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Country Specific Advantage, Firm Specific Advantage and multinationality – sources of competitive advantage in emerging markets: Evidence from the electronics industry in China*

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Abstract:

The extant literature on emerging market multinationals (EMNEs) suggest that they derive their advantages from country-specific advantages (CSAs) such as economies of scale, as opposed to traditional firm specific advantage (FSA) such as technology. We use firm level data from the Chinese electronics industry and an empirical methodology that has thus far not been used in the literature to provide clear empirical support for this proposition. Further, we demonstrate that not all emerging market firms can leverage CSAs equally and that EMNEs are better at exploiting CSAs than their non-MNE domestic counterparts. We also demonstrate that developed country MNEs operating in emerging market economies are not as good as leveraging available CSAs as their EMNE competitors, arguably on account of liability of foreignness. Our results have implications for outward investment by emerging market firms as well as for the ability of developed country MNEs to significantly benefit from efficiency-seeking FDI in emerging market economies.

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1. Introduction

As several authors have noted, notably Meyer and Xia (2012), Meyer and Peng (2005) and Ramamuti (2008), MNEs from emerging economies present a challenge for international business theory, as their firm specific advantages do not conform to the standard analysis of ownership advantages that is applied to western firms. Bhaumik, Driffield and Pal (2010), for example, highlight the importance of EMNEs' ability to manage assets across subsidiaries, access to finance, and the ability to coordinate resources in the context of varying institutional quality as at least as important in explaining FDI by EMNES[1] as the more traditional analysis that is built around the notion that ownership advantages of MNEs correspond to intangibles such as technological advantage. The literature on EMNEs further emphasises country-specific advantages such as access to natural resources as an alternative to traditional firm-specific "ownership" advantages (FSAs). In the context of large emerging market economies, the literature highlights the importance of home market size and therefore resulting economies of scale as a key country-specific advantages explaining outward investment by EMNEs.

The existing literature on EMNEs is possibly sufficient to explain how emerging market firms can internationalise through overseas investment without having any pronounced technological advantage (e.g., Mathews, 2002, 2006; Luo and Tung, 2007; Dunning, Kim and Park, 2008; Kedia, Gaffney and Clampit, 2012; Ramamurti, 2012; Gaffney, Kedia and Clampit, 2013). However, analysis of country-specific advantages (CSAs), in particular, is somewhat broad, and does not contrast other sources of competitive advantage, or explain how seemingly some firms are better able to gain from CSAs than others. As such our understanding of EMNEs is incomplete. Further, the sources of CSAs, in terms of their relative importance, scale economies and more general efficiency for example are seldom contrasted, and never, to the best of our knowledge compared empirically.

We therefore finesse the existing argument concerning CSAs of EMNEs by contrasting the potential for scale economies as a country level advantage, with the ability to exploit them as a firm level advantage. In order to do this however, it is necessary to extend the existing analysis which

[1] The ability to manage resources efficiently within contexts of institutional void is particularly important if EMNEs hold a greater share of their asset portfolio in other developing economies as opposed to developed countries (Bhaumik, Driffield and Pal, 2010).

either looks at EMNEs as a distinct group alone, or compares them with MNEs from the OECD. A CSA, e.g., a supportive financial system or access to a scarce natural resource, is an advantage that should, in theory, benefit all domestic firms equally. Yet, evidence suggests that while some emerging market firms have become prolific investors in overseas markets, it is hardly a widespread phenomenon. Further, it is well understood in the extant literature on developed country MNEs that their investment in emerging market economies can be – and in part is – efficiency seeking (Vernon, 1966; Athukorala and Chand, 2000; Dunning, 2000; Bevan and Estrin, 2004). This is consistent with the premise that scale economies are a CSA in emerging market economies but, in light of the inability of a vast majority of emerging market firms to leverage this advantage for a global presence, it is not evident as to whether developed country MNEs can tap into this potential advantage of emerging market economies. It is necessary to compare ability of EMNEs to leverage scale economies with the comparable ability of both developed country MNEs and domestic emerging markets firms that do not invest overseas and we are able to make this comparisons in this paper.

Our paper, therefore, makes a two distinct contributions to the growing literature on emerging market multinationals. First, to the best of our understanding, it is the first paper to provide empirical evidence about the relative impact of scale economies and technological progress on productivity growth and hence on competitive advantage of EMNEs and their domestic and overseas competitors. While there is a literature on the dynamics of changing competitive advantage of EMNEs (Athreye, Kale and Ramani, 2009; Chittoor, Sarkar, Ray and Aulakh, 2009) and the impact of capabilities on performance (Ethiraj, Kale, Krishnan and Singh, 2005), there is as yet no empirical evidence about how much factors such as scale economies contribute to a EMNE and its competitors' competitive advantage. Second, it adds to the discussion about whether there is a significant difference in the ability of emerging market firms to exploit or leverage CSAs such as scale economies. In doing so, it complements the literature on how firm-specific factors, observed or otherwise, that can hold emerging market firms from internationalising through overseas investments (Bhaumik, Driffield and Pal, 2010).

We do this by comparing the contribution of scale economies to the productivity growth of Chinese firms, both MNEs and non-MNEs, with those of western MNEs, within the electronics industry, a well-defined sector[2] that accounted for 10 percent of China's GDP growth and about 35 percent of China's foreign trade at the end of the last decade (APCO, 2010). We are able to do so my exploiting a methodological approach that, to our knowledge, has hitherto not been used in the international business literature and which enables us to decompose growth in total factor productivity into the contributions made by scale economies, technological change and efficiency.

Our results, discussed in Section 5, suggest that EMNEs do indeed demonstrate firm specific advantages over their domestic competitors, and in some aspects are as efficient as OECD MNEs. However, the FSAs associated with the EMNEs appear to be linked to the ability to harness scale economies, rather than any technological superiority over other firms in their home country. The results also demonstrate that developed country MNEs might not be able to leverage CSAs such as scale economies in large emerging markets as successfully as the EMNEs, thereby highlighting the limitations of efficiency-seeking FDI in emerging market economies.

2. The Research Setting

The focus of our analysis is the electronics sector, an industry in which it is accepted that China has significant comparative and competitive advantage, at least in terms of production. This is fuelled in part by the high levels of both inward investment and outsourcing to China by western firms, and benefiting from significant economies of scale.

From 2001 to 2008 the Chinese electronics sector generated double digit growth rates, peaking in 2005 with a growth rate of 45%. Based on Ministry of Industry and Information Technology (MIIT) figures, the industry grew at 6% even in 2010, recovering from the decline on global demand through the crisis. The sector also accounts for some 30% of total exports, exceeding $520bn in 2009. Equally, imports exceeding $130bn in 2009. The US is the largest export market, followed by Japan and the EU, lead by Germany and the Netherlands. This shows clear evidence of export penetration into the most technologically advanced electronics markets, though domestic demand is also very strong, with home sales growth outstripping export growth over the period. This

[2] For further discussion of this sector, and its global value chain, see Dedrick et al. (2010), Sturgeon et al. (2010) and Tung. and Wan (2013).

is boosted by government intervention, encouraging adoption of newer more energy efficient consumer electronics domestically[3].

However, at the same time, there has been much talk of the position of Chinese manufacturing within global supply chains, and the "smile of value creation", suggesting that China dominates by volume but not by value. The financial crisis has therefore placed significant pressure on the margins of Chinese exporters, who as a result are seeking to move up the value chain, with internationalisation playing a key role in this (Wei et al 2014).

As such therefore, this industry is one that may be expected to be an industry that can spawn "traditional" EMNEs whose competitive advantage lie in economies of scale and other country-specific advantages, but also provide a comparison in terms of both the global technology frontier in terms of the large number of MNEs from OECD firms, and a large domestic Chinese sector who have not internationalised. This provides therefore a focus for our analysis, concerning the differences between domestic firms that rely on that competitive advantage and Chinese MNEs that have to build on CSAs and potentially move up the value chain.

INSERT Figure 1 here

Figure 1 illustrates the distribution of firms across the sector, with Chinese firms more prevalent in components (2611), circuit boards (2612) and consumer electronics. These typically represent activities higher up the supply chain, and lower down the value chain, than for example optical media (2680) or electric medical equipment (2660). These are also sectors where economies of scale, rather than for example internal innovation are key drivers of productivity.

INSERT Table 1 here

Table 1 presents this contrast in more detail. Chinese MNEs are significantly larger than other types of firms, in sectors in which they are prevalent. Interestingly, in for example electronic components, the average Chinese MNE employs nearly twice as many people as the average Chinese non-MNE, and 50% more than OECD MNEs. This gives a good deal of credence to the "scale economies" explanation of FDI from emerging markets, and also points to significant differences

[3] The best known examples of this are the "*Home appliances to the countryside*" ,"*Household Appliance Replacement*" programmes, and the "*Energy Saving Products Benefits People*" project.

between Chinese MNEs and Chinese non-MNEs in terms of their ability to harness economies of scale. In contrast, more specialised sectors such as optical media, with no Chinese MNE presence, appear to have lower levels of scale economies. Finally, it is noticeable that Chinese firms are less prevalent in sectors with the highest capital – labour ratios, such as medical equipment.

All of this provides support for the standard explanations of the existence of EMNEs, that they produce relatively standard products with high efficiency. It does not however shed much light on how different firms are able to exploit CSAs, and why in some sectors non MNEs appear to be larger than MNEs in China. This requires a more finely grained analysis.

3. Competitive advantage of emerging market firms

Traditional theories of internationalisation suggest that a firm's ability to internationalise through overseas investment is dependent on its ownership of some intangible ownership advantage or resource that it can leverage to facilitate expansion into overseas markets and subsequently increase returns. The role of ownership advantage is explicitly acknowledged in the OLI-eclectic theories and its extensions (Buckley and Casson, 1976; Dunning, 1993). In general, these intangible ownership advantages are believed to be technological advantage, innovative designs, business models etc that cannot be replicated outside of the firm without incurring significant transactions cost. At the same time, the resource-based theory explains how a firm's strategies related to growth and, by extension, internationalisation is dependent on ownership of resources that gives the firm distinctive competencies (Andersen and Kheam, 1998; Peng, 2001; Westhead et al., 2001). The resources associated with competitive advantage of the firm can be both tangible, such as access to a natural resource, and intangible, such as the global networks of their owners and managers. The corollary to this has been the "technology sourcing" literature (e.g., Driffield and Love (2003), which assumes that firms engage in FDI, not motivated by the desire to exploit their existing assets, but in order to augment them through access to host country technology. This argument has also been applied to the phenomenon of EMNEs, and indeed has been the subject of more recent discussion concerning the necessity for ownership advantage at all, see for example Hashai and Buckley (2014).

Treated separately however, these arguments, when applied to emerging market firms are incomplete. For example, it has since been observed that EMNEs are organisations whose internationalisation cannot be explained by ownership advantages of the traditional or developed country MNEs. Indeed, Mathews (2002, 2006) argues that EMNEs internationalise in large measure to look for these intangible ownership advantages – in most cases, technology and brand recognition – and that their quest for these advantages complemented by the linkages they develop with overseas firms and their ability and willingness to learn from these firms. The importance of acquisition of intangible resources (or “knowledge”) to EMNE internationalisation strategy has also found empirical support is the literature (Kedia et al., 2012; Gaffney et al., 2013). However, the literature acknowledges that EMNEs may have competitive advantages related to ownership of resources such as cheap semi-skilled labour or natural resources such as oil and gas. Ramamurti (2008, 2012) points out that these advantages are country-specific – e.g., all IT firms in India have access to a large pool of relatively inexpensive semi- or skilled labour – such that EMNEs enjoy CSAs rather than traditional FSAs. In the words of Rugman (2005), “[i]n Porter (1990) terminology, the CSAs form a global platform from which the multinational firm derives a home-base “diamond” advantage in global competition” (pp. 35).

It is reasonable to conclude, therefore, that in their quest for internationalisation EMNEs benefit much more from CSAs than from FSAs. For resource-poor but large and fast-growing emerging market economies that correspondingly have large and growing domestic demand bases, economies of scale is considered to be an important CSA. Advantages of scale economies can be found in Indian producers of generic pharma products (Mazumdar, 2013) that have accounted for a significant proportion of overseas acquisitions of Indian MNEs (Nayyar, 2008; Bhaumik et al., 2010), and is consistent with the wider argument that firms are able to leverage macro-economic environment of a country (which necessarily includes demand) into mobile assets (Balasubramanyam and Forsans, 2010; Buckley et al., 2012). By contrast, the quintessential proxy for traditional FSA is access to technology and the intangible advantage with which it is associated. Hence, over a given time period, productivity growth (which is the basis of competitive advantage) of EMNEs is much more likely to be driven by changes in scale economies then by changes in technical progress.

Let us now consider the two other types of firms in an emerging market context, namely, the non-MNE domestic firms and the developed country MNE subsidiaries that operate in that context. Given that EMNEs are much more likely than their non-MNE domestic counterparts to have access to technology through their overseas investment and their linkages with companies elsewhere in the world, the dominant role of scale economies (a CSA) in driving productivity growth (and hence competitive advantage) is even more likely to be observed among the non-MNEs. Similarly, if the investment made by developed country MNEs is efficiency-seeking (Vernon, 1966; Dunning, 1998), which is quite likely in contexts that are resource-poor but offer scope for efficiency gain and a base for export to the global market, scale economies are likely to prove more important than technological progress for subsidiaries of developed country MNEs as well. This is especially true if weak institutions and the correspondingly high transactions cost in the emerging market economies limits the extent of technology transfer from the parent MNEs in developed economies and their emerging market subsidiaries (Young and Lan, 1997), and if, more generally, technological advancement is much more likely to be achieved through outward investment to high-technology countries than through inward investment from high-technology countries (van Pottelsberghe and Lichtenberg, 2001).

In the light of the above discussion, our ***H1*** is as follows:

In large emerging market economies, all firms (i.e., local MNEs, local domestic firms, and developed country MNE subsidiaries) generate productivity growth by leveraging country-specific advantages like scale economies rather than through technological progress.

In any country, a relatively small proportion of firms internationalise by way of outward investment. From an OLI-eclectic perspective, this is not difficult to explain in the context of a developed country: not all firms have the ownership advantages that are an important component of the internationalisation process. If, on the other hand, internationalisation of emerging market firms by way of outward investment is driven (or facilitated) largely by CSAs, some thought has to go into why a large proportion of the emerging market firms do not become EMNEs, given that they are all similarly affected by these CSAs. It has, of course, been pointed out that some CSAs are not available to all firms in the relevant country and only some firms have access to them (Hennart, 2012); natural resources constitute a good example of such CSAs. However, since CSAs like scale economies are based on a large domestic demand pool that can simultaneously benefit a large number of firms, especially of the threshold turnover to generate scale economies is relatively low (e.g., Indian pharmaceutical industry; see Mazumdar, 2013), whether EMNEs and their non-MNE domestic peers can benefit from CSAs such as scale economies to the same extent remains, in principle, an open question. Early evidence suggests that in contexts such as the Indian pharmaceutical industry only a handful of firms such as Dr. Reddy's and Ranbaxy can be classified as emerging global or global (Chittoor and Ray, 2007).

Teece and Pisano (1994) and Luo (2000) argue that a firm's dynamic competitive advantage depends not only on its ownership of certain key resources that are synonymous with certain capabilities, but also on its ability to deploy and upgrade these capabilities. Emerging market firms are known to have strategic disadvantages with respect to both access to capabilities and the ability to deploy these capabilities. For example, they may be at a disadvantage with respect to knowledge about best practices in human resource management, supply chain management etc. Indeed, it can be argued that an EMNE's quest for knowledge acquisition through linkage and learning is not limited just to acquisition of technical knowledge and information but also about acquisition of softer knowledge. Importantly, Luo and Tung (2007) argue that the acquisition of knowledge through internationalisation involves a number of incremental steps such that there is a time dimension to this process of acquiring capability and learning how to deploy them in the best possible way. If, therefore, an emerging market firm has the capability to deploy CSAs better than its counterparts and can cross the threshold to become an EMNE, it may open up a significant gap between itself and its non-MNE counterparts with respect to the ability to leverage CSAs.

The special nature of emerging market firms that become EMNEs is intangible in nature and can take many forms. Bhaumik et al. (2010), for example, argue that EMNEs are a select group of companies within their home country on account of being better governed and thereby able to overcome the burden of organisational forms such as family-ownership that may be otherwise incongruent with overseas investment. Certain firms may also have greater strategic flexibility, which includes "flexibility in coordinating the use of resources" (Wright et al., 2005; pp. 8), and which is important for success in contexts where market conditions change continually (Filatotchev et al., 2000; Uhlenbruck et al., 2003). In other words, emerging market firms that transform themselves into EMNEs may have an advantage vis-à-vis their non-MNE domestic counterparts with respect to leveraging (or benefitting from) CSAs, to begin with. Early literature on EMNEs suggest that their capability lay in optimally adapting available technology to contexts that are resource scarce and where production is a labour intensive process (Lall, 1983), and that argument can easily be extended to accommodate contexts of institutional void. Thereafter, once they internationalise and therefore acquire greater ability to deploy and upgrade capabilities through linkage and learning, they further consolidate this advantage over their domestic peers.

In the light of the above discussion, our ***H2*** is as follows:

Even though all firms operating in large emerging market economies can potentially benefit from country-specific advantages such as scale economies, local firms that have internationalised as EMNEs are better at leveraging these advantages than their local competitors.

While EMNEs may have an advantage over their non-MNE domestic counterparts in terms of their ability to leverage CSAs, comparison with MNE competitors from developed countries needs to be considered in different terms. Such firms are perceived to be better at managing supply chains and internal processes that are important considerations in the context of scale economies. Narula (2010), for example, argues that there is significant path dependence in the firm-specific advantages of EMNEs which leads to “cognitive limits” that can limit firm performance. Indeed, if EMNEs and developed country MNEs were to operate in neutral developing country or emerging market contexts, there is nothing to suggest that the former would automatically have an advantage over the latter on the basis of institutional familiarity, i.e., the similarity of institutions and their weaknesses across developing countries (Arita, 2013).

However, in the home country of EMNEs, where these emerging market firms have the ability to leverage CSAs better than other firms, it would be difficult for developed country MNEs to compete with these local firms on the basis of leveraging CSAs such as scale economies. There is a large literature on liability of foreignness of developed country MNEs (Zaheer, 1995), especially in unfamiliar contexts where transactions cost of doing business is high (Calhoun, 2002; Eden and

Miller, 2004), that suggests that developed country MNEs would be decidedly less able to leverage CSAs and benefit from factors such as scale economies than their EMNE counterparts. The disadvantage of developed country MNEs can be exacerbated if they are unable to transfer a significant proportion of their technological (or other ownership) advantages to their developing country or emerging market subsidiary (Young and Lan, 1997).

In the light of this discussion, our ***H3*** is as follows:

Subsidiaries of developed country MNEs that operate in large emerging market economies do not benefit from country-specific advantages such as scale economies to the same extent as the local EMNEs.

4. Methodology and data

4.1 Productivity, technological progress and scale economies

To recapitulate, we aim to decompose productivity growth in firms – EMNEs, non-MNE emerging market firms, and developed country MNEs – into its different components, so as to be able to focus on scale economies that is an important aspect of country specific advantages of emerging market firms and technological progress that is a central aspect of firm-specific advantages of traditional developed country MNEs. This is best achieved using the stochastic frontier approach to modelling production, which isolate differences in efficiency and random differences amongst firms by dividing the error term into a deterministic component and a random one. In this methodology, realised output is seen as bounded from above by the stochastic frontier (Schmidt and Sickles, 1984) and technical inefficiency is seen as the amount by which a firm's actual output falls short of the efficiency frontier. Thereafter, Malmquist total factor productivity (TFP) index to measure the performance evolution at firm level that identifies firm level scale effect, technical progress and efficiency improvement, TFP being the most relevant measure of productivity in the relevant literature. This has been used in the context of both transition and developing economies, exporting, inward investment and internationalisation through imports of capital goods, see for example Driffield and Kambhampati (2003) and Henry et al (2009).

The Malmquist TFP index allows the decomposition of TFP growth into three distinctive sources, which are change in scale economies, technology progress and technical efficiency change (Coelli et al. 2005). The change in scale economies measures how firm level production diverges from constant return to scale (CRS), with economic theory suggesting that in the long run a firm doing business in a competitive market should operate at the minimum point of the long run average cost curve, i.e., at constant returns to scale. The value of change in scale economies measures the extent to which a firms static returns to scale have changed over time. If for example returns to scale increase, then the value would be greater than 1, if they decrease it would be less than 1. Technological progress is measured by the increase in output production resulted from pure technology improvement without any change in inputs. This would be positive if a firm can produce more output with the same inputs used as before, whilst negative otherwise. Finally, a firm is said to be technically efficient if it cannot sustain an output level by reducing *one* of the factor inputs such as labour unless it increases *another* factor input such as capital. Measures of changes in technical efficiency are derived by comparing firm level technical efficiency across the period of interest. It is easily seen therefore how the adoption of this methodology enables us to examine the hypotheses developed in the previous section.

The starting point, therefore, is to estimate a production function in which a firm's output (Y) is dependent on (or a function of) two factor inputs, namely, labour (L) and capital (K). It is stylised in the literature to use a translog production function in which (log) output is a nonlinear function of (log) labour and (log) capital:

$$lnY_{it} = \beta_L lnL + \beta_K lnK + \frac{1}{2}\beta_{LK} lnL lnK$$

An important econometric issue that has to be addressed during the estimation of this production function is that it has to be able to capture firm specific heterogeneities that might affect output. Schmidt and Sickles (1984) assume that the firm specific heterogeneity can be treated a fixed effect to be included in firm level inefficient. Similarly, in Kumbhakar (1990), Kumbhakar and Heshmati (1988), Pitt and Lee (1982) and Battese and Coelli (1988, 1992 and 1995), it is captured by a time invariant random inefficiency term. The models by Schmidt and Sickles (1984), Kumbhakar (1990), Kumbhakar and Heshmati (1988) and Pitt and Lee (1982) have been criticised for assuming firm level inefficiency to be time invariant. Others have assumed that inefficiency decreases over time at a constant rate (Battese and Coelli, 1995), but it has been argued that such an assumption is also restrictive and could lead to extreme results (Greene 2005). We therefore follow Greene (2003) and employ a true random effect panel stochastic frontier, which has been adopted by Pieres and Garcia (2012) to study the productivity of countries around the world. The random effects approach, of course, has the added advantage of being able accommodate time-invariant variables such as industry or location dummies.[4]

This estimation method is particularly suitable therefore for the electronics industry because firm characteristics such as size varies significantly within the computer, electronic and optical products manufacturing sectors. The modified equation for stochastic frontier estimation is as follows:

$$lnY_{it} = (\beta_0 + w_i) + \sum_{n=1}^{N} \beta_n lnX + \frac{1}{2}\sum_{n=1}^{N}\sum_{j=1}^{N} \beta_{nj} lnX_{nit}\, lnX_{nit} + \sum_{n=1}^{N} \beta_t \quad tlnX_{nit}$$

$$+\beta_t t + \frac{1}{2}\beta_{tt} t^2 + v_{it} - u_{it} \quad (4)$$

where Y_{it} denotes the output produced by firm *i* at time period *t*, *X* denotes the inputs in this case labour and capital of firm *i* at time *t*. v_{it} represents the normal error term, u_{it} denotes the measure for firm *i*'s inefficiency at time *t* and w_i denotes a random firm specific effect that is invariant across time. Further, *n* indicates the *n*th input and *N*=2 denotes the total number of inputs in our case. In this paper the total number of firms is *i* = 13,107 and, as we shall see later, we have data for a 5-year period, i.e., T = 5. In keeping with the standard assumptions of stochastic frontier models, we assume that the

[4] Consider two firms A and B. Both these firms can be technically efficiency, i.e., neither of these firms may be able to sustain its output level if one of the factor inputs such as labour is reduced without increasing the use of the other factor input (in this case, capital). However, Firm A may have greater managerial ability that enables it to generate more output per unit of input than Firm B, and in this sense the two firms may be different. Our methods enables us to capture this type of heterogeneity. We assume the firm level heterogeneity affects firm production in a time invariant fashion but that it is independent of firm level time-varying technical efficiency. This means the possible production capacity of firms might vary significantly even if they have the same technical efficiency level – on account of unobserved factors such as management capacity – and would therefore affect the level of output.

error term (v_{it}), inefficient terms (u_{it}) and individual random effect (w_i) follow the following distributions:

$$v_{it} \sim N[0, \sigma_v^2],\ u_{it} \sim N^+[0, \sigma_u^2],\ w_i \sim N[0, \sigma_w^2]$$

Where $N^+[0, \sigma_u^2]$ is a truncated normal distribution with mean 0 and varianceσ_u^2. Once the production function has been estimated using this stochastic frontier approach, following Jondrow *et al.* (1982) the inefficiency parameter u_{it} can be estimated as follows:

$$\hat{E}[u_{it}|\varepsilon_{it}] = \frac{\sigma_\varepsilon}{1+\lambda^2}\left[\frac{\phi(z_{it})}{1-\Phi(z_{it})} - z_{it}\right]$$

$$\varepsilon_{it} = v_{it} - u_{it},\ \ \sigma_\varepsilon = \sqrt{(\sigma_v^2 + \sigma_u^2)}, \lambda = \frac{\sigma_u}{\sigma_v}\ , z_{it} = \frac{\varepsilon_{it}\lambda}{\sigma_\varepsilon}$$

$\phi(.)$ and $\Phi(.)$ denote the density and CDF function evaluated at z_{it}. Given the translog specification in equation (1) the efficiency level (i.e. TE) of each individual *i* at time *t* can be calculated as:

$$TE_{it} = Exp\left(-\hat{E}[u_{it}|\varepsilon_{it}]\right)\ (2)$$

After estimating the coefficients for stochastic frontier function and efficiency level, we construct and decompose the Malmquist TFP index into efficiency change (EC), technical progress (TC) and scale change (SC) as in Coelli *et al.* (2005) and Malmquist TFP index is the geometric mean of these three components.

In particular, Coelli *et al.* (2005) show the EC, TC and SC between time period *t* and *s* can be written as:

$$EC = \frac{TE_{it}}{TE_{is}}\ \ (5)$$

$$TC = exp\left\{\frac{1}{2}\left[\frac{\partial lnY_{is}}{\partial s} + \frac{\partial lnY_{it}}{\partial t}\right]\right\}\ (6)$$

$$SC = exp\left\{\frac{1}{2}\sum_{n=1}^{N}[\mathrm{e}_{nis}SF_{is} + \mathrm{e}_{nit}SF_{it}]ln\left(\frac{X_{nit}}{X_{nis}}\right)\right\}\ (7)$$

where $SF_{is} = \frac{(\mathrm{e}_{nis}-1)}{\mathrm{e}_{nis}}$, $\mathrm{e}_{is} = \sum_{n=1}^{N}\mathrm{e}_{nis}$ and $\mathrm{e}_{nis} = \frac{\partial lnY_{is}}{\partial X_{nis}}$

An evident from our discussion in the previous section, we shall focus on SC and TC that are closely aligned with the competitive advantage of firms, and MNEs in particular. Note also that, as indicated earlier, *technical change* and *technical efficiency* are not one and the same thing. Technical change indicates technical (or technological) progress whereas technical efficiency is a measure of whether a firm is operating efficiently, i.e., whether is capable of increasing output without increasing at least one of the inputs.

4.2 Data

in order to examine the decomposition of productivity for three sets of firms, several particular features are required of the data. Firstly, one needs to be able to identify the ownership of foreign subsidiaries, not merely in terms of their existence as listed entities, but in terms of their activities. This confirms for example that they are not merely "shell" companies and are production activities rather than for example simply distribution networks of franchisees. All of our multinationals have at least one meaningful subsidiary.[5] In order to examine changes in scale efficiency and technical progress of three sets of firms one requires meaningful data on both inputs and outputs for both consolidated and unconsolidated accounts. Finally, in order to have meaningful variation one requires a sector that is international but with a significant number of comparable domestic players. The focus therefore is the NACE 26 industry (i.e. Computer, Electronic and Optical products) manufacturing firms, and the data are obtained from the Orbis company information dataset from Bureau van Dijk. Data from Orbis have been used widely for empirical studies involving firms from more than one country; see, for example, Bhaumik et al. (2010) for India, Yong et al. (2013) for a multi-country study, and Greenaway et al. (2012) for a paper on China.

All firms in the industry with valid annual data on output and inputs between 2005 and 2009 are included. Prior to this there were too few Chinese MNEs for meaningful comparison. The data are at the firm level, i.e. for the consolidated global operations of the parent company, not merely that for the Chinese subsidiary[6]. Although subsequent analysis involves comparison of various groups, the

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[5] In order to do this one has to build the dataset over rather than simply taking a snapshot of the Orbis data at a given point in time. It should also be pointed out that while these data include both listed and unlisted with turnover of firms that have turnover of some US$1m or equivalent, so very small firms are excluded. For the purposes of our study, where we wish to compare domestic and multinational firms, excluding very small ones is less of an issue as they are clearly not comparable.

[6] Hence the inputs and outputs of the firms reflect the overall performance of the corporation rather than their foreign subsidiary alone, but since developed country MNEs generally have global value chains that create

determination of the frontier, and the estimates of TFP overall is done for all firms, irrespective of nationality or location. This enables us to determine the global efficiency frontier, and in turn an individual firms distance from it, irrespective of nationality. For highly tradable goods such as electronic products, this is important, such that a firms absolute productivity can be calculated, rather than simply its position relative to its peers. This highlights again the necessity for internationally comparable data of this kind.

INSERT Table 2 here

A total of 13,107 firms around the world and 65,535 observations over the period of five years are included.[7] Chinese MNEs account for over 10% of total Chinese output over the period, growing to 12% in the final year. Table 2 below reports the key variables used for stochastic frontier estimation. Multinationals are defined in the usual manner, the requirement being to have a subsidiary in a foreign country. As the basis of our analysis is the derivation and comparison (specific components) of TFP growth using the stochastic frontier approach, the focus then becomes the measures of output and inputs, and the need for them to be internationally comparable. Our proxy for output is US dollar value of sales and capital too is measured in US dollars. Our measure of labour, on the other hand, is the employment figure reported by the firms.[8]

5. Analysis

In this section we discuss the key results from our empirical analysis. Table 3 below reports the marginal productivity of capital and labour estimated from panel stochastic frontier model as discussed earlier (equation 4). It shows capital contributes to around two third of output and labour contributes to around one third of output in the computer, electronic and optical products

value in developed countries by leveraging intellectual property and generate scale economies in emerging market operations this does not affect the spirit of our analysis.

[7] All firms from India are excluded from the sample due to unobserved employee data.

[8] Note that it is perfectly normal for input values to be highly correlated to not only the output but also to each other in a production function set up, because of the very nature of a production function. The correlations reported in Table 2 therefore not a manifestation of the usual multicollinearity problem.

manufacturing (i.e. NACE 26) industry, and the industry is operating under mild increasing return to scale.

INSERT Table 3 here

Next, following the methodology discussed above, we decompose TFP growth in the NACE 26 industry into its components, namely, change in scale economies, change in technical progress and change in efficiency with which inputs are converted into output. The results of the decomposition are reported in Table 4. They suggest that TFP growth in the industry was 2.32 percent overall during the 2005-09 period, with the pre-crisis year of 2006 accounting for much of the growth and with the start of the crisis in 2008 coinciding with negative growth in TFP. TFP growth in the Chinese industrial sector is well documented (Bosworth and Collins, 2008) and the annual pattern of TFP growth around and during the crisis years is entirely plausible. Note also that efficiency change is negative during 2008, indicating that use of input failed to adjust appropriately to changes in output during the start of the crisis. This, in turn, is consistent with the large literature on labour hoarding (Bernanke and Parkinson, 1991). Specifically, if firms are unable to reduce the size of their labour force during periods of weak demand and hence slowing (or indeed falling) output, then there would be a slack in the firm and this would be reflected in the negative change in technical efficiency. Even though we shall not focus much on this aspect of productivity growth, this result, which is consistent with our understanding of the impact of the financial crisis on firms, nevertheless increases our confidence on our decomposition results.

INSERT Table 4 here

Hypothesis 1: We now discuss the implications of our results for H1. The results reported in Table 4 suggest that productivity growth in China's (broadly defined) electronics industry is mainly driven by the scale efficiency change at firm level, rather than by technical progress. Indeed, technical progress is negative in each of the years, which indicates lack of technological advance in production in the sector over the sample period. The negative technical progress has been observed by Pires and Garcia (2012) at aggregate level, where most of the countries in the world suffered negative technical progress between 1995 and 2000, apart from these most developed countries such as US, Germany and Japan. This is consistent with the arguments (discussed earlier in this paper) that not only does the competitive advantage of local firms in large emerging market economies lie with CSAs such as scale economies but also that these CSAs matter more to efficiency-seeking FDI from developed countries. In other words, H1 is supported by our empirical results and this, in turn, provides greater empirical validity to the growing literature on CSAs of emerging market firms in general and EMNEs in particular.

INSERT Table 5 here

INSERT Figure 2 here

Hypotheses 2 and 3: We focus therefore on Table 5 in which we report the relative contribution of change in scale economies, technical progress and change in efficiency on TFP growth of the three types of firms in the sample. Consistent with the results reported in Table 4, for each of the three types of firms, technical progress was negative during the sample period and change in scale economies accounted for most of the TFP growth. More importantly for our purposes, while the annualised change in scale economies is comparable for the Chinese non-MNEs (4.00) and developed country MNEs (3.75), the change for the Chinese EMNEs is more than double that of their local and developed country competitors (8.86). This difference is also reflected in the Figure 2, which shows that there was continual divergence in the scale economy driven competitive advantage of Chinese MNEs (i.e., EMNEs) over both the local non-MNEs and developed country MNEs during the sample period. Hence, the results support H2 and H3.

These results are consistent with the work on dynamic capabilities by Teece and Pisano (1994) and Luo (2000), who argue that the ability to upgrade capabilities derived at home is a crucial element of the multinationality advantage. This however is the first time, to our knowledge that the magnitudes of these effects has been demonstrated and the implication is quite significant. If, on the basis of the existing (but admittedly small) literature (Bhaumik, Driffield and Pal, 2010; Narula, 2010), we can make the reasonable assumption that only a small proportion of firms in developing countries or emerging markets have the intangible ability to successfully exploit and leverage CSAs, then our results suggest that relatively few among these firms would be able to successfully emerge as EMNEs, with the possibility of making outward FDI from these countries either underwhelming or limited to a small set of firms who would be involved in repeated incidents of outward incidents (Nayyar, 2008).

These results also highlight the importance of the liability of foreignness in the context of competition between emerging market firms and foreign affiliates in emerging market countries, especially where FDI is efficiency-seeking such that different factor inputs and intangibles such as managerial skill have to be optimally combined to benefit from host country characteristics that are associated with CSAs such as scale economies. In the context of emerging markets, liability of foreignness is typically expressed in cultural or institutional terms, and this highlights two features of the disadvantage that inward investors face. Evidently, superior technology is not a solution, either because they cannot help bridge the institutional distance between the home and host countries, or because institutional distance discourages transfer of technology in the first place. This suggests that inward investors will always struggle to close the gaps with the leading firms in emerging markets, and may explain the widely reported phenomenon of inward investors failing to lever productivity growth into profits growth in emerging markets (Driffield et al., 2013).

6. Conclusions

The purpose of this paper is to extend the existing literature on EMNEs by examining the drivers of their development over time. To begin with, we provide empirical evidence of the relative magnitudes of CSA and FSA in driving firm capabilities, as measured by TFP growth. We have also sought to link the analysis on CSA and the current debate concerning the importance of FSA, to the drivers of productivity in such firms, notably scale economies and internal efficiency, and firm’s specific advantage, through technological progress. In doing this, we contrast the development paths not merely on EMNEs with more traditional MNEs in terms of highlighting the importance of CSAs, but also contrast EMNEs with similar domestic firms in order to highlight the importance of interactions between different sources of competitive advantage in the context of different firms.

Using a large firm level dataset and a stylised yet sophisticated methodology, we are able to compare technological progress and change in scale economies of all three types of firms over time. Our sample period traces these changes in scale efficiency and technological progress both before the onset of the financial crisis in 2008 and for one year into the crisis. To the best of our knowledge no one has compared EMNEs and OECD MNES in this way. The performance of EMNES (in our case, Chinese MNEs) is compared both with firms who have potentially the same access to country specific advantages associated with scale economies but less access to technology (i.e., Chinese non-MNEs), and with a set of firms that may be considered to be represent the technological frontier of the industry but have imperfect access to the aforementioned sources of scale economies (i.e., developed country MNEs).

In the context of scale economies, our analysis has implications for the question as to why some Chinese firms are able to leverage this form of CSA than others. It is clear from a comparison of Chinese MNEs and domestic firms, all of whom potentially have the same country-specific advantages, that the key difference is one of scale, as Chinese MNEs are significantly larger than their domestic counterparts (Table 1) and therefore are able to better leverage this CSA than their domestic non-MNE counterparts. These are number of explanations of this, which suggest future avenues of research. First, it is plausible that the EMNEs are the most successful of the emerging market firms in terms of process innovation; they are those that have overcome the organisational and other problems of operating efficiently at very large scale. Secondly, EMNEs may have succeeded in accessing finance required for such large scale operations much more than their domestic competitors. In the context of emerging market firms, this hints at for example family connections, political patronage, government contracts, or perhaps foreign investment facilitating access to global capital and goods markets. Exploration of these conjectures would add significantly to the literature of EMNEs. There is much less evidence however of technological superiority over domestic competitors. This represents an interesting departure from the existing literature, which suggests that while CSAs are crucial in allowing emerging market firms to compete internationally, there is still a degree of technological superiority at home. Equally this has implications for the extent to which emerging market firms might, in the future, be able to leverage their country specific advantages to become global competitors of developed country MNEs, and links to our finding regarding productivity growth more generally.

Our results also raise the question as to how or why developed country MNEs retain an advantage over EMNEs. If one allows for the fact that globally a large proportion of OECD FDI is market seeking, then Western firms will determine location by demand for products, and the need to be close to the customer. FDI by these developed country firms is therefore leveraging superior technology with the flexibility of locating near customers in a OLI-consistent manner, often across a many countries within a geographical region, dictating that scale economies are not as important as technological progress, and the need to protect the firm's intellectual property. Our result therefore provides one of the first hard evidence to facilitate an informed discussion about the differences in the sources of advantages of traditional developed country MNEs and EMNEs. Product innovation in the electronics sector is still relatively concentrated in a few leading locations, and there is little evidence that internationalisation by EMNEs is changing that *status quo*. This may in part be related to the sectors in which Chinese firms are distributed, in components and peripherals for example, but our findings suggest that internationalisation in these sectors may not be facilitating EMNEs to move up the value chain. As such, therefore, internationalisation is a not a key part of technology transfer at the product level, but may be linked to technology transfer at the process level. These results demonstrate that long run competitive advantage of EMNEs perhaps needs to be grounded in technical progress. In the absence of technological progress, developed country MNEs would be able to compensate for any scale economy related disadvantage with technology related advantage, thereby preserving any initial gap between the two types of MNEs. However, our results also demonstrate that EMNEs are better able to assimilate technology than their non-MNE domestic counterparts and hence the technological advantage of the developed country MNEs will not necessarily be preserved in the long run. While there is some scope for speculation about these issues, what we can say with much more confidence, on the basis of our results is that while internationalisation does not guarantee technological progress to match developed country MNEs, it is a more reliable route than dependence on spillover effects in the home market. In other words, if developing countries want to develop competitive advantages based on technological progress, they should perhaps focus on creating environments that facilitate overseas investment by domestic firms than on environments that attract inward FDI.

It has been commented on elsewhere, in well known studies of iconic brands such as first IBM, and then Apple, as well as in consumer electronics, that the main driver of profitability is innovation, while the main driver of productivity is scale efficiency at the firm level; it dominates technological progress, on average, in each of the years in the same period. Extending this casual empiricism, our results are consistent with the hypotheses that EMNEs have an advantage with respect to scale economies but that developed country MNEs continue to have an advantage with respect to technological progress. Overall, therefore, the EMNEs and developed country MNEs in our sample can convert factor inputs into output with (roughly) the same degree of efficiency, and both groups are much more efficient than the Chinese non-MNEs. A notable difference between the two groups, however, is in the distribution of firms across sectors: OECD MNEs achieve efficiency gains in less standardised sectors while EMNEs' advantage relates to the production of relatively standard components.[9]

Taken together, these findings represent an important contribution over the existing literature which is based on the *ad hoc* assumption that EMNEs invest overseas in search of technology to enhance their competitiveness. Our results suggest that even subsequent to internationalisation the main source of competitiveness of EMNEs remains their ability to generate growth of scale efficiencies. On the other hand, while developed country MNEs are not able to match the ability of EMNEs to benefit from scale efficiencies their advantage with respect to technological progress keeps them competitive vis-à-vis these emerging market competitors.

Managerial implications: There is a burgeoning literature in the popular press, and the practitioner oriented literature that questions the long term profitability of western firms seeking to relocate to emerging markets. Typically studies find that such firms struggle to convert efficiency gains from low cost production into greater profits. Our findings offer an interesting interpretation of

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[9] In our sample, the Chinese MNEs are generally concentrated in industries with standardised product such as electronic components and computers and peripheral equipment, while the OECD MNEs are concentrated in industries with less standardised product such as instruments and appliances for measuring, testing and navigation and irradiation, electrometrical and electrotherapeutic equipment. For example, while over 20% of Chinese MNEs are concentrated in computers and peripheral equipment, which has a fairly standardised product and where average firm size is 1,447 employees, over 20% of OECD MNEs are concentrated in industries such as Instruments and appliances for measuring, testing and navigation in which products are arguably less standardised and where average firm size is only 965.

this, for both emerging market firms and developed country firms seeking a response to the so called rising powers. From the perspective of developed country MNEs the question of a strategic response to EMNEs is more pertinent. Our results suggest that their ability to generate further gains from scale economies is somewhat limited, even by moving into larger markets, so their focus needs to be on technological development. We have seen large scale investment into China and other emerging markets by western firms seeking a low cost base, but our results suggest that as such countries develop their own capacity, the ability of western firms to compete on these terms is limited. Establishing wholly owned subsidiaries in emerging or developing countries may lead to lower costs, but the extent to which this will drive long run competitive advantage as these countries internationalise is questionable.

Extensions and future work: One significant advantage of our data are the firm numbers across the three categories of firms. Our analysis requires both a large number of firms and a carefully defined sector in order to carry out comparisons in the context of a given country. At present few sectors offer this opportunity. We also acknowledge however that the electronics industry is unusual in terms of the extent to which supply chains are internationalised in this way. Earlier work in this area (see for example Bhaumik et al 2010) focussed on sectors such as automotive and pharmaceuticals, with similar results in terms of the interactions between country and firm level phenomena in explaining internationalisation. However, it is important to recognise the particular features of this sector, and perhaps in the future compare them with other sectors as they develop. Finally, while we have sought to identify firms and their subsidiaries in terms of a relatively well defined sector, we have essentially had to make an assumption that the same scale economies enjoyed by EMNEs are available to (even if not attained by) developed country MNEs. As such we are not able to distinguish between scale economies that are not attained (because perhaps the firms cannot reach sufficient scale) and those not permitted by the technology. Nevertheless we argue that this paper makes an important contribution by bringing into focus some aspects of Chinese EMNEs and other (domestic and foreign) firms with Chinese operations that adds some quantitative evidence to the CSA-FSA debate using a hitherto unused methodology.

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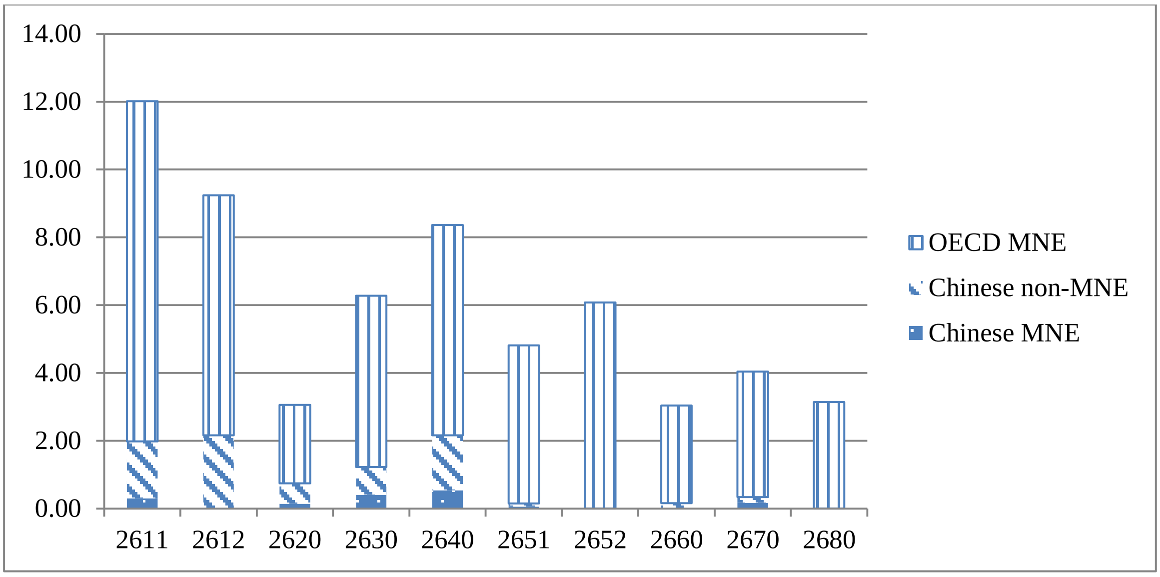
Figure 1: Number of firms in NACE 26 as percentage to industry total by ownership



Note: Figure above represents the number of Chinese MNE, Chinese non-MNE and OECD MNE as percentage of all the firms in the respective industry.

Table 1: Summary statistics by 4-digit NACE code

Industry name	All firms			Chinese MNE			Chinese non-MNE			OECD MNE		
	Output	**Capital**	**Employee**	**Output**	**Capital**	**Employee**	**Output**	**Capital**	**Employee**	**Output**	**Capital**	**Employee**
Electronic components	371972.3 (1734319)	474417.1 (2257169)	1864.54 (7070.34)	1149385 (2240481)	845365.4 (1228209)	10796.97 (18606.23)	256868.1 (299610.4)	367957.8 (495967.3)	4178.09 (5355.918)	1627809 (3891359)	2142011 (5005127)	7318.28 (14592.11)
Loaded electronic boards	231396.4 (1009121)	192736.8 (652842.2)	1557.08 (5797.79)	-- --	-- --	-- --	197494.3 (190662.8)	250773.2 (207181.3)	3505.88 (2740.15)	1508048 (2718115)	1051590 (1599862)	8719.93 (14849.22)
Computers and peripheral equipment	421975.1 (4125162)	312752.6 (3305121)	1447.57 (16024.62)	1937185 (1366762)	1659288 (1301790)	7488.4 (6070.22)	271300.3 (445818.3)	241265.4 (245489.9)	2088.23 (2680.019)	7168477 (18813878)	5889471 (15980694)	16553.99 (45082.69)
Communication equipment	384461.1 (3350892)	403621.6 (3311052)	1228.59 (9043.26)	3028057 (3647819)	3158966 (4107686)	32147.74 (37398.55)	553352 (1315899)	333735.7 (501964.2)	3197.85 (7542.686)	3712459 (11303694)	3939221 (10759334)	9294.93 (26679.48)
Consumer electronics	798428.7 (7032856)	1070502 (10713831)	2352.36 (15848.83)	115949.9 (36229.39)	189005.4 (59342.87)	1459.2 (541.73)	280284.1 (187471.7)	147383.1 (85583.66)	2969.6 (454.6348)	7758179 (21888774)	11054814 (33603607)	21493.33 (47801.67)
Instruments and appliances for measuring, testing and navigation	229753.7 (3164878)	271476.3 (3814212)	965.6244 (13307.93)	355934.6 (49523.41)	377336.9 (49444.23)	92.2 (17.65)	96956.52 (49484.13)	165895.1 (64259.1)	1856 (372.742)	1544501 (4341700)	1758169 (4505672)	6437.66 (18641.34)
Watches and clocks	225074.1 (899100.6)	254922.1 (1015683)	1003.15 (3853.79)	-- --	-- --	-- --	-- --	-- --	-- --	2424224 (1878143)	2714828 (2151748)	10440.4 (8013.61)
Irradiation, electrometrical and electrotherapeutic equipment	67552.35 (654668.6)	111261.6 (1297180)	283.24 (2683.31)	-- --	-- --	-- --	43050.91 (46449.45)	75386.07 (58466.01)	914.9 (376.69)	985790.2 (2436556)	1874360 (5441617)	3178.25 (7080.50)
Optical instruments and photographic equipment	283638.6 (1835179)	329387.2 (2218934)	1217.96 (6432.17)	445754 (32983.07)	347356.3 (47586.77)	2690 (151.49)	119210.4 (32485.17)	145644.1 (20725.06)	6480.4 (744.061)	4175198 (6497694)	4997941 (7918989)	15580.46 (20990.58)
Magnetic and optical media	33285.23 (100785.8)	43684.72 (127137.3)	239.72 (862.44)	-- --	-- --	-- --	-- --	-- --	-- --	609.344 (118.64)	731.026 (148.83)	12.6 (2.88)

Note: The figure reported are the mean value, standard deviation in parentheses.

Table 2: Summary statistics and correlation

Variable	Obs.	Mean#	Std. Dev.	Turnover	Asset	Employee
Full sample						
Output*	65535	250006	2994043	1		
Capital	65535	280787	3801338	0.9128	1	
Employee	65535	969	10686	0.9003	0.8118	1
Chinese MNEs						
Output	120	2144876	3749464	1		
Capital	120	1721883	2799651	0.8745	1	
Employee	120	16177	25407	0.6484	0.8301	1

#The arithmetic mean values.

*The value of output and capital are converted into US dollar at end of year exchange rate.

Table 3: Estimation results

Explanatory Variable	True Random Effect+	Geometric mean value of variable		
		Chinese MNEs	Chinese non-MNEs	Developed country MNEs
Capital	0.649*** (0.002)	53373	14556.76	35948.82
Labour	0.375*** (0.004)	576	343	219

+The elasticity of capital and labour measured at their geometric mean.
***Indicating significant at 1% statistical level

Table 4: Total factor productivity changes (mean value)

Year	Malmquist TFP	Scale Change	Technical Progress	Efficiency Change
2006	7.85	12.21	-4.95	0.60
2007	0.95	2.07	-4.46	3.33
2008	-2.40	3.60	-4.02	-1.98
2009	2.86	5.82	-3.61	0.66
2005-2009	2.32	5.92	-4.26	0.65

Source: Authors' own calculation.

Table 5: Comparison between Technical efficiency change and scale change rates

	Chinese MNEs			**Chinese non-MNEs**			**D**
Measure	Annualised Change rate	Cumulative change rate 2005-9	Std. Dev.	Annualised Change rate	Cumulative change rate 2005-9	Std. Dev.	Annua Chang rate
Technical efficiency change rate	3.71	7.85	22.53	8.49	21.35	74.72	5.65
Scale change rate	8.86	21.91	32.00	4.00	10.32	10.94	3.75
Technical progress	-3.87	-10.15	1.87	-5.22	-13.53	2.71	-2.93

Figure 2: Cumulative of scale change rate