Products inspired and developed in advanced countries but commercialized in developing countries
4	ADDD	Emerging Country-Based Development	Products inspired in advanced countries, but developed and commercialized in developing countries
5	DADD	Advanced-Country-Based	Products inspired in developing countries, developed in advanced

		Localization	countries, and commercialized in developing countries
6	DDDD	Developing-Country-Only Innovation	Products inspired, developed and commercialized in developing countries

Table 3 Global innovation flows, with reverse innovation flows in the strong and the weak sense.

In the first case a simplification of the product and a more user friendly configuration allowed the company to shift from its traditionally exclusive B2B perspective to the penetration of the residential market in Europe. In the second case, Carel developed a new product with two additional functions. Once this product has been successfully adopted by the Chinese branch of a soft-drink producer, it was later adopted on a global basis by the same company for the same purposes, allowing energy savings up to 50% compared to the other available solutions.

3. DDAD: In this type of exclusively emerging-country developed innovation, products are primarily developed for advanced markets before ultimately reintroduced to emerging countries, usually as part of a general globalization of the product. One example is Pepsi's R&D effort to study traditional Chinese flavor, food and beverage characteristics in their Shanghai R&D center and develop new beverages based on Chinese ingredients and performance claims, such as energy-restoring tea. This tea is then to be marketed in advanced countries as a new beverage category and, subsequently, once global credibility of the new product has solidified, again in emerging markets including China, where this tea is to compete with the indigenous home-base tea rivals.
4. DDAA: This is one of the more aggressive types of reverse innovation, where a product is conceived and developed entirely in an emerging country solely for the purpose to be marketed and sold in advanced countries. Some of Huawei's high-tech products, when developed in China for global customers, are of this type. Goodbaby, a Chinese company making baby strollers and other juvenile durable goods for international advanced-country-based brand labels, uses its own designs and its own China-based R&D labs to develop new products designed for specific overseas markets only. It is occasionally also using design proposals of its global customers, relayed by its overseas design offices, which would then be better described by the ADAA innovation flow.

5. DDDA: In this reversal of the product life cycle, innovations are almost completely developed and launched in emerging countries first before subsequently introduced in advanced countries. Immelt et al (2009) provide the example of how GE Healthcare's Chinese R&D lab developed a low-cost portable ultrasound machine for the Chinese market that was later sold on US market opening new segments.

The resulting model is internally consistent inasmuch as that it is logically complete, not redundant, and non-contradictory. It is based on a distinction of advanced versus emerging countries, and while there is no unanimous definition for what constitutes membership in either of those categories, it is a mutually distinct definition. It is also based on a relatively simple and hence widely applicable linear flow of innovation from product ideation / concept development, product development, initial product launch, and subsequent secondary market introduction. This flow of innovation was integral to Vernon's development of the product life cycle hypothesis, but it is also firmly established as a key model of innovation in innovation management literature (Cooper, 1990; Trott, 1998). The argumentation that it is simplistic to map the flow of innovation in a linear pattern will ultimately revisit earlier discussions of the merit and deficiencies of the linear model of innovation. While modern concepts such as open innovation and frugal innovation were not explicitly mentioned, we are confident that they can be adequately reduced to be mapped into the typology of global innovation flows if they cross over the spatial dimension.

The primary purpose of this typology was not to develop a grand unified model of all innovation types but rather to provide a mental map of global innovation flows and our focus subset of reverse innovation. Many of the labels of the innovation flows are based on recent predominant practice in global innovation which may evolve over time and thus need renaming. Although it is practically impossible to take stock of all global innovations, it is safe to assume that some flows are less frequent than others. Whether this is a consequence of managerial practice or conceptual oversight is a topic of future research.

3.4 Discussion and Implications

3.4.1 Overall Merits of the Typology

The presented framework is an analytical model of reverse innovation: it is based not on extensive empirical research but rather on a review of existing definitions of reverse innovation, a systematic analysis of its characterizing properties, and the development of a typology that permits researchers and practitioners to identify and classify different types of reverse innovation as part of global innovation flows. It meshes two dominant strands of research: innovation in industrialized nations and innovation in emerging economies. Research that so far has been conducted separately, exemplified by the pioneering work on the globalization of R&D in industrialized countries (e.g., Ronstadt, 1978; Behrman and Fischer, 1980; Hirschey and Caves, 1981; Pavitt, 1984; Pearce, 1989; Patel and Pavitt, 1991; Cantwell, 1995; Hedge and Hicks, 2008), the more recent work on the R&D expansion of MNCs from advanced countries into emerging economies (Reddy, 1997; Sun, 2003; von Zedtwitz, 2004; Luo, 2006), research on learning from subsidiaries and R&D in emerging countries (e.g., Kuemmerle, 1997; Frost, 2001; Subramaniam and Venkatraman, 2001; Belderbos, 2003; Buckley et al, 2003; Ambos et al, 2006), and last but not least indigenous outward innovation from emerging economies (Hart and Christensen, 2002; von Zedtwitz, 2006; Luo and Tung, 2007; Zeng and Williamson, 2007; Di Minin and Zhang, 2010; Hang et al, 2010; Christensen et al, 2010; Govindarajan and Ramamurti, 2011) is coalesced into a coherent and consistent global framework.

The model also focuses on the nature of innovation as a process and weaves this notion as an integral part into the concept of reverse innovation. Research on the flow of knowledge in innovation has been extensive, starting with Allen (1977) and Katz and Allen (1982) and later e.g. Sorenson et al. (2006) on communication and knowledge sharing in R&D settings. The international dimension of such flows were added by Ghoshal and Bartlett (1988), Gupta and Govindarajan (1991) and De Meyer (1993), and later by e.g. Kuemmerle (1997), Subramanian and Venkatraman (2001), and Gertler and Levitte (2005). Hakanson and Nobel (2000 and 2001), Buckley et al (2003), and Ambos et al (2006) have addressed the reversal of such flows. Our model has expanded the notion of reverse innovation to go beyond a reintroduction of products successful in emerging markets to markets in advanced countries. Knowledge is created, codified and embodied in new products and services before launch, and our model captures the innovative value added in emerging economies (e.g., Christensen et al., 2010; Hang et al., 2010).

3.4.2 Pitfalls of Simplicity

The relative simplicity and leanness of the model allows it to be applied to a variety of themes in international business and innovation research; at the same time, the simplicity of its key dimensions permits reservations about its functional power.

Differentiating countries into "advanced" and "developing" economies is a simplification that ignores other classifications such as "newly industrialized countries (NICs) or "least developed countries" (LDCs). First, our review of pertinent literature on this topic has revealed that a multitude of definitions even just for advanced and developing countries exist (the most important proponents of such definitions are Worldbank, OECD, International Monetary Fund; furthermore, almost every author has developed his own measure for distinguishing between advanced and developing economies depending on the purpose of his research), and most of them do not consider application to the realm of innovation and R&D. Second, the model does not assume that the membership of countries is fixed to either advanced or developing countries, and future researchers may well choose a more suitable definition of advanced or developing countries relevant to their research purpose. Third, introducing a third category of countries would be not only impractical but also beside the point. For the reversal of a flow only two countries are needed, and the literature on reverse innovation so far has exclusively considered such flows from developing to advanced countries. The model may well be extended eventually by a third market dimension to accommodate research that focuses on innovation flows through more than two categories of countries.

With four distinct phases, the innovation flow is linear and gives the impression of being deterministic. As discussed earlier, we followed Vernon's (1966) outline of the product life cycle which implies a flow of innovation from its science and technology bases to product development to product launch and eventually to a secondary market. The innovation flow could have been modeled in a more refined way with more phases, but it would not have fundamentally changed the flow. The key transition points at which reversals can take place have been identified. Ideation/concept development and product development could have been combined into a single R&D stage, but at the loss of differentiation of early-stage and main-stage development, which would have made it more difficult to map some of the front-end innovations that emerging economy actors increasingly engage in. Stage-gate models are also firmly established as corporate innovation management tools and distinguish between pre-concept and post-concept

definition stages and prepare for product launch (Cooper, 2008). Immelt et al. (2009) and Govindarajan and Ramamurti (2011) as among the first proponents of reverse innovation focus on the flow from emerging to advanced countries. The four chosen phases of the innovation flow are thus a minimal representation of elementary innovation activities.

A related concern is the time that may pass between each phase of innovation. If e.g. too much time elapses between concept ideation and product development, is this technically still a flow of innovation, and as such a flow that could have been reversed? For instance, the chemical explosives later to be known as gunpowder were used in China for centuries to make firecrackers and simple bombs for use against cavalry. They were introduced to Europe in the 13th century and rather to be thrown at the enemy, they were redeployed to fire projectiles towards the enemy. By the middle of the 14th century gunpowder and canons were standard weaponry in European battlefields (Needham, 1986; Norris, 2003). Eventually, canons and guns were used as well in China. In our typology, this would be classified as a DAAD innovation – a weak reverse innovation. It is beyond the scope of this paper to compare the level of development of Europe and China in the 13th century, but at the time China was probably as developed and perhaps more advanced in certain aspects than many countries in Western Europe. Not the time that elapses between individual steps of innovation is important, it is the state in which the countries are in at the time of the flow.

Last but not least, product development can take place in multiple countries, and products can be launched in multiple markets simultaneously. The majority of NPD projects though are still conducted in one location or in one country only (and most research suggests this is the more efficient approach), and even when multiple countries are involved, the lead and the lion's share of the work usually resides in one location. Still, there will always be a few innovation cases that are truly multinational in nature and that may thus be more difficult to map into our simplified scheme. Given the multi-lateral collaboration in such innovation projects, however, they would hardly be classified as reverse innovations.

3.4.3 Ethnocentricity in Reverse Innovation

According to product life cycle theory, a product that is developed and launched in an advanced country and later (perhaps) introduced to a market in an developing country is

considered the "normal" flow of innovation; for this reason, scholars labeled the flow of innovation from a developing to an advanced country "reverse". Products developed and launched in e.g. India and subsequently introduced in the US will thus be considered cases of reverse innovation. Products developed and launched first in Singapore will not be called reverse innovations because Singapore is an advanced country (see Appendix 1). But what about Singapore in 1960? Back then, Singapore was an emerging economy itself, not unlike China or India today, and products developed and first launched in Singapore would have been classified as reverse innovations. From a Chinese point-of view, any innovation that is first launched somewhere else before it is launched in China, can rightfully also be considered a reverse innovation, because the flow of innovation is reverse from the Chinese vantage point.

We have this terminological problem because our definition of reverse innovation is ethnocentric. For instance, ADAA is a case of reverse innovation, while DADD, the mirrored flow of innovation switching advanced and emerging countries, is not. Constructing a 'fair' definition, in which reverse innovation would have indicated any change of direction in the flow of innovation, would have been inconsistent with the current understanding of the phenomenon and likely have led to confusion. It may also have necessitated a more complex model capable to map a more sophisticated rule for what is reversal of flow. We decided to stay close to the original understanding of reverse innovation and not present a model of only theoretical value with little relevance in reality. The asymmetry of the definition introduced a cultural bias that creates the expectation that reverse implies a flow from an emerging to an advanced country. Echoing an earlier point made, it is not the country itself that defines the reverse direction of the flow of innovation, it is its classification of the involved countries at the time of the flow that determines whether the innovation is reverse or not. As more and more emerging countries mature and become more like advanced countries themselves, we will expect to see less and less cases of reverse innovation – at least according to our definition.

3.4.4 Other Shortcomings and Future Research Areas

Because of the model's ambition to provide a framework with more breadth and depth in global innovation, it has to be less detailed in the description of its components. These are opportunities for future research, such as sharper characterizations of individual types

of innovation flows, identification of best practices to make reversals of innovation happen, or research on managerial context of innovation flows in each phase of global innovation. Some innovation paths or flows are underresearched and poorly described in literature so far, either because they are underrepresented in management practice or because they have not attracted enough scholarly attention. The comprehensive nature of our model allows spotting such oversights and focusing future research in new directions.

For instance, much research has been carried out on innovation in advanced countries and industrialized contexts. More research is needed on innovators – either subsidiaries of foreign MNCs or home-grown MNCs themselves – in emerging countries, their role in initiating and executing innovation, and conditions to maximize innovation benefits for both host and home of the innovation owner (see e.g. Birkinshaw and Hood, 2001). Another area of great importance for innovation is the complexity of intellectual property management related to R&D internationalization (Di Minin & Bianchi, 2011). Emerging economies usually have weak intellectual property regimes that hamper R&D and innovation processes (Zhao, 2006), and despite a constant reinforcement of their IP regimes, IP frauds are still perceived quite common (Keupp et al, 2010). Do weak regimes favor a launch in countries with strong regimes, i.e., do we have potentially reverse innovations because of poorer IPR regimes earlier in the innovation process? We expect that the presented typology will be useful in structuring such questions differently and facilitate research in the appropriate context.

3.5 Conclusions

Introducing a conceptual link in the literature between innovation research and international business, this paper outlines a reference framework which presents sixteen different types of global innovation between advanced and emerging countries, ten of which were found to be reverse innovation flows. We expand the definition of reverse innovation beyond a purely market-introduction concept by identifying two additional reversals in the flow of innovation: development-based reverse innovation and idea-based reverse innovation. The different types of reverse innovation are described by a four-phase innovation flow on the one hand, a binary distinction between advanced countries and emerging countries as the locus of the innovation activity on the other hand. The resulting framework provides researchers with consistent terminology and an analytical model to

study global innovation and R&D patterns in general and reverse innovation flows in particular.

References

Allen, Thomas J. (1977). *Managing the flow of technology: technology transfer and dissemination of technological information within the R&D organization*. Cambridge: MIT Press.

Almeida, Paul; Phene, Anupama (2004). Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation. ***Strategic Management Journal.*** 25 (8/9): 847-864.

Ambos, Tina C.; Andersson, Ulf; Birkinshaw, Julian 2010. What are the consequences of initiative-taking in multinational subsidiaries. ***Journal of International Business Studies***. 41 (7): 1099-1118.

Ambos, Tina; Ambos, Björn; Schlegelmilch, Bodo B. 2006. Learning from foreign subsidiaries: An empirical investigation of headquarters' benefits from reverse knowledge transfers. ***International Business Review.*** 15 (3): 294-312.

ARWU 2011. *Academic Ranking of World Universities 2011*. http://www.arwu.org/. Website accessed 21 December 2011.

Asheim, Bjørn; Isaksen, Arne 2002. Regional innovation systems: the integration of local 'sticky' and global 'ubiquitous' knowledge. ***Journal of Technology Transfer***. 27 (1): 77-86.

Bartlett, C.A.; Ghoshal, S. 1990. Managing innovation in the transnational corporation. In: *Managing the Global Firm*. C.A. Bartlett, Y. Doz and G. Hedlund (eds.). Routledge, London., pp. 215-255.

Behrmann, J.N.; Fischer, W.A. 1980. Transnational corporations: market orientations and R&D abroad. ***Columbia Journal of World Business***. 15 (3), 55–59.

Birkinshaw, Julian 2002. Managing internal R&D networks in global firms: what sort of knowledge is involved? ***Long Range Planning***. 35 (3): 245-267.

Birkinshaw, Julian; Hood, Neil 2001. Unleash innovation in foreign subsidiaries. ***Harvard Business Review***. May/Jun Vol 79, 3, p131-138

Birkinshaw, Julian M.; Young, Stephen; Hood, Neil 2004. Subsidiary entrepreneurship, internal and external competitive forces, and subsidiary performance. ***International Business Review***. 14 (2): 227-248.

Boutellier, R.; Gassmann, Oliver; von Zedtwitz, M. 2008. *Managing global innovation: uncovering the secrets of future competitiveness*. Heidelberg: Springer Verlag.

Bouquet, Cyril; Birkinshaw, Julian M. 2008. Weight versus Voice: how foreign subsidiaries gain the attention of headquarters. ***Academy of Management Journal***. 51 (3): 577-601.

Brown, Shona L.; Eisenhardt, Kathleen M. 1995. Product development: past research, present findings, and future directions. ***Academy of Management Review***. 20 (2): 343-378.

Brusoni, Stefano; Prencipe, Andrea; Pavitt, Keith 2001. Knowledge specialization, organizational coupling, and the boundaries of the firm: why do firms know more than they make? ***Administrative Science Quarterly.*** 46 (4): 597-621.

Buckley, Peter J.; Clegg, Jeremy; Tan, Hui 2003. The Art of Knowledge Transfer: Secondary and Reverse Transfer in China's Telecommunications Manufacturing Industry. ***Management International Review.*** 43 (2): 67-93.

Buckley, Peter J.; Ghauri, Pervez N. 2004. Globalization, economic geography and the strategy of multinational enterprises. ***Journal of International Business Studies***. 35(2): 81–98.

Cantwell, John 1995. The Globalization of Technology: What Remains of the Product Cycle Model? ***Cambridge Journal of Economics***. 19 (1): 155-174.

Chiesa, Vittorio 2000. Global R&D project management and organization: a taxonomy. ***Journal of Product Innovation Management***. 17 (5): 142-359.

Christensen, Clayton M.; Hang, Chang-Chieh; Chai, K.H.; Subramian, Annapoornina M. 2010. Editorial Managing innovation in emerging economies: an introduction to the special issue. ***IEEE Transactions on Engineering Management***. 57 (1):4-8.

Cooper, Robert G. 1990. Stage-gate systems: a new tool for managing new products. ***Business Horizons.*** May-June: 44-54.

Cooper, Robert G. 1994. Perspective: Third-generation new product processes. ***Journal of Product Innovation Management***. 11 (1): 3-14.

Cooper, Robert G. 2008. Perspective: The Stage-Gate Idea-to-Launch Process—Update, What's New, and NexGen Systems. ***Journal of Product Innovation Management***. 25 (3): 213–232.

Costa, Ionara 2005. Technological Learning, R&D and Foreign Affiliated in Brazil. In UNCTAD: *Globalisation of R&D and Developing Countries: Proceedings of the Expert Meeting*. UNCTAD: Geneva, 141-154.

De Meyer, A. 1993. Management of an international network of industrial R&D laboratories. ***R&D Management***. 23 (2): 109-120.

Di Minin, A., Bianchi, M. 2011. Safe nests in global nets: internationalization and appropriability of R&D in wireless telecom. ***Journal of International Business Studies***, 42(7): 910-934.

Di Minin, Alberto; Zhang, Jieyin 2010. An exploratory strategy on international R&D strategies of Chinese companies in Europe. ***Review of Policy Research.*** 27 (4): 433-455.

Dutta, Soumitra 2011 (ed.). *The Global Innovation Index: Accelerating Growth and Development*. Fontainbleu: INSEAD.

European Commission 2011. *The 2011 EU Industrial R&D Investment Scoreboard*. Joint Research Centre, Directorate General Research & Innovation. Luxembourg: Publication office of the European Union.

Financial Times 2011. FT Global 500 -- The Worlds Largest Companies. *http://www.ft.com/intl/reports/ft-500-2011*. Website accessed December 21st 2011.

Fortune 2011. Fortune 500 – 2011. *http://money.cnn.com/magazines/fortune/fortune500*. Website accessed December 21st 2011.

Franchini, John D.; Fink, Rachel A. 2011. Strategic solar M&A transactions: a look at Chinese dominance of the global PV market. ***North American Clean Energy***. 5 (5).

Frost, Tony S. 2001. The geographic sources of foreign subsidiaries innovations. ***Strategic Management Journal***. 22 (2): 101-123.

Frost, Tony S.; Birkinshaw, Julian M.; Ensign, Prescott C. 2002. Centers of excellence in multinational corporations. ***Strategic Management Journal***. 23 (11): 997-1015.

Frost, Tony S.; Zhou, Changhui 2005. R&D co-practice and reverse knowledge integration in multinational firms. ***Journal of International Business Studies***. 36 (6): 676-687.

Gassmann, Oliver; von Zedtwitz, Maximilian 1999. New concepts and trends in international R&D organization. ***Research Policy.*** 28 (2/3): 231-250.

Gassmann, Oliver: von Zedtwitz, Maximilian 2003. Trends and determinants of managing virtual R&D teams. ***R&D Management***. 33 (3): 243-262.

Gertler, M. S.; Levitte, Y. M. 2005. Local nodes in global networks: The geography of knowledge flows in biotechnology innovations. ***Industry and Innovation***. 12 (4): 487–507.

Ghoshal, Sumantra; Bartlett, Christopher C. 1988. Creation, adoption, and diffusion of innovations by subsidiaries of multinational corporations. ***Journal of International Business Studies***. 19 (3): 365-388.

Ghoshal, Sumantra; Nohria, Nitin 1989. Internal differentiation within multinational corporations. ***Strategic Management Journal***. 10 (4): 323–337.

Govindarajan, V.; Ramamurti, R. 2011. Reverse innovation, emerging markets, and global strategy. ***Global Strategy Journal***. 1(3-4), 191-205.

Gupta, Anil K.; Govindarajan, Vijay 1991. Knowledge flows and the structure of control within multinational corporations. ***Academy of Management Review***. 16 (4): 768–792.

Håkanson, Lars; Nobel, Robert 1993. Determinants of foreign R&D in Swedish multinationals. ***Research Policy***. 22 (5/6): 397-411.

Håkanson, Lars; Nobel, Robert 2000. Technology characteristics and reverse technology transfer. ***MIR: Management International Review***. 40 (1): 29-48.

Håkanson, Lars; Nobel, Robert 2001. Organizational characteristics and reverse technology transfer. ***MIR: Management International Review***. 41 (4): 395-420.

Hang, Chang-Chieh; Chen, Jin; Subramian, Annapoornina M. 2010. Developing disruptive products for emerging economies: lessons from Asian cases. ***Research Technology Management***. 53 (4): 21-26.

Hart, Stuart. L.; Christensen, Clayton M. 2002. The great leap. Driving innovation from the base of the pyramid. ***MIT Sloan Management Review***. 44 (1): 51-56.

Hedge, D.; Hicks, D. 2008. The maturation of global corporate R&D: Evidence from the activity of US foreign subsidiaries. ***Research Policy***. 37 (3): 390-406.

Hedlund, Gunnar 1986. The hypermodern MNC-A heterarchy? ***Human Resource Management***. 25 (1): 9-35.

Hirschey, Robert C.; Caves, Richard E. 1981. Research and transfer of technology by multinational enterprise. ***Oxford Bulletin of Economics and Statistics***. 43 (2): 115-130.

Immelt, Jeffrey R.; Govindarajan, Vijay; Trimble, Chris 2009. How GE is disrupting itself. ***Harvard Business Review.*** 87 (10): 56-65.

Jaruzelski, Barry; Dehoff, Kevin 2008. Beyond borders: the global innovation 1000. ***Strategy+Business***. 52 (Winter): 52-69.

Katz, Ralph; Allen, Thomas J. 1982. Investigating the Not Invented Here (NIH) syndrome: a look at the performance, tenure, and communication patterns of 50 R&D project groups. ***R&D Management***. 12 (1): 7-20.

Kose, M.A.; Prasad, E. (2010). *Emerging markets: Resilience and growth amid global turmoil*. Brookings Inst Pr.

Keupp, Marcus M.; Beckenbauer, Angela; Gassmann, Oliver 2010. Enforcing intellectual property rights in weak appropriability regimes: the case of de facto protection strategies in China. ***Management International Review***. 50 (1), 128-159.

Koen, Peter; Ajamian, Greg; Burkart, Robert; Clamen, Allen; Davidson, Jeffrey; D'Amore, Robb; Elkins, Claudia; Herald, Kathy; Incorvia, Michael; Johnson, Albert; Karol, Robin; Seibert, Rebecca; Slavejkov, Aleksandar; and Wagner, Klaus 2001. Providing clarity and a common language to the 'Fuzzy Front End'. ***Research Technology Management.*** 44 (2): 46-55.

Kuemmerle, Walter 1997. Building effective R&D capabilities abroad. ***Harvard Business Review.*** 75 (2): 61-70.

Leifer, Richard; Triscari, Thomas 1987. Research versus development: differences and similarities. ***IEEE Transactions on Engineering Management.*** 34 (2): 71–78.

Li, Jiatao; Kozhikode, Rajiv Krishnan 2009. Developing new innovation models: Shifts in the innovation landscapes in emerging economies and implications for global R&D management. ***Journal of International Management.*** 15 (3): 328-339.

Luo, Yadong 2006. Autonomy of foreign R&D units in an emerging market: an information processing perspective. ***Management International Review.*** 46 (3): 349-378.

Mudambi, Ram; Mudambi, Susan M.; Navarra, Pietro 2007. Global Innovation in MNCs: The Effects of Subsidiary Self-Determination and Teamwork. ***Journal of Product Innovation Management***. 24:442–455.

Narula, Rajneesh; Dunning, John 2000. Industrial development, globalization and multinational enterprises: New realities for developing countries. ***Oxford Development Studies***. 28(2): 141–167.

Needham, Joseph 1986. *Science & Civilisation in China, V:7: The Gunpowder Epic*. Cambridge University Press.

Nonaka, Ikujiro; Takeuchi, Hirotaka 1995. *The knowledge creating company: how Japanese companies create the dynamics of innovation*. New York: Oxford University Press.

Norris, John 2003. *Early Gunpowder Artillery: 1300-1600*. Marlborough: The Crowood Press.

Patel, Pari; Pavitt, Keith 1991. Large firms in the production of the world's technology – An important case of non-globalization. ***Journal of International Business Studies.*** 22 (1): 1-21.

Pavitt, Keith 1984. Sectoral patterns of technical change: towards a taxonomy and a theory. ***Research Policy***. 13 (6): 343-373.

Pearce, Robert D. 1989. *The internationalisation of research and development by multinational enterprises*. London: Macmillan.

People's Daily Online 2010. *China home to 1,200 foreign R&D centers*. March 16, 2010. Website accessed December 31, 2011.

Phene, Anupama; Almeida, Paul 2008. Innovation in multinational subsidiaries: the role of knowledge assimilation and subsidiary capabilities. ***Journal of International Business Studies***. 39: 901-919.

Polanyi, Michael 1967. *The Tacit Dimension*. New York: Doubleday Anchor.

Quan, Xiao; Chesbrough, Henry W. 2010. Hierarchical segmentation of R&D process and intellectual property protection: evidence from multinational R&D laboratories in China. ***IEEE Transactions on Engineering Management.*** 57 (1): 9-21.

Reddy, Prasada 1997. New trends in globalization of corporate R&D and implications for innovation capabilities in host countries: a survey from India. ***World Development.*** 25 (11): 1821-1837.

Reddy, Prasada 2005. R&D Related FDI in Developing Countries: Implications for Host Countries. In UNCTAD: *Globalisation of R&D and Developing Countries: Proceedings of the Expert Meeting*. Edited by UNCTAD: Geneva, 89-103

Reinertsen, Donald G. 1999. Taking the fuzziness out of the fuzzy 'front end'. ***Research Technology Management.*** *42 (6): 25-31*.

Rogers, Everett M. (1962). *The diffusion of innovations*. Glencoe: Free press.

Ronstadt, Robert C. 1978. International R&D: the establishment and evolution of research and development abroad by seven US multinational. ***Journal of International Business Studies***. 9 (1): 7-24.

Seely Brown, John; Hagel, John III 2005. Innovation blowback: disruptive management practices from Asia. ***The Mckinsey Quarterly***. 1: 34-45.

Smith, Preston G.; Reinertsen, Donald G. 1991. *Developing products in half the time*. John Wiley & Sons.

Sorenson, Olav; Rivkin, Jan W.; Fleming, Lee 2006. Complexity, networks, and knowledge flows. ***Research Policy***. 35 (7): 994-1017.

Sun, Yifei 2003. Strategic or tactical? Foreign research and development in developing countries, a case study of China. ***Asian Geographer.*** 22 (1/2): 143-167.

Subramaniam, Mohan; Venkatraman, N. 2001. Determinants of transnational new product development capability: testing the influence of transferring and deploying tacit overseas knowledge. ***Strategic Management Journal***. 22 (4): 359-378.

Szulanski, Gabriel 2003. *Sticky knowledge: barriers to knowing in the firm*. London: SAGE Publications.

Trott, Paul 1998. *Innovation management and new product development*. Essex: Pearson Professional Limited.

Tsurumi, Yoshihiro 1972. R&D Factors and Exports of Manufactured Goods from Japan. In: *The Product Life Cycle and International Trade*. Edited by Wells, Louis T. Boston: Harvard University Press. 161-189

Tsurumi, Yoshihiro 1977. *Multinational Management: Business Strategy and Government Policy*. Cambridge, M.A.: Ballinger Publishing.

UNCTAD 2005. *World Investment Report: transnational corporations and the internationalization of R&D*. New York and Geneva: United Nations Publications.

UNCTAD 2011. *World Investment Report: Non-equity modes of international production and development*. New York and Geneva: United Nations Publications.

Vernon, Raymond 1966. International Investment and International Trade in the Product Cycle. ***Quarterly Journal of Economics.*** 80(2): 190-207.

Vernon, Raymond 1979. The product cycle hypothesis in a new international environment. ***Oxford Bulletin of Economics and Statistics***. 41 (4): 255-267.

von Zedtwitz, Maximilian 2004. Managing foreign R&D laboratories in China. ***R&D Management.*** 34(4): 439-452.

von Zedtwitz, Maximilian 2005. International R&D strategies of TNCs from developing countries: the case of China. In UNCTAD: *Globalization of R&D and Developing Countries: Proceedings of the Expert Meeting*. Geneva. 117-140

Watanabe, Chihiro; Tsuji, Youichirou S.; Griffy-Brown, Charla 2001. Patent statistics: deciphering a 'real' vs a 'pseudo' proxy of innovation. ***Technovation***. 21 (12): 783-790.

Zeng, Ming; Williamson, Peter J. 2007. *Dragons at your door: how Chinese cost innovation is disrupting the rules of global competition*. Boston, MA: Harvard Business School Press.

Zhao, Minyuan 2006. Conducting R&D in countries with weak intellectual property rights protection. ***Management Science.*** 52 (8): 1185-1199.

Zhou, P., Leydesdorff, L. 2006. The emergence of China as a leading nation in science. ***Research Policy.*** 35(1): 83-104.

Chapter 4: Chinese Market as a Source of Global Innovation: Foreign MNCs' R&D Activities in China[7]

4.1 Introduction

China has gained the attention of Foreign Direct Investment (FDI) some 30 years ago. Specifically since 1978 with Deng Xiaoping's Open Door Policy. Since then, foreign multinational corporations (MNCs) have triggered internationalization processes in China that have progressively involved a large range of activities with more and more added value (OECD, 2008). Foreign Research and Development (R&D) oriented FDI in China have been considered only by a few studies (Gassman & Keupp, 2008) and, so far, a clear understanding on the dynamics that rule subsidiary evolution towards such kind of activity has been neglected. The aim of this paper is to shed light on host country factors that may affect foreign subsidiary role evolution in China and that may trigger innovative activity at corporate level.

China has been showing a stable interest towards FDI as an essential tool for developing indigenous technology development capabilities. This has being done in accordance to the win-win solution "technology for market", where foreign companies have been granted with market access in exchange of technology transfer.

In an attempt to simplify, we can read the internationalization of foreign MNCs in China since 1978 through 4 different phases. In a first phase foreign firms have delocalized part or their entire production facilities in China in order to achieve cost reduction, especially in labor intensive industries. In most cases the production was then exported back to the developed world. The motivation to invest abroad lied in the cost saving that was possible thanks to Chinese low-cost labor. In a second phase, the interest for the Chinese domestic market has grown. Foreign production facilities in China have been therefore used both for exporting products in the developed world by exploiting the cost advantage and for serving the Chinese market with a price that was accessible to a growing part of the local consumers.

In a third phase, characterized by the growing importance of China in the economic and scientific global context, MNCs have moved to China part of their R&D activities (Gassman & Han, 2004; Von Zedtwitz, 2004) responding to the main drivers of this kind

[7] This paper is single-authored by Simone Corsi. An adapted version of this chapter has been presented at the 2012 Academy of Management Annual Meeting, August 3rd-7th, Boston: USA.

of internationalization such as new markets access (Kuemmerle, 1997; Hakansson and Nobel, 1993), better communication or integration with other firm processes already delocalized in the same area (Quan and Chesbrough, 2010), access to low-cost skilled human capital (Brusoni et al, 2001). However, in this phase, R&D labs of foreign MNCs in China were restricted to the task of adapting global products to the local market. Along the maturation of a foreign market, requirements on products and processes are more challenging for foreign companies that want to sell their products there.

It is only in a fourth phase, still almost completely unexplored, that R&D activities of foreign MNCs in China gain a crucial role in the global strategy of firms. Indeed they impose themselves as interpreters of sources of innovation coming from the Chinese context. An innovation that can be exploited on global markets (Immelt et al, 2009; Govindarajan & Ramamurti, 2011).

Despite a growing importance of China as "producer" of highly qualified scientists and engineers (von Zedtwitz et al, 2007), and the emergence of Chinese MNCs that are disrupting global markets (Hang et al, 2010), the idea of the nascent giant as global innovator keeps sticking to a low-cost innovation approach. Though, incredibly high GDP and market growth rates and a fast technological catch-up, configure a Chinese competitive context where innovation can at least be stimulated, if not generated.

Trough the analysis of four case studies of foreign MNCs that have internationalized R&D activities in China, this paper contributes to a better understanding of host country factors that can trigger innovation at corporate level and boost subsidiary role evolution. The paper is organized as follows. In the next section, a literature review on R&D internationalization and foreign R&D in China is provided for introducing our research question. Then in section 3 I explain our methodology and in section 4 I present our cases. Empirical evidence is discussed in section 5 while section 6 provides conclusion and future research suggestions.

4.2 Literature Review

4.2.1 R&D Internationalization and Classic Evolution of Foreign R&D Labs

International Trade and MNC theories have widely investigated the reasons behind cross border economic relations. While classical economists have used factor endowments

and cost of production factors for explaining international trade (Smith, 1776; Ricardo, 1817; Hecksher & Ohlin, 1933), scholars focusing on MNCs' activities explored a wide range of factors affecting the decision of investing abroad (Hymer, 1976; Buckley & Casson, 1985; Vernon, 1966; Dunning, 1980; Johanson & Vahlne, 1977).

Most of these studies concentrate their attention on foreign direct investment (FDI) adopting a parent company perspective (Birkinshaw et al, 1998). FDI are mostly seen as a way to reproduce abroad firms' specific advantages, without considering subsidiaries as potential contributors to the enhancement of this competitive advantage or to the development of a new one.

Since the mid Eighties a new literature stream started considering such an approach and extensive research on subsidiary role and its evolution has lead to the development of new perspectives on MNCs' configuration, sources of their competitive advantages and factors affecting such a process. Ghoshal and Bartlett's (1990) and Gupta and Govindarajan's (1991) network models, Hedlund's (1986) heterarchy model and Ghoshal and Nohria's (1989) differentiated organization are only four of the several studies that have questioned the parent company perspective.

Scholars have investigated subsidiaries' roles in different areas such as center of excellence (Chiesa, 2000; Birkinshaw, 1998; Frost et al, 2002), strategic roles of subsidiaries (Jarillo & Martinez, 1990; Anderson et al, 2002), reverse knowledge transfer (Buckley et al, 2003; Ambos et al, 2006; Frost & Zhou, 2005), and so on.

Main factors affecting subsidiary role evolution can be summed up in three categories (Birkinshaw et al, 1998; Tavares, 2001): 1*) internal category*: related to the activity and power exercised by the parent company and sister subsidiaries; 2) *subsidiary category*: related to the endogenous forces of the subsidiary itself; 3) *external category*: related to the host environment.

R&D represents one of the most debated business areas when it comes to internationalization. Several authors have built categorization of foreign R&D labs and subsidiaries devoted to R&D that can be summarized as *efficiency seeking* (Quan & Chesbrough, 2010; Brusoni et al, 2001), *market seeking* (Kuemmerle, 1997; Håkansson & Nobel, 1993), *knowledge-resource seeking* (Pearce, 1989; Håkansson & Nobel, 1993; Chiesa, 1994). Kuemmerle's (1997) distinction between *home base exploiting* and *home base augmenting* foreign R&D centers has paved the way to a whole generation of scholars' categorizations and classifications.

While it seems valid that R&D is the last activity to be internationalized by a company, following a line drawn by more than one model such as the Product Life Cycle Theory (Vernon, 1966, 1979) or the Uppsala Model (Johansson, Vahlne, 1977), it remains unclear to which extent it can be internationalized. For example, issues connected with Intellectual Property (IP) management and appropriability of research activities (Teece, 1986) have been proposed as barriers to the internationalization of crucial R&D (Patel & Pavitt, 1991; Di Minin & Bianchi, 2011). Moreover all these studies have investigated the phenomenon of localizing R&D abroad only in a developed economy perspective. Be them of a quantitative nature using patent analysis and surveys or of a qualitative one using a case study approach, almost all of them take into consideration generation of new knowledge from investments localized in developed countries or, more specifically, in the TRIAD (USA, Europe, Japan). Adopting Kuemmerle's dichotomy of *home-base augmenting* and *home-base exploiting* R&D sites abroad, scholars have identified a classic evolution pattern of foreign R&D labs that usually shift from the exploitation of parent company knowledge into foreign markets to the exploration of new knowledge tapping into local pockets of scientific contexts once substantial subsidiary's embeddedness is reached (Asakawa, 2001; Florida, 1997). Thus the ability for the foreign R&D center to develop new knowledge strongly depends on the increasing number and intensity of technological relations that it is able to set up during its operations. Once reached this stage of maturity, reverse technology transfer (Håkanson & Nobel, 2000; 2001) or reverse knowledge transfer (Ambos et al 2006), where parent companies learn from subsidiaries, will most likely happen.

4.2.2 China as Host Country for Foreign R&D and New Product Development

Most of the studies concerning foreign subsidiaries mandate and evolution reaching the last stage of maturity (R&D) or contributions on R&D internationalization have been analyzing operations of companies from advanced economies in other advanced economies (Birkinshaw & Hood, 1997; 2000; Frost, 2001; Frost & Zhou, 2005). Yet, as mentioned above, a clear understanding on the dynamics behind the objectives and motivations of R&D internationalization is still missing.

When it comes to China R&D internationalization is even more confused. Only a few studies have considered this kind of activity in the process of going abroad (Von Zedtwitz,

2004; Gassman & Han, 2004; Gassman & Keupp, 2008; Walsh, 2007). Most of them point at China as a recipient of R&D FDI for local adaptation rather than, as other studies on developed countries found, a source for valuable knowledge transfer to the headquarters.

With respect to Kuemmerle's dichotomy, *home base exploiting* tends to be considered as the most common option for foreign companies that locate their R&D in China. In other words, the role of China as a host of foreign R&D labs that aim at conducting 'state of the art' research is still limited to a few cases and anecdotal evidence (Govindarajan & Ramamurti, 2011). The idea of a developing country is very often related to a not well developed customer base with needs that can be fulfilled by simple adaptations of Western products. In other words, despite the increasing number of both foreign and local R&D labs and the emergence of a strong patenting activity, China is rarely seen as a plausible location of specialized industry clusters (Porter, 1990; Chiesa, 1996; Cantwell & Janne, 1999) where MNCs can tap for getting access to high-value knowledge. Though it can certainly offer a vast amount of highly skilled human capital at a lower cost and competitive infrastructure as a basis for further advancement.

Another issue that might hamper R&D internationalization in China is the relatively ineffective Intellectual Property (IP) Regime. Chinese IP regime is not yet well developed enough to guarantee sufficient protection to foreign companies' technology that are thus not willing to transfer or locate crucial R&D activities there (Zhao, 2006). On the other side, some authors showed how this contingency can be overcome using different strategies (Keupp et al, 2009; Quan & Chesbrough, 2010). As a matter of fact, patent applications at the Chinese IP Office show a progressively growing innovation activity in China on both local and foreign side. In 2009 China overcame US for the number of patent applications filed by resident inventors in its country IP office. In 2010 the Chinese IP Office received a total of 293.066 patent applications filed by residents and 98.111 foreign residents, totalizing 391.177 patent applications. Respective numbers for US were 241.977 and 248.249 for a total of 490.226. In 2000, China was far behind with only 25.346 patent applications filed by residents while the US were leading with 164.795 (WIPO). Chinese innovation activity is also internationally witnessed by the large number of PCT (Patent Cooperation Treaty) applications that local companies are filing. It is also the only newly industrialized country that exhibit companies amongst the World Top PCT filers listed by WIPO, and a Chinese company (Huawei) ranked first in 2008 for the number of PCT applications.

Contributions that refer to China as a location for advanced or basic R&D have been analyzed in a few occasions but only anecdotal evidence have been collected so far (Govindarajan & Ramamurti, 2011). Gassman & Keupp (2008) stressed the importance of concentrating the attention not only on absorptive capacity (Cohen, Levinthal, 1990) of foreign companies investing in China but also on the dispersion to the whole MNC of knowledge absorbed by these companies on the Chinese market (multiplicative capacity). A growing interest towards a reverse cycle of innovation originating from China has been showed by practitioner oriented journals (Immelt et al, 2009; Zeschky et al, 2011; Hang et al, 2010). These studies explain how more and more innovation is generated in developing countries by both local and foreign firms at the expense of a decreasing importance of advanced countries as locus of idea generation or product development. This emerging trend is facilitated by a constant reduction of the technological gap between advanced and newly industrialized countries like China, the availability of highly skilled personnel and outstanding market growth rates. However a clear understanding of the factors that drive foreign MNCs towards more committed form of R&D investments in China still lacks. Furthermore, it is not clear which factors trigger an evolution of foreign MNCs' R&D labs in China from simple adaptive processes to the pursue of global technological solutions. I believe an important dimension of this phenomenon is represented by peculiarities that shape the Chinese competitive context in a unique form. Specifically I would like to address the following research question:

How host country peculiarities affect foreign MNCs' R&D activities in China?

4.3 Methodology and Data

Although case studies methodology has provided strategic management literature with valuable contributions especially in generating and testing theory (Gibbert et al, 2008), its validity as a tool for research in social sciences has been discussed and doubted by many authors from several disciplines in social sciences. Despite this it has been assessed in the last 20 years as a useful mean for researching in particular contexts. Indeed several authors have stated its usefulness in generating and testing new hypothesis and in testing and building theories (Eisenhardt, 1989).

The purpose of this paper is to provide a more comprehensive perspective about the evolutionary process of foreign R&D firms in China with particular emphasis on contextual factors that may affect R&D activities and drive them towards global products development.

This perspective is rather new to the management literature. Indeed it emerged only in the last years and mainly with a practitioner perspective. Then the explorative nature of the study and the limited population of companies that implement this strategy justifies and makes the case study research the best method for assessing the phenomenon investigated.

Data collection is particularly crucial in case studies in order to avoid narration effects and respondent bias. For this reason I collected different kinds of data through different sources.

We can identify three different phases of the data collection process. Firstly, I gathered secondary data through different sources such as companies' websites, Lexis Nexis Academic, Il Sole 24 Ore Database, One Source – Business Information, internal and miscellaneous documents (including balance sheets). Secondly, I conducted semi-structured interviews with companies' managers in the headquarters. Data collected in the first two phases have been triangulated for avoiding misinterpretation and improving the validity of data (Eisenhardt, 1989; Yin, 2003). In doing this a report based on collected information and material has been produced for each company. In order to have researcher triangulation the reports have been circulated amongst other researchers that are partner of the authors in a wider project on similar topics and they have been discussed in order to pursue a more objective reading of the data. In the third phase, we conducted on-site interviews with Chinese subsidiaries' managers in China. Collected secondary data were triangulated again with these further contributions and single case integrated reports have been produced. Reports have been circulated again amongst the 'external' researchers for triangulation and they have been sent back to companies for feedbacks and validation. Interviews were conducted face to face, in Italian for headquarter managers and in Italian or English for subsidiary ones, depending on the nationality of the interviewee. The average length of the interviews was between one and three hours and all have been taped, transcribed and sent to the interviewees for feedbacks and integrations before the redaction of companies' reports.

4.4 Cases

All cases are Italian companies that have set R&D operations and are successfully developing products and adaptations for the local market. All companies also share a strong commitment towards increasing their R&D investment in China for reinforcing local development capacity and build the foundations for a subsidiary with a role as global contributor.

4.4.1 Esaote Spa

Esaote is an Italian designer and manufacturer of medical diagnostic systems. The company operates along three main business lines - Ultrasound Diagnostic Imaging, Dedicated Magnetic Resonance, Non-Imaging Cardiology – and it also develops information technology solutions for healthcare. Its operations in China date back to 1992, when Esaote's products were sold in China through trading company based in Hong Kong. Since then, Esaote's investments in China have been driven by the growing importance of China both as market and supplying source. Forms of investments have been strongly affected by Chinese regulations and progressive opening to foreign investment in crucial industries such as healthcare. Esaote has therefore passed through an equity joint venture (JV) in 2006 and the total acquisition of the JV in 2006, officially becoming a Wholly Owned Foreign Enterprises (WOFE). Nowadays its presence is China is represented by a productive site with R&D activities and a sales office in Mainland China, a sales office in Hong Kong and a Representative Office in Beijing. The establishment of the R&D lab was decided in order to have a local design capability for adapting Esaote's portfolio to the Chinese market and supporting local production. Esaote's corporate management is now implementing a reinforcement of R&D strategies in China in lights of three main considerations that are pushing Esaote to develop technological solutions commercially exploitable also in other, more advanced, markets:

1. *Chinese market peculiarities*: ultrasound medical care in China is managed directly by physicians specifically specialized in this area, while in the rest of the world there are doctors with wider specialization such as radiology. This specialization provides companies with more informed and technology focused feedbacks from the users. Furthermore Chinese very large population offers a number of clinic cases that is not available in any other country. Thus Esaote is exploiting the

possibility to develop innovative technological solutions in environmental conditions that are not replicable elsewhere. Another area in which China represents a unique environment for developing new solutions is the application of wi-fi technologies in China to ultrasound machines, in a market where wi-fi technologies are widely diffused. Esaote is developing ultrasound machines that are able to communicate with smartphones or other similar machines through wi-fi technology. This kind of technology would allow to provide ultrasound technologies at low cost n rural areas or to be transported for temporary or home point of cares. The same technological solution would also permit to overcome the problem, especially in Europe or US, of a commonly lower medical qualification of the technician who deliver the ultrasound, by putting him in contact with qualified physicians or with best performing machines over a wi-fi connection.

2. *Chinese competition*: Esaote's most important competitors are foreign MNCs (mostly north-American and Japanese) but there are some Chinese companies that are very strong on a territorial level thanks to their embeddedness and the well-known *guanxi* system (Park & Luo, 2001). These companies are also gaining more and more visibility and market share in advanced countries. Their peculiarity is to offer low performing low cost technological solutions to the local market, and to develop updated products for advanced countries that are challenging incumbent firms. For example, a well known Chinese manufacturer of ultrasound machines is selling black and white imaging machines, which are not of any interest for incumbent firms that now work only on color machines. This will probably have an impact on incumbents' sales when this particular Chinese company will be able to develop color ultrasound machines at acceptable quality and, most probably, at a lower price. They might as well be able to develop entry level color ultrasound machines fitting the needs of a specific market segment that incumbents are not currently well serving in advanced countries. From these considerations, the need to have on site R&D capability to interpret such trends and anticipate their moves with *ad hoc* technological solutions is urgent.
3. *China's health reform*: Chinese Government is implementing a health reform of major proportions. With a $125 billion investment plan between 2009 and 2012, the Government aims at providing equal access to healthcare to all Chinese population, mixing government action and market mechanisms to support efficiency and improve quality (Yip & Hsiao, 2009). A specific part of the reform includes the

construction of 30.000 new rural hospitals, care centers or clinics across the country (Rein, 2009). These new facilities are a response to the need of a basic and functional health care system expressed by rural China. Clearly, Chinese Government's stimulus package will offer consistent market opportunities to companies that operate in health care. Though products that will be successfully commercialized are those that better address the specific needs of a resource constraint rural hospital. Thus they will have to be cheaper, more robust for facing harshest environmental conditions and simpler to use for the lack of qualified personnel. The technological and market sense of the forthcoming health care solutions in China are very well expressed in Immelt et al (2009) who show the case of technological solutions developed *in* and *for* emerging markets that are now pioneering specific segments in advanced countries. Again, the investment in Chinese R&D for Esaote is a priority in consideration of the technology and market opportunities explained above.

4.4.2 Magneti Marelli Spa

Magneti Marelli is one of the largest automotive systems suppliers with revenues in 2009 of about 4,5 billion euros. Magneti Marelli entered China in 1996 with an equity JV, but scarce results and bad management relations with the local partner pushed the company to acquire the totality of the partnership and become a WOFE. It now operates with productive and R&D facilities in three locations geographically distributed and along 4 main business lines: powertrain, exhaust systems, lighting, electronics.

I here focus on the latter unit, which is responsible for three business lines: 1) instrument clusters; 2) body vehicles; 3) navigation. Work related to the development and industrialization of these lines are carried out by a local R&D team, with the assistance of basic technologies available in the European R&D units. The Chinese R&D team grew from 10-12 individuals in 2007 to the current almost 100 (2011). This high growth rate is justified by two main reasons. First, the increasing sales volume on the local market asked for more personnel to work on customers' projects. Automotive industry is indeed characterized by a high level of customization even if the basic technology is the same. Second, certain peculiarities of the Chinese market provides Magneti Marelli with new sources of innovation for products that are not found elsewhere.

Specifically, three main conditions, two of them ascribable to Government intervention, have pushed Magneti Marelli to foster its innovative effort in China through the implementation of local projects for worldwide technological solutions:

1. *Future compulsory introduction of Tyre Pressure Monitoring System (TPMS) on passenger vehicles*: as for other, more advanced markets, state intervention that made TPMS compulsory for vehicles determined the market success of such a technology. The Chinese case represents a special situation given the relatively high price of a TPMS and the relatively low power of purchase of Chinese customers. One of Magneti Marelli's R&D labs in China has been thus forced to study new solutions to overcome this obstacle and is developing a new product which integrates TPMS Software Algorithms and Access Vehicle Systems, a smart electronic key for accessing and starting the vehicle[8]. The integration of these two functions, which is new in Magneti Marelli's global product portfolio, would be revolutionary for its cost reduction esteemed around 30% for consumer costs. This solution is globally marketable and fits Chinese market peculiarities by responding to synergies between low cost needs and government regulations.
2. *Environment*: Chinese Government is heavily supporting and promoting investments that will lead towards more environmental friendly vehicles. Company B, together with other supporting cases we are not using for this paper, is detecting interesting opportunities to this respect. While Europe and US are moving towards alternative energy vehicles at a much lower rate, China is putting forward great efforts in order to fill the technological gap and restore a China image often linked to pollution and environment concerns. Electronics developed within Magneti Marelli's R&D labs offer good intermediate solutions for energy saving control or energy management (e.g. Start & Stop System, efficient battery monitoring) and the strong pressure on environmental control received in China is reported by our interviewees as a unique context in which developing new solutions for global markets.
3. *Consumer behavior*: linked to the former context, environmental concerns in China are also providing strong incentives to innovate in navigation systems. Dynamic GPS solutions are indeed being developed for integrating vehicles

distribution and traffic information in major Chinese cities with itinerary suggestions in order to lowering fuel and energy consumption. Navigation technological solutions are strongly affected by Chinese peculiar consumer behavior which differs from European or US ones for its preference for, for example, touchscreen interfaces. This trend is mainly related to the introduction of GPS and navigation systems parallel to the large diffusion of touchscreen smartphones in China. Navigation systems in China are indeed characterized by an unusual contamination with consumerism and they thus include a number of applications much wider than the one provided in Europe or US. Once developed for Chinese market, applications can be added to products in other markets at no expenses for the company.

4.4.3 Brembo Spa

Brembo is a global leader in design and manufacturing of braking systems for high performance cars and motorcycles, as well as commercial vehicles. The company stepped into the Chinese market with a physical presence in 2000, acquiring a minority stake in a JV with a local producer. Since 2008 its stake grew to 70%, allowing the Italian company to hold the control over technology and commercial strategy. Nowadays its business lines in China are represented by three main areas of development: 1) brake calipers; 2) disc brakes; 3) drum brakes. The localization of an R&D lab in China was motivated by the increasing growth rates of the local market and the need to dynamically interact with customers, both foreign and domestic. Brembo adopted a stage strategy for new product development. Since they acquired a participation in a company, its first step was to qualitatively assess, especially from a safety point of view, products already existing in the Chinese company. Secondly they implemented a 'project review' on the same products for increasing their performance and life length. Eventually they started developing new products for local customers. For the latter step, Brembo's management identified two main areas of investment focus and global potentials:

1. *Drum brakes*: the large diffusion of this brake typology in China represents a strong dissimilarity from more advanced markets such as Europe, US, and Japan. 'Advanced' carmakers usually limit drum brakes to small capacity vehicles and trucks, and only in its *simplex* (front wheels) version. On the other side, Chinese car

manufacturers tend to privilege *duplex* (both front and rear wheels) drum brakes on a large range of vehicles. The moderate growth rates of advanced countries' automotive market does not allow Brembo to invest much on the development of new technological solutions for "low profile" segments such as those which require drum brakes. Therefore the company is using the commercial potential of Chinese market for drum brakes to develop innovative solutions that will be implemented on advanced markets later on.

2. *Environment*: as reported before, sustainability is an area of major interest for Chinese Government who is promoting investment, both local and foreign, for technologies that support environmental friendly solutions. As for Magneti Marelli, also Brembo is developing solutions that respond to the strong sustainability requirements of the Chinese market. Specifically, Brembo's Chinese subsidiary has ongoing projects that will reduce the weight of brake systems by 10% (a lower weight means lower consumption), a reduction of residual torque (no friction during no braking means also lower consumption and emissions), and an improvement on wear and disposal of components. The choice to respond to this market input with a strong local R&D presence witnesses the importance of China as global "think tank" for the development of environmental related innovations.

Brembo's strategy in China includes also the strengthen of its capacity to develop and produce disc brake systems for the local market, both for foreign and local carmakers. This has brought to a significant investment in a new foundry in Nanjing and a related plant for disc manufacturing.

4.4.4 Carel Spa

Carel is an Italian mid-sized firm operating in three main business to business industries: air-conditioning, commercial refrigeration (OEM and Retail), humidification system. The company has been operating in China since 1997 with a commercial branch located in Hong Kong and it established a productive WOFE supported by an R&D lab, firstly set for local adaptation of products developed overseas. Carel's motivations for entering Chinese market were mainly three: 1) to serve foreign companies that were already its customers; 2) to enter the Chinese domestic market; 3) to avoid that Chinese competitors would have step into the European market. At the beginning of the activities,

Carel's customers were mostly MNCs and part of these were already customers in other markets. Furthermore, even if the company set up an R&D lab, the development of new products was very limited. In order to better respond to the domestic market requirements in terms of functionality and prices, Carel realized that it would have need a more focused product development. Indeed while in the first phases the objectives of the company were focusing on the service for foreign companies that were operating in the Chinese market, in a more advanced stage of the internationalization process the aim shift to a more domestic focused work. For doing this, the company "copied" and learned from Chinese competitors local products design and product innovations in order to face a low cost challenge that characterizes Chinese domestic market. In other words, Carel's way to get similar products with a lower price for serving the Chinese market was to observe its competitors' products for understanding on what attributes of them it was necessary to focus on. The company realized later on that the development work done thanks to the Chinese R&D lab was of great value also on western markets. Chinese subsidiary's contribution concerned two products, subsequently commercialized in advanced markets:

1. *Cheap and user-friendly*: Chinese R&D lab analyzed local market requirements for electronic controllers for the air-conditioning industry and defined the characteristics of the product demanded by the Chinese customers and provided by local competitors, a controller for temperature and humidity. The inputs coming from the Chinese market provided the basis on which Carel developed a new product, relying on its existing technology platform but responding to local requests. The new design and characteristics are offered with a 25% price reduction and a more user-friendly interface that allow to be competitive on both Chinese and European markets. In the industrial European and North-American markets the new product allowed to extend Carel's customers portfolio and to enrich the offering to the previous clients. Furthermore the new product gave Carel the chance to penetrate the residential air-conditioning business in Europe and North-America. In the past this business area was not widely covered by the company because its products did not meet the usability easiness requested by residential users.
2. *Environment:* China's demand for energy, as well as the increasing cost of energy sources, are well known. On this trend Carel's Chinese subsidiary detected a need coming from the Chinese branch of one of the most important global producer and distributor of soft drinks. This big player asked Carel China to develop a solution for an electronic controller for bottle cooler that would have responded to energy

saving requirements. The aim was to save energy in a process where it represents a considerable portion of the total cost of the product. Based on its previous experience in the refrigeration and energy saving industry and relying on headquarters knowledge, in 2009 Carel developed a new technological solution. The new product has a strong energy saving attitude thanks to two alternative functions, developed in this occasion for the first time on global markets by Carel. Once this product has been adopted by the Chinese branch of the soft-drink producer, it was later on adopted on a global basis by the same company for the same purposes. This technological solution is now in Carel's product portfolio and it is offered on a global basis allowing, in accordance with customers' data in different environmental and working conditions, an up to 50% energy saving compared to the other solutions on global markets.

4.5 Discussion

All examined cases have a few comparable characteristics concerning their entry into the Chinese market. This has commonly happened as an internationalization process that seems in line, with some necessary updates on the characteristics of the stages, with the Uppsala Stage Model (Johansson & Vahlne, 1977; 2009). An increased commitment on the foreign market is pushed forward by the collection and analysis of additional knowledge and experience on the competitive context. Despite a growing knowledge and development capability within the Chinese subsidiaries, favored by the establishment of *ad hoc* R&D labs, local engineers have to rely on existing knowledge at corporate level to be able to detect technology opportunities and develop new products, even in the case of locally marketable products. Though, our companies state that China provides them with a large number of highly qualified engineers and technicians. If anything the problem is to be identified in a relatively young industrialization of the country that is not providing experience or accumulated knowledge in process or product innovation in several industries. Chinese R&D personnel hired by foreign companies has thus to be trained both in China and in European headquarters. In the latter case training periods (weeks or months) are organized by parent companies when a pool of Chinese engineers need to be focused on the development of new products whose concept stems from Chinese market inputs. This approach not only allows for an increase in Chinese personnel capabilities and

information on corporate technologies and products, it also represents a strong tool for consolidating corporate identity and reducing cultural distance in the Chinese branch. The same objective is pursued through the recruitment of Chinese personnel that grew up or spent years for studying in Europe.

Chinese subsidiaries' managers have a relatively low autonomy for starting new product development projects without the approval of the parent company. Despite this, all cases confirm the necessity to have R&D identities in China and the need to reinforce their managerial and technological capabilities for autonomously develop future products.

As to host country factors that drive the evolution of R&D investments in China, our cases allow us to identify three primary reasons behind this phenomenon: 1) *State Intervention*; 2) *Local Competition*; 3) *Local Market Peculiarities*. Chinese government action, be it for example the promotion of new rules and laws or special fiscal or FDI policies, is especially effective in creating the premises for foreign R&D to detect new product development opportunities. Despite the socialist market economy seems to share a lot of characteristics with western capitalism, Chinese Government is certainly invisibly, but strongly, handling local economy and thus affects technological paths and foreign players' strategies. While foreign companies commonly have the highest technological competence, local companies struggle for reducing the technological gap. In the meanwhile, local companies compete, generally speaking, over what they do best: low cost. They mostly provide products with a lower quality at a much lower price than western ones. This strategy proves successful in an economy where awareness on product quality or performance has still to be refined. Foreign companies' counter attack can't neglect this aspect. They thus develop locally new products that can compete with local firms. Eventually the same products (might) find market success in advanced markets. Maybe in a so far ignored segment, configuring what has be defined as low-end disruptive innovation (Christensen, 1997) or disruptive innovation from emerging economies (Hart & Christensen, 2002). Cost approach is not the only difference that leads innovation from China. Other Chinese market peculiarities can drive such a process. Cultural differences are one of them. Familiarity or diffusion of a certain technology can affect the development of complementary technologies or products as in the case of wi-fi for Esaote and Magneti Marelli. On the other side, low competence or experience related to a young industrialization can cause the effect presented for Carel: customers need simple and user-friendly products. Identified factors are summed up in Table 4.

Company	**State Intervention**	**Local Competition**	**Local Market Peculiarities**
Esaote Spa	Health Reform	Risk of erosion of global incumbents' share through low cost entry level technology	- Physicians specialized in ultrasound. - Very high number of clinic cases; - Large diffusion and familiarity with wi-fi technologies
Magneti Marelli Spa	- TPMS compulsory on all passenger vehicles; - Environmental policies	Local firms compete on low cost low quality products and customers are very price sensitive	- High number of applications for navigation systems; - touchscreen interface
Brembo Spa	Environmental policies		- Focus on drum brakes. Exploit Chinese large market as development field
Carel Spa	Environmental policies	Local firms compete over low cost and products simplicity for penetrating Western markets	- High cost of energy implies strong energy saving incentive - Need of user friendly products

Table 4 Innovation Stimuli from Chinese Market

So far, literature has mostly asserted that learning process of foreign subsidiaries in China can happen almost exclusively on cost dimensions (Zeng & Williamson, 2007). The discussion of our cases suggest us to extend such a view.

We here propose a three categories typology of products that can be originated from Chinese market stimulus:

1. *Traditional innovation*: companies, foreign and domestic, compete on the same technological and product grounds, developing innovations according to international standards and fighting over the same technological level. This is possible thanks to the fast technological catch-up that has been realized by a few emerging economies such as China and India. Typical example of this kind of innovation can be retrieved in electronics and more specifically in the case of Huawei for domestic firms (von Zedwitz, 2005).
2. *An innovation suggested by cultural distance or differences:* Chinese typical lifestyles, so different from what in the advanced world is considered as traditional, have generated an amount of market stimuli that push domestic companies (the ones that can better interpret local needs) to innovate. These innovations, developed according to needs or cultural specificities that have been

neglected until now by western MNCs, are mass marketable also in advanced countries that are eager to experience multi-cultural products and different solutions. Food & drink and packaging are typical examples.

3. *Disruptive products:* increasing knowledge of foreign MNCs on low income markets makes them able to develop locally products that, once brought to western markets, have disruptive characteristics. They have been defined in several ways such as low-end disruptive innovations (Hart & Christensen, 2002), frugal innovations (Zeschky et al, 2011), cost innovation (Zeng & Williamson, 2007), good enough products, resource-constrained innovations (Ray & Ray, 2010), etc…

We are thus far from a framework where host country affects MNCs' subsidiaries innovation activity based on its technological richness and diversity (Almeida & Phene, 2004; Phene & Almeida, 2008; Frost, 2001; Frost & Zhou, 2005). Chinese subsidiaries can instead be read as interpreters of local market characteristics whose inputs configure unique innovation sources. Context factors are thus classified as especially important in shaping subsidiaries' evolution. In order to properly exploit these inputs, subsidiaries need to be guided by parent companies through a technological evolution. A commonly intended shift of R&D activities from home base exploiting role to a more explorative oriented development objective (Asakawa, 2001; Florida, 1997) is thus confirmed. Strong technological knowledge must be hold by parent companies, but China is the right place to develop it on the basis on new market inputs once Chinese R&D labs have filled the knowledge gap.

4.6 Conclusion and Future Research

In this paper we have analyzed four cases of foreign R&D activities in China. We have seen how foreign subsidiaries' evolution in China is affected by host country. These are not determined by the possibility to tap into local knowledge or technology pockets, but rather by innovative inputs coming from local market peculiarities. We have distinguished these factors in three category: 1) *State Intervention*; 2) *Local Competition*; 3) *Local Market Peculiarities* and we have confirmed a traditional evolution path of foreign R&D activities from an exploitative to an explorative nature. The combination of corporate knowledge and technology with innovation inputs coming from Chinese market can

suggest technological paths to explore. The duty to explore gradually shifts from headquarters to subsidiary in accordance to the competence evolution path of the latter one. Based on these evidence, a taxonomy of innovation potentially originating from Chinese market inputs is provided.

We think future research should address two issues. A first one concerning Chinese FDI policies. Scholars have already draw a tentative Chinese developmental state approach (Breslin, 1996) and spillover effects of foreign R&D investments have been assessed from different perspectives (Cheung & Lin, 2004; Wei & Liu, 2006). The effects of Chinese developmental state approach on foreign MNCs at corporate level still need to be clarified from a technological point of view. Can a foresight developmental state have an effect on the perpetration of foreign MNCs' competitive advantage on a global level?

A second research stream that we think might be interesting to see addressed is a link connecting subsidiary's role evolution and disruptive innovation from emerging economies. In their work on disruptive innovation Christensen (1997) and Christensen & Raynor (2003) argue on the importance of an independent spin off company for taking advantage of innovation inputs coming from emerging markets or unserved market segments. Chinese subsidiaries of foreign MNCs can thus be seen as those independent spin off companies responsible for the development of disruptive innovations from Chinese market inputs that may have disruptive potential on global markets.

In a world in which innovative activity has been traditionally driven by market inputs (Myers & Marquis, 1969; Vernon, 1966; 1979) rather than technology push, we are inclined to think that China can play the role that originally belonged to the US market. The oriental giant can represent a strong source of inspiration and generation for new products, reversing the traditional view of industrialized countries as innovation leaders.

References

Almeida, P., Phene, A. 2004. Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation. ***Strategic Management Journal***, 25 (8/9): 847-864.

Ambos, T., Ambos, B., Schlegelmilch, B. 2006. Learning from foreign subsidiaries: An empirical investigation of headquarters' benefits from reverse knowledge transfers. ***International Business Review,*** 15(3): 294-312.

Andersson, U., Forsgren, M., Holm, U. 2002. The strategic impact of external networks: subsidiary performance and competence development in the multinational corporation. ***Strategic Management Journal,*** 23(11): 979-996.

Asakawa, K. 2001. Organizational tension in international R&D management: the case of Japanese firms. ***Research Policy,*** 30: 735-757.

Birkinshaw, J., Hood, N. 1997. An empirical study of development processes in foreign-owned subsidiaries in Canada and Scotland. ***MIR: Management International Review***, 37(4): 339-364.

Birkinshaw, J., Hood, N. 2000. Characteristics of foreign subsidiaries in industry clusters. ***Journal of International Business Studies,*** 31(1): 141-154.

Birkinshaw, J.M. 1998. Foreign owned subsidiaries and regional development: the case of Sweden. In Birkinshaw J.M., Hood N. (Eds.). ***Multinational Corporate Evolution and Subsidiary Development*****:** 268–298. London: Macmillan.

Birkinshaw, J.M., Hood, N., Jonsson, S. 1998. Building firm-specific advantages in multinational corporations: the role of subsidiary initiative. ***Strategic Management Journal***, 19(3): 221–241.

Breslin, S.G. 1996. China: developmental state or dysfunctional development?. ***Third World Quarterly,*** 17(4): 689-706.

Brusoni, S., Prencipe, A., Pavitt, K. 2001. Knowledge specialization, organizational coupling, and the boundaries of the firm: why do firms know more than they make?. ***Administrative Science Quarterly*****,** 46(4): 597-621.

Buckley, P., Clegg, J., Tan, H. 2003. The Art of Knowledge Transfer: Secondary and Reverse Transfer in China's Telecommunications Manufacturing Industry. ***Management International Review****,* 43: 67-93.

Buckley, P.J., & Casson, M. 1985. ***The Economic Analysis of the Multinational Enterprise: Selected Papers.*** London*:* Macmillan.

Cantwell, J.A., Janne, O.E.M.. 1999. Technological globalization and innovative centres: the role of corporate technological leadership and locational hierarchy. ***Research Policy***, 28(2–3): 119–144.

Cheung, K., Lin, P. 2004. Spillover effects of FDI on innovation in China: evidence from the provincial data. ***China Economic Review,*** 15(1): 25-44.

Chiesa, V. 1994. International technology development organisation: a frame work. In: Bertelé, U., Chiesa, V. (Eds.), ***La globalizzazione delle attività di ricerca e sviluppo.*** Consorzio Mip-Politecnico di Milano, October, Vol. 3.

Chiesa, V. 1996. Managing the internationalization of R&D activities. ***IEEE Transactions on Engineering Management,*** 43(1): 7-23.

Chiesa, V. 2000. Global R&D project management and organization: a taxonomy. ***Journal of Product Innovation Management,*** 17: 142-359.

Christensen, C. M. 1997. ***The innovator's dilemma: when new technologies cause great firms to fail***. Cambridge: Harvard Business Press.

Christensen, C.M., Raynor, E. M. 2003. **T*he innovator's solution: creating and sustaining successful growth.*** Cambridge: Harvard Business Press.

Cohen, W.M., Levinthal, D.A. 1990. Absorptive capacity – a new perspective on learning and innovation. ***Administrative Science Quarterly***, 35(1): 128-152.

Di Minin, A., Bianchi, M. 2011. Safe nests in global nets: internationalization and appropriability of R&D in wireless telecom. ***Journal of International Business Studies,*** 42(7): 910-934.

Dunning, J. H. 1980. Towards an eclectic theory of international production: some empirical tests. ***Journal of International Business Studies,*** 11(1):. 9-31.

Eisenhardt, K.M. 1989. Building theories from case study research, ***Academy of Management Review***, 14(4): 532-550.

Florida, R. 1997. The globalization of R&D: results of a survey of foreign-affiliated R&D laboratories in the USA. ***Research Policy,*** 26: 85-103.

Frost, T. S. 2001. The geographic sources of foreign subsidiaries innovations. ***Strategic Management Journal,*** 22 (2): 101-123.

Frost, T.S., Birkinshaw, J.M., Ensign, P.C., 2002. Centers of excellence in multinational corporations. ***Strategic Management Journal,*** 23(11): 997–1018.

Frost, T.S., Zhou, C. 2005. R&D co-practice and reverse knowledge integration in multinational firms. ***Journal of International Business Studies***, 36(6): 676-687.

Gassmann, O., Han, Z. 2004. Motivations and barriers of foreign R&D activities in China. ***R&D Management***, 34(4): 423-437.

Gassmann, O., Keupp, M.M. 2008. The internationalisation of Western firms' R&D in China. ***Int. Journal Entrepreneurship and Small Business*****,** 6(4): 536–561.

Ghoshal, S., Bartlett, C.A. 1990. The Multinational Corporation as an Interorganizational Network. ***The Academy of Management Review*****,** 15(4): 603-625.

Ghoshal, S., Nohria, N. 1989. Internal differentiation within multinational corporations. ***Strategic Management Journal*****,** 10: 323–337.

Gibbert, M., Ruigrok, W., Wicki, B. 2008. What passes as a rigorous case study?. ***Strategic Management Journal***, 29(13): 1465-1474.

Govindarajan, V.; Ramamurti, R. (2011). Reverse innovation, emerging markets, and global strategy. ***Global Strategy Journal*** 1(3-4), 191-205.

Gupta, A. K., Govindarajan, V. 1991. Knowledge flows and the structure of control within multinational corporations. ***Academy of Management Review***, 16(4): 768–792.

Håkanson, L., Nobel, L. 1993. Determinants of foreign R&D in Swedish multinationals. ***Research Policy***, 22(5/6): 397-411.

Håkanson, L., Nobel, R. 2000. Technology characteristics and reverse technology transfer. ***MIR: Management International Review***, 40 (1): 29-48.

Håkanson, L., Nobel, R. 2001. Organizational characteristics and reverse technology transfer. ***MIR: Management International Review***, 41 (4): 395-420.

Hang, C., Chen, J., Subramian, A.M. 2010. Developing disruptive products for emerging economies: lessons from Asian cases. ***Research Technology Management*****,** 53(4): 21-26.

Hart, S.L., Christensen, C.M 2002. The great leap. Driving innovation from the base of the pyramid. ***MIT Sloan Management Review***, 44(1): 51-56.

Hecksher, E., Ohlin, B. 1933. ***Interregional and International Trade,*** Cambridge: Harvard University Press.

Hedlund, H. 1986. The hypermodern MNC-A heterarchy?. ***Human Resource Management,*** 25(Spring).

Hymer, S. 1976. ***The International Operations of National Firms: a Study of Direct Foreign Investment,*** Cambridge: MIT Press.

Immelt, J.R., Govindarajan, V., Trimble, C. 2009. How GE is disrupting itself. ***Havard Business Review*****,** 87(10): 56-65.

Jarillo, J.C., Martinez, J.I. 1990. Different roles for subsidiaries: the case of multinational corporations in Spain. ***Strategic Management Journal,*** 11: 501-512.

Johanson, J., Vahlne, J. E. 1977. The internationalization process of the firm. A model of knowledge development and increasing foreign market commitments. ***Journal of International Business Studies,*** 8(1): 23-32.

Johansson, J., Vahlne, J. E. 2009. The Uppsala internationalization process model revisited: from liability of foreignness to liability of outsidership. ***Journal of International Business Studies*****,** 40(9): 1411-1431.

Keupp, M.M., Beckenbauer, A., Gassmann, O. 2009. How managers protect intellectual property rights in China using de facto strategies. ***R&D Management*****,** 39(2): 211-223.

Kuemmerle, W. 1997. Building effective R&D capabilities abroad. ***Harvard Business Review***, 75(2): 61-70.

Myers S., Marquis D. 1969. ***Successful Industrial Innovations,*** National Science Foundation Report No.69-17,G.P.O., Washington.

OECD 2008. ***Review of Innovation Policy: China****,* Paris.

Park, S. H., Luo, Y. 2001. Guanxi and organizational dynamics: organizational networking in Chinese firms. ***Strategic Management Journal,*** 22: 455-477.

Patel, P., Pavitt, K., 1991. Large firms in the production of the worlds technology – An important case of non-globalization. ***Journal of International Business Studies,*** 22(1): 1-21.

Pearce, R. D. 1989. ***The internationalization of research and development by multinational enterprises***, London: The McMillan Press Ltd.

Phene, A., Almeida, P. 2008. Innovation in multinational subsidiaries: the role of knowledge assimilation and subsidiary capabilities. ***Journal of International Business Studies***, 39: 901-919.

Porter, M. E. 1990. ***The competitive advantage of nations***, New York: Free Press.

Quan, X., Chesbrough, H.W. 2010. Hierarchical segmentation of R&D process and intellectual property protection: evidence from multinational R&D laboratories in China. ***IEEE Transactions on Engineering Management*****,** 57(1): 9-21.

Ray, P. K., Ray, S. 2010. Resource-constrained innovation for emerging economies: The case of the Indian telecommunications industry. ***IEEE Transactions on Engineering Management****,* 57(1): 144 – 156 .

Rein, S. 2009. Health-care reform, China style. ***Bloomberg Business Week,*** August 21 online (http://www.businessweek.com/globalbiz/content/aug2009/gb20090821_005732.htm)

Ricardo, D. 1817. Principles of political economy. In Sraffa, P. (Ed.) (1951), ***The Works and Correspondence of David Ricardo,*** Vol. 1, London: Cambridge University Press.

Smith, A. 1776. ***An inquiry into the nature and causes of the wealth of nations,*** *Edited by E. Cannan*, Methuen, London.

Tavares, A. 2001. Strategic Management of Multinational Networks: A Subsidiary Evolution Perspective. University of Reading Discussion Papers in *International Investment and Management*.

Teece, D. J. 1986. Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. ***Research Policy,*** 15: 285-305.

Vernon, R. 1966. International Investment and International Trade in the Product Cycle. ***Quarterly Journal of Economics***, 80(2): 190-207.

Vernon, R. 1979. The product cycle hypothesis in a new international environment. ***Oxford Bulletin of Economics and Statistics,*** 41 (4): 255-267.

Von Zedwitz, M. 2004. Managing foreign R&D laboratories in China. ***R&D Management***, 34(4): 439-452.

Von Zedtwitz, M. 2005. International R&D strategies of TNCs from developing countries: the case of China. In UNCTAD: ***Globalisation of R&D and Developing Countries: Proceedings of the Expert Meeting.*** Geneva. 117-140.

Von Zedtwitz, M., Ikeda, T., Gong, L., Carpenter, R., Hämäläinen, S. 2007. Managing foreign R&D in China. ***Research – Technology Management,*** 50(3): 19-27.

Walsh, K.A. 2007. China R&D: a high-tech field of dreams. ***Asia Pacific Business Review***, 13(3): 321-335.

Wei, Y., Liu, X. 2006. Productivity spillovers from R&D, exports and FDI in China's manufacturing industry. ***Journal of International Business Studies***, 37: 544-557.

Yin, R.K. 2003. ***Applications of case study research,*** Sage Publications

Yip, W., Hsiao, W. 2009. China's health care reform: a tentative assessment. ***China Economic Review***, 20: 613-619.

Zeng, M., Williamson P.J. 2007. ***Dragons at your door: how Chinese cost innovation is disrupting the rules of global competition.*** Boston, MA: Harvard Business School Press.

Zeschky, M., Widenmayer, B., Gassman, O. 2011. Frugal innovation in emerging markets: the case of Mettler Toledo. ***Research Technology Management,*** 54(4): 38-45.

Zhao, M. 2006. Conducting R&D in countries with weak intellectual property rights protection. ***Management Science***, 52(8): 1185-1199.

Appendix 1: Sources of Patent Applications and Classification of "Advanced" and "Emerging"

Data on patents presented in this paper are sourced from Worldbank Database - for domestic patent applications - and World Intellectual Property Organization (WIPO) - for Patent Cooperation Treaty (PCT) applications. Whenever possible data have been crosschecked with patent offices of each country. Countries are classified between *advanced* and *emerging* according to the classification of the International Monetary Fund, as listed in the table below.

Advanced Countries	**Emerging / Developing Countries**
Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong (until 1997), Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Republic of Korea, San Marino, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States of America.	Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cameroon, Chad, Chile, China, Colombia, Congo, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Democratic Republic of Congo, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, Georgia, Ghana, Grenada, Guatemala, Guinea, Haiti, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Lithuania, Madagascar, Malawi, Malaysia, Mali, Marshall Islands,

	Mauritania, Mauritius, Mexico, Mongolia, Montenegro, Morocco, Myanmar, Namibia, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Qatar, Republic of Moldova, Romania, Russian Federation, Saint Kittis and Nevis, Saint Lucia, Saint Vincent and the Grenadine, Samoa, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, South Africa, Soviet Union (until 1989), Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, TFYR of Macedonia, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, United Arab Emirates, United republic of Tanzania, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.