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Abstract: This paper discusses the opportunities and limitations that the location-specific (L) assets of the home country represent for MNEs, particularly at the early stages of internationalization. The systemic weaknesses of the home country can constrain the long-term competitiveness of its firms, and ultimately, the competitiveness of its MNEs. It is the contention of this paper that many of the emerging countries have a constrained set of L assets from which their firms are able to develop ownership-specific assets. Are their economies developing improved L assets that will promote a new generation of EMNEs? We examine data for the case of India, an economy regarded as having considerable potential to expand to knowledge-intensive sectors. At the macro level, India's performance is not different from countries of similar economic structure, and its current pockets of excellence are a reflection of its L assets. Our analysis suggests that the failure to foster and upgrade the L assets of emerging economies is likely to stunt the growth of their domestic firms, and ultimately any new MNE activity in the long-term.

Keywords: Emerging economies; India; FDI; MNEs; Knowledge infrastructure

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Introduction

The last two decades have seen a growing interest in emerging country multinational enterprises (EMNEs) which have come to wield a growing influence on the competitive dynamics of a variety of sectors. The EMNE itself is not new: the subject was the focus of a number of studies in the 1980s and 1990s (e.g., Lecraw, 1981; Lall, 1983; Tolentino, 1993; Dunning et al, 1998). However, the surge in outward foreign direct investment (OFDI) activity from developing economies since the early 1990s has again brought the subject to the forefront of international business research (e.g. UNCTAD, 2006; Van Agtmael 2007; Ramamurti and Singh 2009; Gammeltoft et al, 2010; Meyer and Thaijongrak, 2013). Some have gone so far to suggest that the rise of the EMNEs will help define a new global economic order (e.g. OECD, 2010). We take a sceptical view of such irrational exuberance, asking more modestly: is this growth of OFDI from developing countries really sustainable, given the L assets of their underlying home economies?

Whether the EMNE represents a new form of MNE with a fundamentally different *modus operandi* has promoted a rich debate[1]. This discussion has hinged upon whether EMNEs have the necessary ownership advantages (or O assets[2]) to compete with MNEs from developed

[1] For an excellent summary, see contributions to the special issue of Global Strategy Journal (2012) edited by Cuervo-Cazurra, particularly Cuervo Cazurra (2012) Hennart (2012), Narula (2012). See also contributions to Ramamurti and Cuervo-Cazurra (eds) 2014.

[2] There is some discussion in the literature as to whether the term 'assets' is more accurate than 'advantages' (Narula and Santangelo, 2012). In this paper we use the terms interchangeably.

countries, and indeed, whether -in a globalised world - EMNEs require such O assets in the first place. Some have argued that EMNEs can utilise investments abroad as a mechanism to acquire these assets through M&A, as well as through strategic alliances, arguing that internationalisation by EMNEs does not require O assets as a precondition (Mathews, 2006). Narula (2012) and Hennart (2012) have insisted that in order to augment assets through internationalisation, EMNEs must already have a threshold level of capabilities, while Ramamurti (2012) and Cuervo-Cazurra (2012) pursues the middle road, suggesting that EMNEs can do both, simultaneously building up assets while acquiring assets abroad. Indeed, there is considerable evidence to suggest that some EMNEs have invested heavily in upgrading their capabilities through R&D as well as through OFDI and strategic partnerships (e.g. Figueiredo, 2003, 2011; Awate, et al, 2012).

Much of the debate on the ownership advantages of EMNEs has revolved around how EMNEs utilize internationalization to access location-specific assets of host countries, and by so doing, access the capabilities associated with firms collocated in these countries. Relatively little has been said on how the home country contributes to the ownership advantages of EMNEs. The home country plays a central role in creating and sustaining competitive domestic firms, and by extension, its MNEs. We pursue this line of enquiry here, by examining the underlying location-specific endowments of the home country in ensuring the competitiveness of its firms.

That the competitiveness of firms from a given economy derives from the competitiveness of their home economy should be relatively uncontroversial (Cantwell, 1989; Lall, 1992; Narula, 1996, 2012). That is, the O assets of firms are a function of the economic, social, and political milieu of the location where their strategic activities are based (normally their home country), which are the location-specific (L) assets. It is well known that the home country L assets define and constrain the kind of ownership-specific (O) assets an MNE possesses. This is particularly crucial for 'new' and 'adolescent' MNEs whose initial O assets have an especially strong influence of their country of origin (Narula, 2012). Home country L assets can be both a 'push' and a 'pull' factor: weaknesses can act to accelerate internationalization, as firms seek to overcome the disadvantages of a domestic footprint (Child and Rodriguez, 2005) or institutional constraints (Witt and Lewin, 2007).

This paper discusses the opportunities and limitations that the L assets of the home country represent for MNEs, particularly at the early stages of internationalization. The systemic

weaknesses of the home country can constrain the long-term competitiveness of its firms, and ultimately, the competitiveness of its MNEs. It is the contention of this paper that many of the emerging countries have a constrained set of location-specific assets from which their firms are able to develop O assets. This ultimately means that there are a few 'pockets of excellence' from which a large percentage of the EMNEs in each country have arisen from. But can these countries sustain this growth, as the comparative advantages and market opportunities available to the earlier generation gradually dissipate? Are their economies developing new and improved L assets that will promote a new generation of EMNEs? We examine data for the case of India, which is often touted as the economy with the greatest potential to enter more knowledge-intensive sectors. At the macro level, India's performance is not different from countries of similar economic structure and development, and its pockets of excellence are a reflection of its L assets. Our analysis suggests that – if India is indeed a good exemplar - the failure of most emerging economies to foster and upgrade their L assets is likely to stunt the growth of their domestic firms, and ultimately any new MNE activity in the long-term.

The EMNE debate and the home country

The emergence of EMNEs and their growing global footprint has generated much debate in academia, resulting in various theoretical views on the topic. The traditional school of thought builds on the ownership-location-internalization (OLI) paradigm (Dunning, 1979, 1980, 1988) and asserts that the OLI framework can explain internationalization by EMNEs (Dunning et al, 1998; Dunning, 2006; Narula, 2012). This perspective argues that EMNEs – like all MNEs - have O assets, and internationalize in much the same way as 'conventional' developed country MNEs, with any differences reflecting their early stage of internationalization and the different initial conditions, largely associated with their home economy. Their capabilities are a function of their own investments in formal and informal R&D, both at home and abroad, as well as their engagement with the knowledge infrastructure in these various locations.

Other researchers have argued that EMNEs are a new phenomenon which require new theories (e.g. Mathews, 2006; Luo and Tung, 2007; Guillen and Garcia-Canal, 2009). Most importantly, they discount the importance of O assets, proposing instead that OFDI can be a means to acquire assets. Mathews (2006) proposed the linkage, leverage and learning (LLL)

model to explain internationalization of EMNEs. The model explains that EMNEs are globally oriented, forming links with incumbent firms and upgrading capabilities through learning. Luo and Tung (2007) advocated the springboard perspective in which EMNEs use internationalization as a springboard to avoid market and institutional weaknesses in their home country, to obtain strategic assets, and to overcome their competitive disadvantages. Guillen and Garcia-Canal (2009) assert that EMNEs follow an accelerated internationalization behavior, and their limited international presence enabled them to adopt an organizational structure and strategy that is appropriate for the current global business environment. Although these researchers argue that EMNEs can obtain O assets by acquiring firms in advanced countries (e.g. Mathews, 2006; Luo and Tung, 2007; Madhok and Keyhani, 2012), there is simply no evidence that the requisite recombinative capabilities to integrate acquisitions into their existing operations are widely available (Hennart, 2012). Moreover, firms embed themselves in host countries only gradually as suggested by the Uppsala model of internationalization.

Ramamurti and his various associates have proposed a 'middle road', arguing that the study of EMNEs simply requires an extension of existing theories. Ramamurti (2009) argues that while EMNEs possess some level of O assets, these are different from the ones possessed by conventional MNEs. They also follow particular paths of internationalization which are influenced by the home country of the firms and the context of their international expansion. This perspective holds that conventional MNEs have had a higher reliance on country-specific assets. EMNEs, on the other hand, seek to overcome home country bottlenecks, overcoming limitations in 'traditional' O assets through asset-augmentation by internationalization (Cuervo-Cazurra, 2012; Ramamurti, 2012).

All these views take a minimalist approach to the home country, implying that EMNEs are unlike 'conventional' MNEs, for whom internationalisation depending significantly on the home country. Following Narula (2012), we argue that this is not the case: the home country plays a significant role in constraining and defining the kind of assets an MNE possesses, and provide the initial conditions for its international expansion, regardless of the nationality of the MNE. These 'initial conditions' are the L assets of a country. There are inevitable differences in the L assets between home countries, because countries have different resource endowments, innovation systems and political economies, and as such there are differences in the economic structure of different home countries, and by extension, the sectors in which they develop competitive firms.

Economic development of any given nation and the growth of its firm sector co-evolve, meaning that lesser developed economies tend to have a smaller and less competitive firm sector. By extension, such an economy will have fewer firms that possess O assets which will permit them to engage in viable outward *direct* investment, and many of the competitive advantages of domestic firms will be location-bound. Countries demonstrate a broadly similar economic structure (and set of L assets) at different levels of economic development, and also a similar degree of competitiveness of their domestic economic actors (and therefore its MNEs), given exogenous limitations due to their resource constraints or abundance (Dunning, 1981; Narula, 1996; Narula and Dunning, 2000, 2010).

Countries evolve as they grow, with a consequent upgrading of L assets. Broadly speaking, there is a movement away from labour- and natural resource-intensive activity towards capital-intensive activity, and later to more knowledge-intensive activity (Dunning and Narula, 1996). A country's comparative advantages and the competitive advantages of its firms show a high degree of interdependence. Strong initial comparative advantages biases a country's economic structure towards industries, and thereby firms that utilise this initial advantage in future periods. Firms tend to embark on a path of knowledge accumulation within the envelope of these L assets, and shape a distinct profile of national technological specialization (Cantwell 1989). The O assets of nascent MNEs – which are the progeny of the more competitive domestic firms from these environments – therefore continue to reflect the home country innovation systems, and industrial structure and specialization (Narula, 1996, 2003). The O assets of firms in any given period tend to be a function of the home country's L assets, but only when these L assets are internalised (Narula, 2012).

[Insert Figure 1 here]

The point we are making in this paper is that on the one hand, the initial O assets of MNEs are based on home country-specific advantages. These in turn reflects the home country's comparative advantages such as the availability of natural resources or low-cost labour (Rugman, 2009), or through government support in the form of subsidies or privileged access to finance (e.g. Buckley et al, 2007). On the other hand, they internationalize to escape the weaknesses of their home country such as 'institutional voids' (Khanna and Palepu, 1997) by moving to countries with better institutions (e.g. Witt and Lewin, 2007; Cuervo-Cazurra and Genc, 2008), or seek knowledge assets associated with location-bound assets of other countries. The balance between O assets that derive from the home and host country shifts

with increasing internationalization. MNEs with greater international experience can become multiply embedded within both the host and the home country innovation systems and socio-economic milieu (Meyer et al, 2011), but the influence of the home country continues to persist and remains non-negligible even for conventional, highly globalised MNEs. As the work pioneered by Rugman and Verbeke (2004) has shown, many MNEs continue to show a strong bias towards their home regions.

Innovation systems and innovative firms: the underlying logic of location assets

Countries evolve over time: comparative advantages shift, and the kinds of L assets available to firms also evolves. Sustaining competitiveness requires upgrading O assets which in turn is dependent on innovation, and this requires research and development (R&D) and a supportive external environment of the firm. Firms have to continuously innovate and upgrade their capabilities to avoid falling behind competitors, and countries have to continuously invest in upgrading their technological infrastructure. Investment in R&D provides new knowledge for the firm as well as the absorptive capacity required to acquire, assimilate, adapt, and apply new and external knowledge. Absorptive capacity is developed as a by-product of the firm's own R&D (Cohen and Levinthal, 1990), as well as its supportive external environment (Caloghirou et al, 2004), which are the L assets.

The competitiveness of firms derives from their ability to leverage, develop and upgrade their knowledge assets, which presumes a certain extent of formal and informal innovation activities. While innovation is utilised and internalised at the firm level, firms exist as part of 'systems'. Firms are embedded through historical, social and economic ties to other actors in their home country (Narula, 2003, 2014). The external environment involves broader factors that shape the behaviour of firms: the social and cultural context; the institutional and organisational framework; physical infrastructure; and innovation systems which create and distribute scientific knowledge (Verbeke, 2009).

The generally accepted view in the IB and economic geography literature is that the technological competences of firms tend to be associated with specific locations, and that these are geographically constrained. Innovative activities are associated with specific location-bound assets, which are often associated with the knowledge infrastructure of that location, and, tend to be spatially concentrated (Asheim and Gertler, 2005; Iammarino and McCann, 2006). Knowledge spillovers tend to be more intense between parties that are located close to each other in space (e.g., Maurseth and Verspagen, 2002). A systems view

builds around the important principle that knowledge diffusion between actors in geographical proximity foster innovation. Proximity, of course, matters differently for different aspects of value-adding activity (Alcacer, 2006). Likewise, L assets (and the importance of collocation) matters differently for different industries, and depending upon a variety of factors, the need for proximity causes agglomerations or clusters. Note that not all clusters require the same degree of geographical concentration, meaning that they may exist over a relatively large geographical area. The concept of clusters in innovation has been fleshed out by Iammarino and McCann (2006), who classify three types of clusters depending on the nature of innovation processes and structural conditions under which technical change occurs across space. First there are clusters that pure agglomerations, based on diversity externalities where knowledge is explicit and codified. The second type is industrial complexes, where cumulative learning derives from other cluster firms of the same or related industry, and relies on non-transferable knowledge. Third, there are social networks, where technological opportunities may derive from firms and industries that are not necessarily collocated.

Emerging economies tend to have a comparative advantage in sectors that rely on low cost inputs (including labour) and economies of scale. They also tend to be in sub-sectors that sectors are some distance away from the frontier, which are themselves often oligopolistic in nature. In oligopolistic industries (as opposed to industries with a competitive market structure), loss to rivals is perceived as costly, and the private good aspect of knowledge is more important than the public good aspect (Iammarino and McCann, 2006). Thus clustering is balanced by the need to have access to scarce knowledge infrastructure and the need to limit unintended knowledge outflows (Narula and Santangelo, 2012).

Emerging economy firms engaged in R&D– not unlike firms of other nationalities - often locate themselves to take advantage of a specific scientific specialization of a university or public research establishment, or to exploit spillovers from other firms in the same industry. The number of specialized institutions in a given scientific field are finite (and especially so in developing countries), so even where a technological leader would prefer to avoid spatial proximity with its less-able rivals, it cannot prevent these firms from collocating in order to establish embedded relationships with these institutions. Thus, the decision to embed locally in order to access local complementary knowledge depends on entry motivations and firms capabilities since such a decision may bring about risks of unintended knowledge spillovers (Perri et al, 2011; Santangelo, 2012). Joining such clusters is also about access to ‘private

clubs' and the informal institutions associated with these. This ties into the idea propagated by Marshall (1920) about successful agglomerations - something that is 'in the air', a stock of knowledge that is only available to members with a particular location-specific absorptive capacity by virtue of their constant interaction.

By virtue of the limited knowledge infrastructure in most emerging economies, there tends to be a concentration of internationally competitive parent firms of EMNEs in just a few industries. In other words, the tendency to be engaged in oligopolistic sectors that are human-capital intensive and rely on scale economies, combined with a few 'pockets of excellence' in the knowledge infrastructure (which are locationally bound), there is a tendency for clusters to exist around these sectors which themselves tend to be geographically concentrated.

It is thus fairly reasonable to expect that only countries with strong L assets will foster internationally competitive domestic firms in the same (or related) sectors, and by examining the relative strengths and weaknesses of L assets we can identify areas of competence or potential competence (and internationally competitive MNEs). Conversely, weaknesses in the knowledge infrastructure can also indicate industrial sectors where domestic firms will be weak, and are likely to venture overseas to exploit the knowledge infrastructure of host locations.

L assets can be divided into three broad categories (figure 1):

1. There are L assets that can be described as basic infrastructure because they are in principle public goods, and are available to all firms at marginal cost. Examples include unskilled human capital, health care, utilities, telecoms, ports, public transport etc. The efficient provision of basic infrastructure has a positive influence on the cost structure and productivity of firms operating in a location. If infrastructure services are not publicly provided, firms seek to create their own private networks, leading to wastage of resources and duplication, thereby affecting their efficiency (Erenberg, 1993). In this paper we classify unskilled human capital as a 'basic' L asset, distinguishing it from skilled human capital which falls into the next category.

2. The second category of L assets is knowledge infrastructure which consists of public research institutes, universities, organisations for standards, intellectual property protection, etc. that enables and promotes science and technology development (Smith, 1997). Knowledge infrastructure is synonymous with what can be usefully described as the 'non-firm sector', because it is not driven by a rent motive (Narula,

2002). Such L assets play an important role in promoting the innovatory and absorptive capacity of firms. They also act as a mechanism to "direct" technology strategy and as a mechanism to implement industrial and innovation policy. Progress towards more knowledge-intensive manufacturing and service activities crucially depends on the existence of knowledge infrastructure. Knowledge infrastructure has the unusual characteristic that it is often not a purely public good, but a quasi-public good. They are available differentially to different players, either because of government policy, or because they are controlled by a group of incumbents. In short they are not freely available, and may not be used by others without (some) detriment to their value. This knowledge may be available to incumbents (whether domestic or foreign), by virtue of their existing activities on that location, and acquired through experience.

Quasi-public goods imply exclusive access, but in the case of developing countries which are resource-constrained, when a certain set of assets is in limited supply, those with access to them may not wish to compete with others through markets for this access, thereby creating barriers to entry. That is, L assets can move from the public to the private domain (i.e., they are internalised by specific economic actors), and they are no longer L assets but constitute O assets.

In addition to L assets that derive from the non-firm sector, knowledge infrastructure also needs to include inward FDI. Foreign-owned affiliates engaged in knowledge intensive activities generate spillovers that are in principle also L assets because they are potentially available to all firms in the same location. Thus, collocation with foreign affiliates has potential knowledge externalities for domestic firms (Criscuolo and Narula, 2008; Narula and Santangelo, 2012). Foreign MNEs are likely to establish local operations in sectors where the L assets are strongest, and in so doing further reinforce the L assets available in a given location. Such

3. The third category of L assets is <u>institutions</u>. The interactions between the various actors within an economy are governed by institutions. They are the 'glue' that binds the various actors together, and determine the efficacy of their interaction (or lack thereof). Institutions are taken here to be of two types, informal and formal, and are generally understood as 'sets of common habits, routines, established practises, rules, or laws that regulate the interaction between individuals and groups' (Edquist and

Johnson, 1997). In essence, institutions underlay the cumulative causation of all elements within a system in the sense proposed by Myrdal (1957). Institutions are associated with public goods, but are not exclusively so, and therefore classified separately in this paper.

Government policies are an essential component of institutions, and include the appropriate intellectual property rights regime, competition policy, the creation of technical standards, taxation, the establishment of incentives and subsidies for innovation, etc. Government policies also foster informal institutions, for example, by encouraging firms and individuals to collaborate, or by promoting entrepreneurial spirit and good governance (Narula, 2014).

In the following sections we examine the strengths and weaknesses of India's L assets within these three categories. The technological activities undertaken by firms in a location reflect the level of technological advancement in that location, and the specialization of firms and their competitiveness is reflected in the specialization and areas of competitiveness of the home country. In other words, the specialization of a country's firms can be identified by examining the specialization at the aggregate level.

Can EMNE activity continue to grow?

OFDI flows from developing countries has been increasing since the 1970s, but it has increased considerably faster since the 1990s as a result of pro-market reforms in many developing countries, and amounted to $426 billion in 2012, which represented a compound annual growth rate of 15% over 20 years. Global FDI growth has a corresponding rate of 10% over the same period. The share of the developing countries in the global outward FDI stock has been increasing, and in 2012 stood at 19% (UNCTAD, 2013). This share includes the Asian NICs, which for all intents and purposes, are wrongly classified as developing countries. In the absence of the NICs, the developing country share stood at just 9% in 2012, a more modest increase. Indeed, when the tax haven economies of the Caribbean are also excluded, the share of the developing countries has shown no appreciable increase *in terms of their share* in the global total. When the BRICS countries' FDI is examined in terms of their share of the total, this can be seen to have a much more modest growth, as shown in Figure 2.

[Insert Figure 2 here]

A small number of developing countries from Asia and Latin America account for much of this OFDI stock. EMNEs have been using M&A as an important mode of entry into foreign markets and therefore cross-border M&A data provides additional evidence on the growth of OFDI from developing countries. The number of cross-border M&A deals by EMNEs increased from 108 in 1990 to more than 1000 in 2012, and majority of the deals by EMNEs were in other developing countries (UNCTAD, 2013).

India as an exemplar: trends in EMNE activity from India

Like other developing countries, OFDI flow from India has been witnessing a drastic drop in the last five years. Indian OFDI flows amounted to $8.5 billion in 2012 which is a significant decrease from the peak of $21 billion it reached in 2008 (UNCTAD, 2013). Moreover, India's share in total global OFDI stock has remained almost constant in the last five years while China has almost doubled its share. In 2008, Indian OFDI stock accounted for 0.4% of global OFDI stock while China contributed 1.1%. By 2012, India increased its share slightly to 0.5% while China almost doubled its share in global OFDI stock to 2.1% (Figure 2). Major outward investor countries such as Brazil, Russia and Mexico also have a higher share of global OFDI stock than India.

The acquisitions made by Indian MNEs were spread across various industries, but concentrated in a few pockets of excellence, with pharmaceutical, software, and machinery and equipment accounting for majority of M&A deals. During 2001-2012, these three industries accounted for almost 67% of the more than 1100 overseas acquisitions by Indian MNEs (Chittoor and Jana, 2013). An important feature of internationalisation by Indian MNEs is the prominence of business group-affiliated companies. Indeed, a majority of the top Indian MNEs belong to business groups such as Tata, Birla and Ambani, as shown in Table 1.

[Insert Table 1 here]

Evaluating India's innovation activity

Examining India's aggregate expenditures on R&D gives a good indication of its competitiveness. India's R&D intensity was 0.7% in 2010 which was lower than countries like China (1.7%), Brazil (1.2%), Russia (1.2%), and much lower than developed countries (UNESCO, 2012). India's R&D intensity has remained almost constant in the last two

decades, while other major developing countries have increased their spending significantly. For instance, China's R&D intensity increased from 0.5% in 1996 to 1.0% in 2002, and 1.7% in 2010. India's per capita R&D expenditure was also much lower than major developing and developed countries. In 2007, India's per capita R&D expenditure was $20.7 while that of China and Brazil were more than 5 times, and Russia's 11 times more than India (UNESCO, 2012).

The R&D intensity of Indian-based firms and the benchmark international R&D intensity in various sectors are given in Table 2. The four highest R&D intensities for India were in pharmaceuticals, chemicals, food products, and motor vehicles. With the exception of food products, no Indian sector comes close to the global R&D intensity. Pharmaceutical sector may have had the highest R&D intensity among Indian companies, but this was still half of its counterparts in the rest of the world (Table 2).

[Insert Table 2 here]

R&D intensity of the largest Indian R&D spenders in 2011 is given in Table 3, but even here, the highest R&D intensity was 7.3% (in the pharmaceutical sector). Infosys was the highest R&D spender in absolute terms in India in 2011 (but with a R&D intensity of just 5.3%). Indian companies in the oil and gas, and iron and steel industries also had high R&D expenditures but had lower R&D intensities than their international counterparts located elsewhere.

[Insert Table 3 here]

Another indicator of the technological capabilities of a location is the patents its firms receive. At the aggregate level, during 2008-2012 the US Patents and Trademarks Office granted 5336 patents to Indian assignees (USPTO, 2013). In terms of sectors, information technology (IT), software, electronics, pharmaceutical and engineering held more than 85% of patents. Table 4 gives details of patents granted to firms based in India between 2008 and 2012, and suggests that 3450 US patents granted were to 91 subsidiaries of foreign MNEs. That is, 77% of all patents granted were to foreign firms. Just 45 Indian firms accounted for 688 patents over the same period, and 90% of patents to private firms were in two sectors: pharmaceuticals and IT/software. The non-firm sector in India accounted for the remaining 334 patents. The patent data for Indian companies indicate that they had not fully leveraged India's location advantages for R&D while foreign multinationals had.

[Insert Table 4 here]

The data suggests that a small group of firms (domestic and foreign) control a disproportionately large share of R&D activity. Estimates are that close to 60% of expenditures in R&D were made by large Indian business groups, 15% by SOEs, and 10% by MNEs (NISTADS, 2008). The following industrial sectors accounted for the majority of R&D expenditures (in order of significance): pharmaceuticals, transportation equipment, defence, electrical and electronic equipment, chemicals, fuels, and IT and software (NISTADS, 2008). These are the same sectors (with the exception of defence) in which India's OFDI is concentrated. Indeed, of the more than 1100 M&As by Indian firms during 2001-2012, the majority were by software and business service companies, and pharmaceutical and chemical companies. In other words, *the sectors with higher levels of R&D and patenting are also the sectors which have internationalized the most.*

The data reviewed in this section make clear that only a few industries in India are internationally competitive, with the commensurate innovation capabilities to sustain this. These industries have higher R&D intensity and patenting levels than others, leading to the creation of 'pockets of excellence'. Most of the rapidly internationalizing Indian MNEs of the last two decades are concentrated in these sectors.

Examining India's location-specific assets

Basic infrastructure bottlenecks

Good infrastructure leads to increase in productivity and decrease in production costs, but it needs to expand fast enough to respond to economic growth, which is especially significant for developing economies. In India, physical infrastructure has failed to expand in response to the rapid economic growth of the last two decades. For instance, during the Eleventh Five-Year Plan period (2007-2012), in spite of the creation of new generation capacity there was still an energy shortage of 8.7% as of 2012 (Ministry of Finance, 2013). More than 40% of firms had invested in private generators due to frequent power blackouts and brownouts (World Bank, 2006). In addition to the widening gap between energy demand and supply, electric power transmission and distribution losses are considerable. As shown in Table 5, the value lost through electrical outages remains very high in India compared to other major developing countries.

[Insert Table 5 here]

Along with energy, transportation forms an important component of physical infrastructure. Transport infrastructure is considered to have great impact on the 'supply chain capability' of a country, given that firms are intricately linked to a variety of customers and suppliers, and the efficiency with which intermediates and other inputs for the focal organization can be delivered (Alam and Bagchi, 2011). It has a pronounced effect on the efficiency and competitiveness of firms operating in that location.

Although India has one of the largest rail networks in the world, it has consistently underinvested in upgrading its network. Between 1950 and 2010, the size of the network grew at a compound annual growth rate (CAGR) of 3%, while freight and passenger traffic grew at a CAGR of 54%, leading to oversaturation of the rail network (Deloitte, 2012). Although India had a larger network than China in 1990, China made significant investments[3] in its railway infrastructure over the last two decades, and by 2011 the total route length in China exceeded India's (Table 5). In addition to the lack of investment in infrastructure, transit times for freight in India are long and uncertain. For instance, a freight train takes as much as 6-8 days to travel a distance of 2000 kilometres (Deloitte, 2012).

61% of cargo is moved by road in India compared to 37% in the US and 22% in China. However, the percentage of paved roads in India is lower than countries like China, Russia, Indonesia, and the developed world (Table 5). In addition to the inadequate road network and poor quality of roads, transit times are also long. For instance, according to a study by Transport Corporation of India, a 2150 kilometre journey between Kolkata and Mumbai trucks typically have to stop for as much as 32 hours at various checkpoints at 26 different locations, taking up to 8 days to cover the distance (Economist, 2006). In addition to railways and roads, other modes of transport also suffer from several issues. For example, the average turnaround time for ships in an Indian port is more than double the turnaround time in ports in Colombo, Singapore, Hong Kong and Rotterdam (Deloitte, 2012).

Telecommunication also forms an integral part of the physical infrastructure in a country. Growth effects are considered to be significantly higher in countries where telecommunication infrastructure has reached universal service (Roller and Waverman, 2001). For instance, a 10% increase in broadband penetration increases per capita income

[3] China spent $8.8 billion on railway infrastructure construction in the first quarter of 2013 (Wall Street Journal, 2013).

growth by 0.9-1.5% (Czernich et al, 2011). Although India is one of the fastest growing telecom markets in the world, it lags behind other developing countries in terms of broadband penetration. Just 1% of India's population has broadband access compared to 11.6% in China, 8.5% in Brazil, and 13.1% in Russia. Overall internet penetration in India is 11.4% of total population which is one of the lowest among developing countries.

Knowledge infrastructure bottlenecks

Knowledge spillovers generated by innovative and technological activities often stay within the location in which knowledge was originally created, leading to regions of specialization. In the absence of a strong knowledge infrastructure, spillovers may be lost. The main function of the knowledge infrastructure is production and diffusion of knowledge, protection of knowledge through regulation and standards, and creating skilled workforce through education and training (Smith, 1997).

The single most important constituent of knowledge infrastructure in any location is skilled human capital. One channel through which human capital affects economic growth is by facilitating the adoption of new technology (e.g. Nelson and Phelps, 1966; Acemoglu, 2003; Caselli and Coleman, 2006). Human capital is an important source of competitive advantage for firms because knowledge is acquired and used by the people in an organization, both collectively and individually.

As Table 6 shows, the number of researchers in R&D per million people in 2009 was 863.2 in China, 703.7 in Brazil, 3092.3 in Russia, 1091.2 in Argentina, while there were only 135.8 researchers per million people in India. The gap between India and developed countries is much wider. Similarly, only 13.1% of total researchers in India have advanced research qualifications such as PhD's (Table 6).

[Insert Table 6 here]

India's output of doctorates in science and engineering (S&E) is possibly insufficient to meet both current and future demand. Most IITs, India's top-tier technical universities have on average almost half their academic positions vacant[4]. Herstatt et al (2008) suggest that the shortfall in qualified PhD-level teaching positions in India was in the range of 40,000. It is worth noting that between 2006 and 2009, there were 8266 Indian recipients of US

[4] Times of India. March 30, 2013.

doctorates, of whom 88% indicated they had plans to stay on in the US. This suggests a rather large (and possibly permanent) brain drain (NSF, 2012). Contrast this with the fact that Indian universities produced fewer than 8000 S&E doctorates in 2006, the most recent year for which data is available (NSF, 2012). This is significantly lower than China, which produces three times as many S&E PhDs.

This lack of academic staff amongst universities has implications for the expansion of university education to meet growing demand for S&E graduates. Although India produces more than half a million S&E graduates every year, a study suggests that in 2011 only 17.5% of the engineers were employable in the IT support services sector, while a mere 2.7% of engineers are employable by information technology product companies which require high levels of knowledge of algorithms and computer science (Aspiring Minds, 2011). Of the 355 universities in India in 2008, only 140 were accredited, of which only a third were rated by the Indian government as 'A' grade (National Knowledge Commission, 2009). Although the Indian government has turned to the private sector to create new capacity in the tertiary education sector, this has yet to make any significant contribution[5] (Ministry of Human Resource Development, 2009). India has one of the lowest expenditures on higher education per student in Asia, in addition to having one of the lowest gross enrolment ratios in the developing world (National Knowledge Commission, 2009).

Shortage of skilled workers puts an upwards pressure on the costs of employing the most competent graduates, and this is perhaps the single largest bottleneck underlying Indian industry over the next few decades. Under-qualified workers require expensive in-house training programmes, which is an additional cost to employers. Indeed, several large companies maintain quite considerable in-house training capacity for this reason (Modwel and Jelassi, 2010). A related issue is the scarcity of skilled and experienced managers, which ultimately tends to be sourced from the same pool of employees within firms. For instance, McKinsey (2001) found that by 2010 there would be a shortfall of 200,000 managers in the IT sector alone.

Interactive learning within an economy depends in large part on collaboration between firms, universities and public research organisations. The non- firm sector plays a dual role as providers of R&D and as providers of human capital (Pavitt, 1984), which is essential for firms to build absorptive capacity. There is limited interaction between academic and

[5] The Yashpal Committee Report indicates that 108 private universities had been set up by 2008. However, in the absence of clear guidelines, accreditation systems and monitoring, the quality remains quite ambiguous.

research institutions and firms in India (D'Costa, 2009), which points to the nascent nature of the innovation system.

While India has a large non-firm sector with about 2000 public research institutes (Ministry of Science and Technology, 2010), most of these are run along administrative lines and suffer from inefficiencies (NISTADS, 2008). An exception to this is the Council of Scientific and Industrial Research (CSIR) which has a stock of 4600 highly specialized scientists and 8,000 scientific and technical support personnel. It supports 7,000 research scholars for doctoral research in S&T throughout the country and awards over 1000 doctorates annually. It is also the single largest Indian patent assignee in India[6]. 65% of their budget is spent on pharmaceuticals, biotech, electronics/electrical equipment, and chemicals/petrochemicals research.

Many of these public research organisations suffer from a fundamental mismatch between their mandate and demand. Although the Indian economy was liberalized in 1991, public research organisations continue to prioritise self-reliance, as expected from an import-substituting model of industrialisation. India's non-firm sector was not intended to promote domestic enterprises to achieve competitiveness at an international level, as would be expected for an export-oriented policy of economic development (NISTADS, 2008). As such, these organisations suffer from systemic inertia, and are acutely unsuited to support industry for the challenges of the global economy (Narula, 2003).

Despite this immense public infrastructure, India has a low share of public sector R&D, and it has fallen in real terms with economic growth, with the private share of total R&D increasing from about 50% to 65% between 2003 and 2005 (NISTADS, 2008). Six industrial sectors (pharmaceutical, automotive, electrical, electronics, chemicals and defence) account for about two-thirds of the total industrial R&D. The higher education sector contributes about 5% of total R&D expenditures, but remains highly concentrated in a few institutions. Moreover, firms are extremely dependent on their internal resources for financing of R&D, with limited resources and support from the public research sector. This is unlike the case in the US and Europe where the innovation system mitigates the uncertainty within innovation, both financial and technological (Arora, 2011).

[6] USPTO granted 260 patents to CSIR during 2008-2012.

Institutional bottlenecks

The dominant view in research on institutions and development is that institutions determine economic performance (e.g. Acemoglu et al, 2005), and quality of institutions have been highlighted as the reason behind differences in competitiveness between countries (Glaeser et al, 2004, Rodrik et al, 2004). Institutional quality has also been found to influence FDI flows: poor institutions at home drive away firms in search of locations with better institutional development (e.g. Witt and Lewin, 2007).

Although India has achieved rapid strides in economic development since liberalization in the early 1990s, institutional development has not kept pace. For example, the settlement of industrial disputes in the organised sector is still governed by the Industrial Disputes Act 1947. Firms employing more than 100 workers still need to obtain government permission before firing employees or closing down.

The quality of administrative practices such as costs of starting a business, obtaining permissions and licences, and hiring employees are important inputs for new enterprise creation and improving productivity (e.g. World Bank, 2010; Branstetter et al, 2013). Procedural delay due to red tape is another constraint faced by firms and multinationals in India. As shown in Table 7, the time taken to enforce a contract in India is double the time taken in Brazil, three times that of China, and five times that of Russia. Senior management of a typical firm in India spends 6.7% of management time in a week to deal with government regulation related to taxes, customs, licensing and labour regulation compared to 0.9% in China, 1.6% in Indonesia and 0.4% in Thailand. It takes almost 30 days to obtain an electrical connection in India whereas it takes only about 7 days in China and 4 days in South Korea. The time taken to clear exports through customs in India is 15 days while it is much lower in other developing Asian economies (Table 7). A delay in shipping a product by an additional day reduces the volume of trade by more than 1% (Djankov et al, 2010).

[Insert Table 7 here]

Another aspect of institutional quality that affects development and competitiveness is corruption (e.g. Shleifer and Vishny, 1991). Corruption is also linked to the procedural delays faced by businesses in many countries. According to the World Bank Enterprise Survey (WBES), 47.5% of firms in India are expected to make informal payments to 'get things done' (Table 7). 25.6% of firms in the WBES considered corruption as a major constraint in India while this is only 0.6% of firms in China.

India has strong democratic political institutions which encourage legislation through debates and discussions. However, this has also created deadlocks due to disruption of the parliament by opposition parties, and also because of the pressure on the leading ruling party to satisfy the ideological whims of its coalition partners to ensure coalition stability (e.g. Spary and Garimella, 2013). This has often resulted in a logjam of bills to be passed by the parliament, many of them pertaining to important policy decisions.

Informal institutions also play a role in business. Research has shown that national pride influence attitudes towards global economic issues (e.g. Muller-Peters, 1998) as well as investment decisions (e.g. Hope et al, 2011). Developing countries have been found to bid higher on average to acquire assets in developed countries. For example, Tata Steel acquired Corus in 2007 for $12 billion, a price that was inflated mainly due to the bidding war with Companhia Siderúrgica Nacional of Brazil. Corus has faced losses since 2009, made 2500 job cuts in the UK, and is trying to dispose assets and refinance debts (Financial Times, 2013).

Sector-specific L assets and the prospects for FDI growth

The previous sections have examined India's L assets on a comparative basis, relative to those of other countries. In this section, we make some sector-specific observations.

India's services sector

The growth of India's service sector is an important curiosity for several reasons (Table 1). First, quite unlike other developing countries, the gradual shrinking of the relative importance of the agricultural sector over the last 40 years has not been associated with a commensurate growth in the manufacturing sector, which has shown only marginal changes in its share of the economy, with the slack being taken up by the growth of the service economy (Kumar and Gupta, 2008). To some extent service sector growth has happened despite government policy.

Second, although it requires knowledge infrastructure, this sector has grown through firms substituting public goods with private goods. Service firms by definition are even more dependent upon recruiting skilled workers (which make up the majority of their employment), and for whom output is crucially associated with the quality of these employees. ILO (2013) notes that salaried workers in services reported a 150% increase in

wages between 2006 and 2010, three times the increase in the consumer price index. The bottlenecks in the education sector discussed earlier, coupled with the high rates of attrition means that Indian firms are pushed to move abroad, as wage costs go up but labour productivity does not demonstrate a commensurate increase. The services sector has benefitted from a large inflow on FDI by highly competitive MNEs, causing domestic firms to 'raise their game' through greater innovativeness. At the same time, this has also caused an upwards pressure on wages.

Data show that over the period 1980-2004, over 60% of the total factor productivity growth in India came from the services sector. (Das et al, 2010) The services sector in India will struggle to grow at quite the same pace it enjoyed during the last two decades because of fundamental shortage of skilled (and affordable) manpower, both technical and managerial. The services sector will see greater internationalisation, because there will be a 'push' effect to overcome shortage of critical inputs, in addition to its natural propensity - by virtue of its demand driven nature - for proximity to the customer. Indeed, services and software are already the largest areas of outward FDI.

The state-owned enterprise sector

The SOE sector – while not as large as China – is still relatively large at approximately 15% of GDP (Dougherty et al, 2009), and a similar share of employment. State-ownership is considerable in sectors as diverse as telecommunications, energy, banking and dairy processing, and in most instances remains highly inefficient. McKinsey (2001) estimated that continued state ownership supressed GDP growth by approximately 0.7% annually and there is little evidence that this has been addressed in the decade since this study. A number of the largest Indian MNEs are SOEs. ONGC Videsh, an SOE in the petroleum sector, has the highest transnationality index of all Indian firms (Table 1).

Dougherty et al (2009) estimated that India's share of highly concentrated industries was three times as large as that of China or the US. This suggests that there is a much greater potential for anti-competitive behaviour by firms, and less of an incentive to upgrade their O assets. It also means that such firms are able to generate monopoly rents and are less likely to venture abroad, and where they do so, will not be concerned with the commercial viability of these activities.

Indian SOEs in India are known to be poorly managed at home, and suffer from low productivity. These firms enjoy a near monopoly (or at least have a market-making position)

in some sectors guaranteeing their profits however unproductive they may be. Poorly-performing SOEs in industries open to competition such as steel and retail banking can get government support, allowing them, too, to survive despite their inefficiencies (McKinsey, 2001). In some sectors, the government controls both the large players and the regulators, creating an uneven playing field for private competitors. Any expansion of this sector abroad – primary amongst them are resource intensive SOEs – will in any case not be based on a financial or performance motive.

Growth in the manufacturing sector

FDI from India's manufacturing sector is very low, and this reflects the overall weakness of India's manufacturing industry. From textiles and apparel to pharmaceuticals, there is considerable evidence that while there are opportunities for export growth, Indian firms remain concentrated in the upstream and low(er) value adding parts of the value chain. The low levels of OFDI compared to the high export propensity of these two sectors indicate that their O assets are location-bound. In pharmaceuticals, despite improvements in India's IPR laws, protection for patents remains weak, acting to limit inward FDI as well as discouraging domestic firms from expanding into new drug discovery (as evidenced by the low R&D intensity of Indian companies).

In sectors such as automotive components and textiles, domestic growth is limited by the problems of small scale production by the multitude of micro-enterprises that dominate in India, in sectors where there are large minimum efficient scales, and there are considerable economies of scale.

The automobile sector has gone shopping for acquisitions to overcome their limited O assets portfolio, and the growing competition from inward FDI. They have responded by engaging in significant acquisitions abroad (Kumaraswamy et al, 2012), but the strength of Indian firms remains as suppliers within low-value automobile components. While Indian automobile manufacturers have also sought to expand through international acquisitions, the evidence points to a failure to integrate their acquisitions with their Indian operations. That is, they maintain their foreign acquisitions as autonomous subsidiaries. From their failure to upgrade the products from their domestic operations with superior technology from these acquired firms, it seems clear that they do not have the organisational and managerial skill to engage in systematic reverse technology transfer. There are few reasons to believe that Indian firms can substitute for weaknesses in the L assets at home by going abroad, or avoiding

investing in R&D themselves by buying up firms with an existing portfolio of technological assets. Both require recombination advantages and an especially high absorptive capacity.

Certainly, there are opportunities in inter-industry integration. For instance, the growth of inward FDI in the IT/software sector is partly driven by hardware companies that seek complementarities in software from India. There is great potential in the hardware side of IT, if the innovation system were upgraded to promote an integrated approach that boosts the hardware and software sectors simultaneously.

There are other areas for possible cross-fertilization, where India's existing pockets of excellence can 'cross-over', such as, for instance, bio-informatics, and the growth of biotechnology (an area where the government has invested considerably (NISTADS, 2008)). However, each presents its own challenges, and broadly speaking, the same bottlenecks in terms of basic and knowledge infrastructure, as well as institutions will constrain each of these 'new' sectors.

It is a particular feature of the Indian economy that a very large share of the economy remains in the informal sector, which accounted for 93% of total employment in 2008 (Ministry of Finance, 2010). Indian manufacturing sector is dominated by micro-enterprises of which the overwhelming majority are in the informal sector, and their total factor productivity is half that of larger enterprises (Dougherty et al, 2009). The dominance of informal sector is a result of India's labour legislation and pre-reform regulations that provide on the one hand special incentives to micro-enterprises by limiting entry to larger firms in certain sectors, while on the other hand, limiting the ability of larger firms to lay off or replace workers, or declare bankruptcy. Firms therefore prefer to be capital-intensive rather than labour-intensive to avoid the complexities of becoming larger. Large firms also tend to fragment outsourced activities to a considerable number of small units (perhaps because the smaller firms predominate) creating further inefficiencies. From our perspective it means that there will be fewer firms with O assets that can be exploited abroad, at least within the manufacturing sector.

There is no evidence to suggest that the domestic manufacturing sector is likely to grow, at least not in the knowledge-intensive sectors. Poor physical and knowledge infrastructure limit India's competitiveness in such sectors, and this applies not only to knowledge-intensive sectors (where India does not have a comparative advantage). Even more labour-intensive

sectors such as textiles and apparel are becoming less competitive due to rising costs caused by infrastructure bottlenecks.

In particular, weakness of state support in education and training creates a cost for private firms, since they must privately provide what is normally a public good, making them less competitive. Larger firms are able to overcome some of these gaps in public goods by investing in their own infrastructure – building training centres and institutes, generating their own electricity, and so on, but smaller firms (and less successful ones) simply cannot absorb such costs. This makes Indian firms less competitive in international markets. Firms without the political clout to seek exceptions (typically the large business groups and SOEs that dominate the Indian economy) will seek to 'exit'. From the point of view of OFDI, it means we are likely to see the more competitive firms seeking to escape institutional voids and India's growing location *disadvantages* by relocating abroad.

Conclusions and Managerial Implications

Much of the literature on EMNEs has explained their rapid growth since the early 1990s by examining their overseas activity *per se* as proof of their competitiveness. This obfuscates a number of other important explanations, which have increased the spread and intensity of MNE activity and growing intra-firm trade by firms of all nationalities. The data on FDI indicates that the growth of EMNE activity has not greatly outpaced the overall growth of MNE activity; it has simply grown faster relative to itself. That is, despite the high growth rate of OFDI from emerging economies, the share of OFDI has not altered dramatically[7].

The growth of FDI has to do with a number of factors associated with the global economy, not least of which has been an adoption of FDI-friendly regimes in a large number of developing and developed countries, the the WTO and agreements such as TRIPS and TRIMs, important breakthroughs in transport and logistics technology, global supply chains, among others. In addition, the rapid growth of service MNEs and the easing of restrictions on cross-border investments in banking, construction, insurance, information technology, and telecommunications have caused rapid FDI growth globally.

[7] The 'boost' in the share of OFDI from developing countries that is so often quoted in the data derives from the inclusion of Korea, Taiwan and Hong Kong as developing countries in UN and World Bank data (See Narula, 2010).

Nonetheless, the fact remains that there are competitive EMNEs which have succeeded in their own right, and some have prospered long enough for it to be obvious that they do possess O assets that allow them to be internationally competitive. A significant number of these MNEs have enjoyed pseudo-monopolies at home, or have resources available to them by virtue of being national champions. They have been able to carefully build up a portfolio of non-location bound O assets through international M&A, and through judicious investments in R&D.

This paper has asked: can we expect to see a new generation of EMNEs from these countries, as their home country comparative advantage has shifted away from low-cost labour and scale-based activities? Can the home countries sustain their need to build and upgrade capabilities to engage in global markets? We have built our arguments around the relationship between home-country L assets and the O assets of its firms. What are the prospects for a greater expansion of EMNEs, given their home country L assets?

Using the case of India, one of the largest sources of OFDI from the developing world, we have sought to make a realistic evaluation of the growth prospects of EMNEs. Along to China and Brazil, India is considered to be one of the most knowledge-intensive emerging economies.

The evidence would suggest that – like other emerging economies – Indian firms are unlikely to be able to rely on the knowledge infrastructure of their home economy, and are 'exiting' the Indian milieu because of its weaknesses in L assets, as much as to seek markets and customers elsewhere (Kumar, 2008). If this is true for India, which has more MNEs than many other emerging countries, the data suggests strongly that the situation is so much worse for most other emerging economies.

Systemic and radical policy changes are needed to upgrade the knowledge infrastructure and institutions to support a shift in the competitive advantages to new sectors outside existing pockets of excellence. Opportunities in new and emerging sectors are more likely to benefit firms when governments have invested in creating a supportive institutional and knowledge infrastructure that encourages entrepreneurship and innovation, and where markets (for goods, capital, and assets) are most efficient. There will be more internationalization by EMNEs, but only when there is significant investment to upgrade L assets and when firms have the capacity to systematically upgrade their O assets there from. The absence of a viable knowledge infrastructure outside pockets of excellence acts as a tax on potential EMNEs,

because they must invest their own resources to upgrade, which in most developed countries is a public good.

This is important not simply from a policy perspective, but also from a managerial one. In the absence of strong technological and managerial capabilities, there is clearly a danger that Indian MNEs will be unlikely to be able to effectively undertake reverse knowledge transfer (RKT) (Mudambi et al, 2014). Effective RKT implies efficient knowledge absorption and coordination between the various units, and where parent firms lag behind their foreign acquisitions, this fundamentally effects the parent-subsidiary power nexus (Mudambi et al, 2013)

Others (e.g., Contractor, 2013) have pointed to the entrepreneurial spirit that these firms have demonstrated in overcoming the disadvantages that accrue from emanating from home countries with poor L assets. However, in many instances, this early wave of EMNEs from the 1990s had been among the largest domestic firms in the home country, and have benefitted both from regulatory capture as well as access to cheap capital through intra-group transfers or discounted capital made available by governments (e.g., Gaur and Kumar, 2009; Buckley et al, 2007). Size matters in the internationalisation process. In the absence of appropriate L assets, there are few opportunities for new generations of firms to venture abroad from a position of strength, rather than as a means to overcome their home country disadvantages.

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Figure 1: Relationship between O assets and L assets

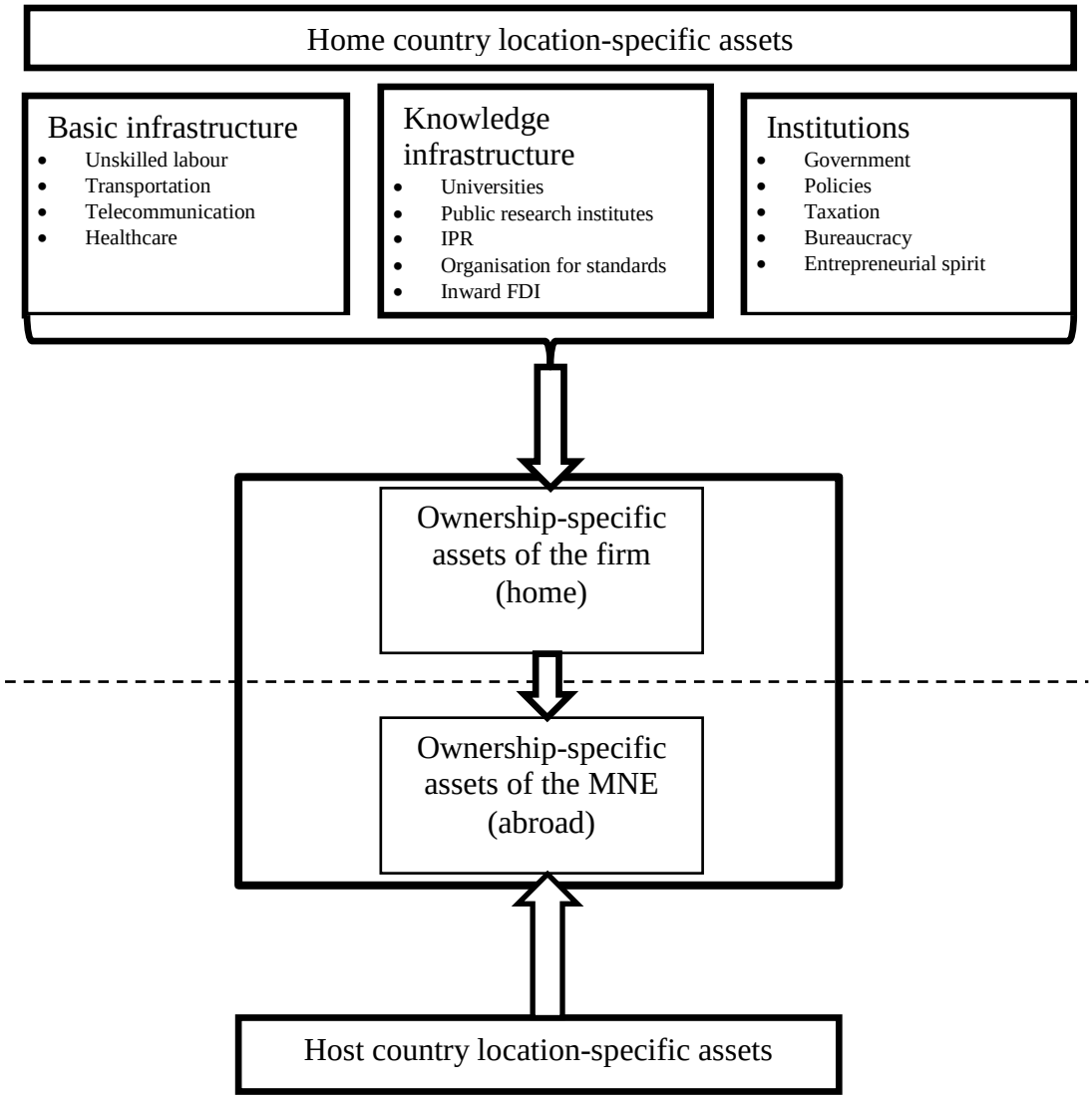
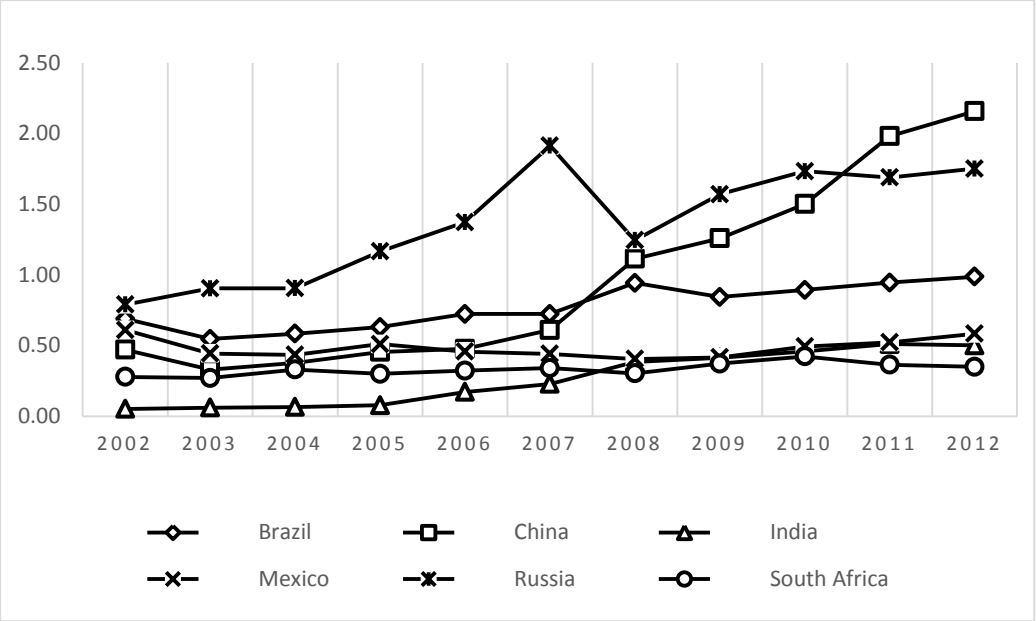


Figure 2: Global OFDI share of major developing countries (%)



Source: UNCTADStat.

Table 1: Top Indian MNEs, 2012

Company	Industry	TNI%
ONGC Videsh	Petroleum	77.0
Hindalco Industries	Metal and mining	62.1
Tata Steel	Metal and mining	60.1
Tata Global Beverages	Food	60.0
Motherson Sumi Systems	Automotive	60.0
HCL Technologies	Software	57.0
Tata Consultancy Services	Software	56.3
Tata Communications	Telecommunication	56.0
Suzlon Energy	Energy	55.0
Tata Motors	Automotive	53.6
Dr.Reddy's Laboratories	Pharmaceutical	49.0
Jubilant Life Sciences	Pharmaceutical	47.0
Infosys	Software	44.0
Punj Lloyd	Infrastructure	43.0
Bharti Airtel	Telecommunication	42.8
Tata Chemicals	Chemicals	40.0
Reliance Communications	Telecommunication	18.8

Source: UNCTAD Top 100 non-financial TNCs from developing countries 2013, Chittoor and Jana (2013).

Table 2: R&D intensities of various industries in India and worldwide.

Industry	R&D intensity, 2006-07	
	India	Global
Pharmaceuticals	6.91	15.1
Chemicals	2.49	3.1
Food products	1.90	1.6
Automobile	1.76	4.2
Machinery	1.33	3.1
Electronics	1.48	5.1
Electrical machinery	0.37	5.8
Software	1.15	9.5
Rubber & plastic	0.59	2.1
Textiles	0.25	2.7
Basic metals	0.14	1.3

Source: NISTADS (2008), Kumar and Gupta (2008)

Table 3: Top Indian R&D spenders, 2011

Company	Industry	R&D expenditure, 2011(million Euros)	R&D intensity (%)
Infosys	IT/software	258.8	5.3
Tata Motors*	Automotive	182.9	2.5
Reliance Industries	Oil & gas, chemicals	143.5	0.3
Dr Reddy's Laboratories	Pharmaceuticals	84.4	6.2
Tata Steel	Iron & Steel	73.4	0.4
Mahindra & Mahindra	Automotive	70.8	0.9
Lupin	Pharmaceuticals	68.1	6.7
Ashok Leyland	Automotive	51.5	2.8
ONGC	Oil & gas	47.0	0.4
Bharat Heavy Electricals	Industrial engineering	46.6	0.8
Cipla	Pharmaceuticals	43.9	4.3
Cadila Healthcare	Pharmaceuticals	42.4	5.7
Glenmark	Pharmaceuticals	42.3	7.3
Sun Pharmaceutical	Pharmaceuticals	41.5	7.3
Wockhardt	Pharmaceuticals	36.0	5.4

*Tata Motors was not ranked in the EU Industrial R&D Scoreboard 2012. They spent INR 11.87 billion on R&D in 2010-2011 which was converted to Euro at the average Euro-INR exchange rate of 64.88 in 2011 (Source: European Central Bank Statistical Data Warehouse) to obtain 182.9 million Euros.

Source: European Union Industrial R&D Scoreboard 2012 and Tata Motors Annual Report 2010-2011.

Table 4: Sectoral distribution of USPTO patent assignees in India (2008-2012)

Industry	Total		Indian firms		Foreign firms	
	Number of firms	Patents	Number of firms	Patents	Number of firms	Patents
IT/software	49	1909	10	188	39	1721
Pharmaceutical	36	506	32	457	4	49
Electronics	32	1003	1	12	31	991
Telecommunication	6	48	0	0	6	48
Engineering	4	497	1	5	3	492
Chemicals	3	88	1	8	2	80
Medical/healthcare	2	14	0	0	2	14
Automotive	1	34	0	0	1	34
Oil and gas	1	13	1	13	0	0
Energy	1	5	0	0	1	5
Textile	1	5	1	5	0	0
Financial service	1	11	0	0	1	11
Media service	1	5	0	0	1	5
Non-firm	9	334	9	334	0	0
Total	147	4472*	56	1022	91	3450

* Includes all organisations that received five or more utility patents and excludes individual patent assignees. Total patents granted were 5336. Note that industry classification of patents is based on industry of patenting firm, not industry of patent granted.

Source: US Patents and Trademarks Office

Table 5: Basic infrastructure indicators for major countries

Country	Access to electricity (% of population) – 2009	Electric power consumption (kWh per capita) – 2010	Electric power transmission and distribution losses (% of output) – 2010	Value lost to electrical outages (% of sales) – 2002-2012*	Rail line (total route kilometres) – 2011	Paved roads (% of total roads) – 2008-2011*	Fixed broadband internet subscribers (per 100 people) – 2011	Internet penetration (% of population) - 2012
Developing countries								
China	99.4	2943.8	6.1	1.3	66239	84.1	11.6	40.1
Brazil	98.3	2383.7	16.6	3.0	29817	12.9	8.5	45.6
India	**66.3**	**616.2**	**21.9**	**8.1**	**63974**	**49.5**	**1.0**	**11.4**
Russia	-	6430.6	10.1	2.0	85292	79.0	13.1	47.7
Mexico	-	1990.4	16.3	3.4	26704	36.4	10.2	36.5
Indonesia	64.5	641.3	9.3	2.2	-	56.9	1.1	22.1
Argentina	97.2	2904.4	13.4	3.5	25023	-	10.5	66.4
S. Africa	75.0	4802.5	9.5	1.6	22051	-	1.8	17.4
Thailand	99.3	2243.4	6.3	1.5	4429	-	5.0	30.0
Venezuela	99.0	3286.6	19.3	8.3	-	-	6.1	41.0
Developed countries								
Germany	-	7215.4	3.8	0.0	33708	-	33.1	83.0
Japan	-	8394.1	4.4	-	20035	-	27.6	79.5
UK	-	5733.1	7.1	-	31471	100.0	32.7	83.6
USA	-	13393.9	5.9	-	228513	100.0	27.4	78.1

*For each country, the latest available year of data is used.

Source: World Bank World Development Indicators, CIA World Factbook, Internet World Stats

Table 6: Knowledge infrastructure indicators for major countries

Country	Researchers in R&D (per million people) – 2005-2009*	R&D expenditure per capita ($) – 2006-2009*	Researchers with ISCED grade 6[#] education (% of total researchers) – 2003-2009*	R&D expenditure (% of GDP) - 2010	Scientific and technical journal articles – 2009	Secure internet servers (per million people) - 2012	High technology exports (% of manufactured exports) - 2011	Inward FDI (million $) - 2012	Per capita inward FDI ($) - 2012
Developing countries									
China	863.2	115.5	-	1.7	74019	3.1	25.8	832882.0	615.3
Brazil	703.7	121.2	34.9	1.2	12306	55.5	9.7	702208.2	3540.1
India	**135.8**	**20.5**	**13.1**	**0.7**	**19917**	**3.5**	**6.8**	**226345.5**	**179.9**
Russia	3092.3	234.5	27.4	1.2	14016	38.6	7.9	508890.0	3566.1
Mexico	383.5	54.5	28.9	0.3	4127	29.7	16.5	314968.0	2711.8
Indonesia	89.6	3.3	14.0	0.1	262	4.0	8.3	205656.3	840.2
Argentina	1091.2	86.6	24.8	0.5	3655	42.3	7.9	110704.3	2692.3
S. Africa	393.0	95.9	47.9	0.9	2864	84.6	5.1	138964.0	2738.8
Thailand	315.5	16.4	17.6	-	2033	19.1	20.7	159124.6	2276.7
Venezuela	182.6		54.8	-	354	10.9	2.4	49079.0	1641.9
Developed countries									
Germany	3849.6	1010.9	-	2.8	45003	1102.4	14.9	716344.0	8736.9
Japan	5179.9	1086.5	17.4	3.4	49627	774.3	17.4	205361.1	1624.2
UK	3794.1	641.3	-	1.8	45649	1534.1	21.3	1321352.0	20961.8
USA	4673.2	1305.1	-	2.8	208601	1501.0	18.1	3931976.0	12301.1

*For each country, the latest available year of data is used.

[#]International Standard Classification of Education 1997, grade 6 – Tertiary programmes leading to the award of an advanced research qualification such as Ph. D.

Sources: World Bank World Development Indicators, UNESCO Institute for Statistics, Battelle/R&DMag 2012 Global R&D Funding Forecast

Table 7: Institutional indicators for major countries (2005-2012)*

Country	Number of days to enforce a contract	Percentage of firms expected to make informal payments to 'get things done'	Management time spent on dealing with government regulation (% of mgmt time in a week)	Days to obtain an electrical connection	Days to clear exports through customs
Developing countries					
China	406	10.7	0.9	6.9	7.6
Brazil	731	11.9	18.7	36.8	15.9
India	**1420**	**47.5**	**6.7**	**29.5**	**15.1**
Russia	270	20.5	14.7	120.4	5.6
Mexico	415	11.6	13.6	17.1	7.0
Indonesia	498	14.9	1.6	15.5	2.3
Argentina	590	18.1	20.8	54.2	7.3
S. Africa	600	15.1	6.0	15.8	4.5
Thailand	440	-	0.4	27.9	1.3
Venezuela	510	23.6	27.6	13.9	18.4
Developed countries					
Germany	394	-	1.2	3.2	4.7
Japan	360	-	-	-	-
UK	399	-	-	-	-
USA	370	-	-	-	-

*For each country, the latest available year of data is used.

Source: World Bank Doing Business, World Bank World Enterprise Survey