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The Roles of Emerging Multinational Companies' Technology-driven FDIs in their Learning Processes for Innovation: A dynamic and contextual perspective

Ju Liu (ju.liu@circle.lu.se)
CIRCLE, Lund University

Rasmus Lema (lema@business.aau.dk)
Department of Business and Management, Aalborg University

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Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University
P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN
http://www.circle.lu.se/publications

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JEL codes: F23, O32, D22

Keywords: Foreign direct investment, Emerging multinational companies, Technology, Innovation, Wind energy, China, Europe

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CIRCLE, Lund University, Sweden.
ju.liu@circle.lu.se

Rasmus Lema
Department of Business and Management, Aalborg University, Denmark.
lema@business.aau.dk

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1. Introduction

Outward foreign direct investments from developing and emerging economies have grown significantly over the last decade and have now reached unprecedented levels. In 2013, outward foreign direct investments from these economies reached 553 billion USD, accounting for 39% of global foreign direct investment outflows (UNCTAD 2014). In China alone it reached a historical high of 120 billion USD. This meant that the country's flow of outward investments overtook the inflow of foreign direct investments (MOC 2014). The most noticeable trend of this new wave of internationalisation is the increase in technology-driven foreign direct investments (TFDIs) undertaken by emerging multinational companies (EMNCs). These EMNCs are targeting what are probably the most important assets in the developed world – knowledge and technology (Awate, Larsen and Mudambi 2012).

TFDI from emerging economies to advanced countries is a new phenomenon in many respects. Empirical research has shown that the practices of internationalisation and innovation in EMNCs, which originate from different industrial and territorial contexts, present important differences from those of the advanced-country MNCs (AMNCs) (Bonaglia, Goldstein and Mathews 2007, i.e. Di Minin, Zhang and Gammeltoft 2012, Tan and Mathews 2014, Lyles, Li and Yan 2014). In this paper we show that Chinese EMNCs' TFDIs are not only different from those of the AMNCs but also differ significantly among themselves with regard to learning and innovation strategies in the different capability-building contexts of the industry.

The emerging phenomenon of EMNCs' TFDIs presents an important challenge to the conventional international business literature. It creates a new rationale for revisiting the literature (Amsden and Chu 2003, Mathews 2006, Rugman 2008, Goldstein 2009, Gammeltoft, Filatotchev and Hobdari 2012, Cuervo-Cazurra and Ramamurti 2014). Conventional international business theories, which have significantly contributed to our understanding of the international strategies and practices of AMNCs, are criticised for being static (Li 2003, Mathews 2006). They appear to ignore the many different resource endowments that EMNCs have (Erdener and Shapiro 2005) as well as the distinctive institutional settings in which EMNCs are embedded (Peng, Wang and Jiang 2008). These criticisms reflect the important fact that the development of international business theories should take EMNCs' practice as a dynamic and contextual phenomenon, particularly when it comes to the fast-growing EMNCs' TFDIs.

A dynamic perspective is needed when understanding the role of TFDI in firms' learning processes for innovation. EMNCs' TFDIs do not constitute a one-stroke transaction of technology ownership but a continuously ongoing learning process for innovation with the phases of preparation implementation and maintenance To understand the role of TFDI in the learning process for innovation, both the pre- and post-TFDI learning processes should be considered.

Contextualised theorising is needed to generate a theoretical contribution about EMNCs' TFDIs. The tension between scientific explanation and context has been an important common concern for international business (IB) research. Research on China, one of the

fastest-growing emerging economies, has presented a lively debate on the need for contextualised theories (Tsui 2006, Child 2009, Jia, You and Du 2012). EMNCs' TFDIs are not isolated activities. Rather, the learning process arising from TFDIs intertwines with the capability-building process in domestic industry. Evolutionary perspective, path-dependent resources and the accumulative learning process are useful perspectives to explain the dynamics of MNCs' TFDIs (Dunning and Lundan 2008, Cantwell, Dunning and Lundan 2010). Therefore, to understand the roles of TFDIs in EMNCs' learning processes for innovation, capability-building of the domestic industry should also be studied as the contextual background.

Taking a dynamic perspective, the aim of this paper is to contextually theorise the roles of EMNCs' TFDIs in their learning processes for innovation. It develops a dynamic and contextual analytical framework from a learning-based view to analyse the pre- and post-TFDI learning process. The framework contains an analysis of learning dynamics and learning context. The learning dynamics refer to changes in the three key elements of learning: knowledge (what to learn), linkage (from whom to learn) and activity (how to learn). The learning context refers to the production and innovation capability-building of the industry, which influences the learning processes of the firms in question. We selected two leading firms in the Chinese wind energy industry who conducted TFDI in Europe in the same year. We investigated the learning dynamics in their pre- and post-TFDI phases and the context of the fast-growing Chinese wind energy industry, in which the learning processes happened so as to contextually theorise the roles of the case firms' TFDIs in their learning processes for innovation.

The key research questions addressed in this paper are as follows:

1) How did the pre- and post-TFDI learning process happen in the case firms?
2) What are the roles of the TFDIs in the case firms' learning processes for innovation?
3) What are the policy implications?

Based on the primary and secondary data collected in the firms' Chinese headquarters and European subsidiaries, it is found that the case firms' TFDIs play different roles. To the pioneer firm, which has accumulated production technology and capacity since the early capability-building stage of the domestic industry, TFDI is an *accelerator* to boost the firm's innovation by seeking and securing the design technology abroad and exploiting the production technology and capacity already possessed by the company. To the newcomer, which was only established when domestic industry was already mature, TFDI is the *starter* for the firm to quickly acquire design technology internationally and to exploit the production technology and capacity not developed within the firm but acquired domestically.

The contribution of this paper is threefold. First, it develops a dynamic and contextual analytical framework from a learning-based view for analysing the learning process in the pre- and post-TFDI period. Second, it contextually theorises the roles of TFDIs in the EMNCs' learning processes based on the learning dynamics of the firms in the learning context of the industry's capability-building. Third, it generates policy implications for emerging countries who intend to tap into the global knowledge and technology pool.

This paper is structured as follows. Section 2 presents the theoretical background and analytical framework of the paper. Section 3 introduces the case study method in detail. Section 4 presents the main findings about the two case firms' learning processes in terms of learning dynamics and learning context. Based on a comparison of the two cases, this section contextually theorises the roles of the TFDIs in the two case EMNCs' learning processes for innovation. It also draws policy insights for emerging countries in a similar situation. Section 5 concludes the paper.

2. Theoretical background and analytical framework

2.1 The EMNCs' TFDI and the learning-based view

TFDIs refer to foreign direct investments aimed at accessing, obtaining or creating technology assets to enhance innovation capabilities in view of the long-term competitiveness in the investing company. Technology assets are typical strategic assets (Dunning 1993, Dunning and Narula 1995), which are critical to firms' long-term competitiveness. The concept of TFDI falls into the same category of strategic asset-seeking FDI as other similar concepts, such as knowledge-seeking FDI (Chung and Alcácer 2002), asset-seeking FDI (Makino, Lau and Yeh 2002, Ivarsson and Jonsson 2003) and springboard FDI (Luo and Tung 2007). The strategic asset-seeking FDI has been widely studied in international business literature, from FDIs among advanced countries (i.e. Kogut and Chang 1991, Almeida 1996, Shan and Song 1997) to FDIs from emerging economies (Chen and Chen 1998, Kumar 1998, Hoesel 1999, Makino et al. 2002, Mathews 2006), particularly, in recent years, from China (Rui and Yip 2008, Deng 2009, Li, Li and Shapiro 2012, Cui, Meyer and Hu 2014, Anderson, Sutherland and Severe 2015). One distinctive characteristic of this type of FDI, compared with other forms of FDI (market-seeking, efficiency-seeking, natural resource-seeking) as distinguished in FDI literature (Dunning 1998, Makino et al. 2002, Buckley et al. 2007), is its explorative motive (Meyer 2015); the explorative motive implies the great importance of learning (Makino and Inkpen 2003).

The concept of learning has long been embedded in international business theories. The learning-based view sees MNCs' internationalisation as a cross-border learning process (Li 2010). An important contribution of the international business model with a learning-based view is the Linkage-Leverage-Learning model (Mathews 2006), which is developed upon the observation of the accelerated internationalisation of latecomers from emerging countries. Linkage refers to connections with incumbents in advanced countries who are the external knowledge suppliers with the knowledge that the EMNCs seek. Leverage implies the integration of acquired external knowledge with prior related internal knowledge for innovation. Learning emphasises the repeated application of linkage and leverage based on previous success or failure.

The LLL model offers a dynamic and external perspective in accounting for the success of EMNCs' accelerated internationalisation. It explains how a latecomer, whose resources and capabilities are initially deficient and weak, overcomes this disadvantage and accelerates its capability- and competence-building by learning from abroad. Unlike the conventional international business model, which is considered to be static and inward-looking, the LLL

model adopts a dynamic and external perspective (Li 2007). It conceptualises the latecomer's internationalisation process as a continual process of linking and leveraging that leads to learning.

Nevertheless, the LLL model focuses on what to learn from external partners but ignores what can be offered to external partners in order to encourage knowledge transfer. It assumes that, once the linkage is set up, the resources owned by the incumbents or partners will be obtained if the resources themselves are imitable, transferable or substitutable. It does not discuss the incumbent or partner's willingness to transfer knowledge, which is directly related to the benefit that the incumbents or partners will get in return (Foss and Pedersen 2004). Thus, the LLL model cannot explain why the EMNCs' acceleration of internationalisation happened at a specific time or place and did not happen earlier or elsewhere. The LLL model has strong explanatory power in the accumulative and accelerated internationalisation of the latecomers from emerging countries, but it cannot give a clear account of the extreme case of accelerated internationalisation, which is the emergence of the born-global newcomers (Knight and Cavusgil 2004).

2.2 Towards a dynamic and contextual analytical framework

Keeping the dynamic perspective and external focus of the LLL model, the paper extends the model by adding an internal focus and extending the external focus. First, we look into not only what can be learnt from outside but also what has been possessed internally that can be offered to the collaborators to encourage exchange. Understanding the knowledge and technology that the EMNCs have accumulated internally is crucial for answering the question of when and why the incumbents in advanced countries are willing to share or trade their knowledge and technology for what they want in return. Second, our framework includes not only external incumbents in advanced countries but also external actors in domestic markets, such as domestic suppliers, customers, universities and research institutions. The domestic linkages are non-separable important relations of the EMNCs' learning networks. The capability-building of the domestic actors forms an important context in which the EMNC learns. Understanding the learning context helps to answer the question of what can be learnt or leveraged domestically instead of internationally.

Hence, the paper suggests a dynamic and contextual learning-based framework (see Figure 1) for understanding the roles of EMNCs' TFDIs in the learning processes for innovation. The framework focuses on the learning dynamics and the learning context.

2.2.1 The learning dynamics

The learning dynamics include the change of the three key elements of learning – knowledge, linkage and activity.

In terms of knowledge, we analyse the internal knowledge that the EMNCs have within the firm and the external knowledge that the EMNCs intend to acquire from outside as a strategic asset. Internal knowledge is related to absorptive capability (Cohen and Levinthal 1990, Lane, Salk and Lyles 2001, Chen 2004), which is essential for learning. It is also related to what the

EMNCs can offer to their international partners to encourage knowledge exchange. External knowledge is related to complementarity to the EMNCs' internal knowledge. Once external knowledge is integrated into the firms' internal system it becomes internal knowledge. By such integration, the firms increased their absorptive capacity and are able to seek more sophisticated external knowledge. The success of knowledge transfer depends highly on the absorptive capacity of the learning firm, which is largely a function of the firm's level of prior internal knowledge (Cohen and Levinthal 1990), the transferability of the external knowledge itself and the external sending firm's willingness to transfer knowledge (Hamel 1991).

In terms of linkage, we investigate the direct linkage for learning. Linkages refer to the firm's connections with both domestic and international players, such as suppliers, universities and research institutions. Unlike the conventional international business literature on FDI, which pays more attention to international linkages, this research investigates both domestic linkages and international connections. It is important to understand the differences and interplay between external knowledge that is domestically acquired and internationally acquired. Such difference and interplay may illuminate important implications in understanding the roles of TFDIs in firms' learning processes for innovation in the context of domestic industrial capability-building.

In terms of activity, we study three kinds of activities of learning, as defined by the OECD Oslo Manual (Oecd 2005), including: 1) accessing openly available information at a low cost, such as visiting industrial fairs, attending conferences and participating in training; 2) acquiring knowledge and technology without active cooperation with the source, such as purchasing equipment, purchasing consultant services, outsourcing contract research or hiring talent; and 3) actively collaborating in innovation projects. The activities imply different modes of knowledge dynamics, such as knowledge spillover with no formal relationship, knowledge acquisition through market relationships and knowledge creation by interactive collaboration. The different modes of knowledge dynamics reflect different intensities of learning.

2.2.2 The learning context

The learning context refers to the domestic industry's production and innovation capability-building, which may have a spillover effect on the focal firm's learning process. Industrial capability-building has long been in the core of analysis in the catch-up literature (Fagerberg and Godinho 2004, Fagerberg and Srholec 2008, Awate, Larsen and Mudambi 2012, Bell and Figueiredo 2012, Lee 2013). It has been used as an analytical device to interpret the success of catch-up in newly industrialised economies, such as Korea and Taiwan (Kim 1993, Park and Lee 2006, Hu 2012, Lee 2013). There are two kinds of capability that are commonly identified as the important catch-up determinants: production capability and innovation capability (Bell and Pavitt 1995, Bell and Figueiredo 2012).

In this paper, production capability is related to technologies, knowledge, and skills which are applied to bring design to marketable products. It contains two aspects of capabilities. The first is the technological capability of incorporating advanced technical and design specifications, as well as the performance features of the product. The second is the

production capacity of increasing productivity and scaling up the product quantity. Innovation capability is related to technologies, knowledge and skills which are used to develop new products and designs.

Production capability is interrelated with innovation capability. Even though it is found that the catch-up of production capability is easier than that of innovation capability (Awate, Larsen and Mudambi 2012)., it is also found that emerging countries' production capability-building through engaging in the global production network has greatly benefited their transition from imitation to innovation (Kim 1993, Lee 2013). This is evident in the capability-building of China's wind energy industry (Ru et al. 2012, Qiu and Anadon 2012, Silva and Klagge 2013, Nahm and Steinfeld 2014).

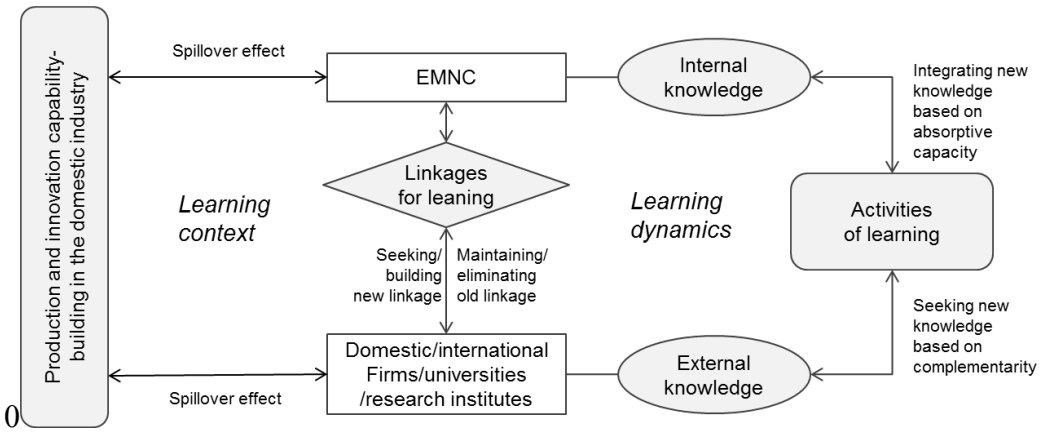

Figure 1. The dynamic and contextual analytical framework

Under this analytical framework, this paper investigates, in the pre- and post-TFDI period, what kind of prior internal knowledge the case EMNCs have possessed, what kind of external knowledge the case firms have looked for, what kind of domestic and international linkages the case firms have had for accessing the target external knowledge, and what kind of learning activities they have conducted to internalise the external knowledge. Combining the analysis of the spillover effect of the domestic industry's capability-building on the EMNCs' learning processes, we expect to have a holistic understanding of the roles of TFDIs in the case firms' learning processes.

3. Methods

The paper adopts a comparative case study method to investigate two leading Chinese wind energy MNCs' pre- and post-TFDI learning processes in the fast-growing Chinese wind energy industry. An in-depth case study method offers great opportunities for understanding the mechanism of the formation of a certain pattern in reality (Eisenhardt 1989, Yin 2003). Both case firms are lead companies in China's wind energy industry. Both case firms have high innovation performance in terms of patent application and new product development compared with other Chinese wind energy companies. Both case firms have TFDI in European countries, with the clear intention of acquiring technological innovation capability. Both case firms' TFDIs became the milestone marking the start of the Chinese wind energy

companies' internationalisation for technology and innovation. Nevertheless, these two companies present very different learning processes. One is the pioneer, starting from scratch in the very early stages of China's wind energy industry, while the other is a newcomer, joining in when the wind energy industry was becoming mature. We intend to see if TFDI plays different roles in the two case firms' learning processes for innovation. If they are different, how and why?

One case is Xinjiang Goldwind Science & Technology Co., Ltd. Goldwind is a leading and pioneering wind energy company, established in 1998 as a spin-off from a public research institution which had started a wind energy project in 1988. It has been a pioneer in China's wind energy industry and is now the biggest wind turbine company in China. The company has operations in six countries, including a manufacturing factory in Germany. It has two headquarters in China and one each in the US, Germany and Australia. Goldwind has one R&D centre in China and one in Germany, which was acquired in 2008 through TFDI.

The other case is Envision Energy Co., Ltd. It was established in 2007 as a latecomer. It built up a global innovation centre in Denmark in 2008, right after its establishment. Four years later, Envision's number of patent applications has reached the highest in China. It is now a key player in China's wind energy industry, characterised by its smart energy solution, which integrates information technologies and energy technologies. The company now has one R&D centre in Denmark, two in the US, one in Japan, two in China and one manufacturing plant and one sales office in China. The Danish R&D centre is Envision's only international centre for wind turbine R&D.

This paper used multiple data sources to search for more accurate information and improve the robustness of the results (Jick 1979). Data sources used by this paper include semi-structured interviews, annual reports, internal documents, industrial reports, policy documents, press news and academic publications on the case firms. The interviews were conducted in both the headquarters in Beijing and Shanghai, China, as well as in the R&D centres in Germany and Denmark in 2013. Each interview lasted around two hours. All interviews, except one in Germany, were recorded and transcript was made under a confidentiality agreement. The subsequent interviews with the two companies' suppliers and industrial experts were conducted in China in 2014 and 2015. These interviews were not recorded, because of the interviewees' reluctance to be recorded.

4. Main findings

First, this section will present the main findings about the two cases, including 1) the summary of the learning process, 2) the investigation of the learning dynamics and 3) the analysis of the TFDI's role in the leaning process. Second, based on our comparison learning dynamics, and particularly the learning contexts of the two case EMNCs' learning processes, this paper will contextually theorise the roles of the TFDIs in the two case EMNCs' learning processes.

4.1 Case A: Xinjiang Goldwind Science & Technology Co., Ltd

4.1.1 The accumulative learning process in Goldwind (1988–present)

Goldwind is the pioneer in China's wind energy industry. It started from running a small wind farm donated by an international donor in the late 1980s. In the 1990s, Goldwind imported a 600kW wind turbine from Germany and started to build up production capacity based on imitation. Until 2002, Goldwind had accumulated a production capacity of 200 units of 600kW–750kW wind turbines per year. In 2003, Goldwind made a strategic decision to focus only on permanent magnet direct drive (PMDD) technology and started to look for foreign design technology suppliers. Through their previous partner in RePower (the RePower senior managers became Vensys's main shareholders), Goldwind linked up with Vensys. Vensys was then a small wind turbine design studio, with around 20 personnel specialised in PMDD wind turbine design, but had no production capacity at all. In the same year, Goldwind was granted Vensys's licence of the 1.2MW model and started to co-develop and test production in the second year. Just a year later, Goldwind started commercial production of the 1.2MW wind turbine.

Goldwind's successful commercialisation of Vensys's design encouraged both sides towards further long-term collaboration. To Goldwind, the licenced Vensys technology helped Goldwind to exploit and further enhance its production knowledge and technology. To Vensys, licensing posed risks of IPR infringements and provided only limited financial benefit. At the same time, selling the PMDD technology, which needs rare earth resources for construction, to the Chinese firm is strategically sensible, as China is one of the few countries to have access to rare earth resources, whereas other countries – such as Germany – struggle to access rare earth resources. It was much more beneficial for Vensys to have a long-term collaborator who could commercialise its design on a big scale. In collaboration with Goldwind, Vensys gets access to the Chinese production capacity, market and contacts. Based on the consensus on the long-term mutual benefit, in 2006 Goldwind built a factory alongside Vensys to further enhance their collaboration on the 1.5MW model. The licensing and collaboration for production greatly improved Goldwind's technological capability. In 2008, Goldwind bought a 70% share in Vensys and in 2009 Goldwind developed the 2.5MW model and the 3.0MW model together with Vensys. In 2013, Goldwind accomplished the R&D and test production of the 6.0 MW model. It can be clearly seen after the 2006 FDI and the 2008 TFDI that Goldwind's patent applications and new product launches were accelerated. By 2013 Goldwind had become the third largest wind energy company in China and had twice been selected as one of "the 50 most innovative companies in the world" by MIT.

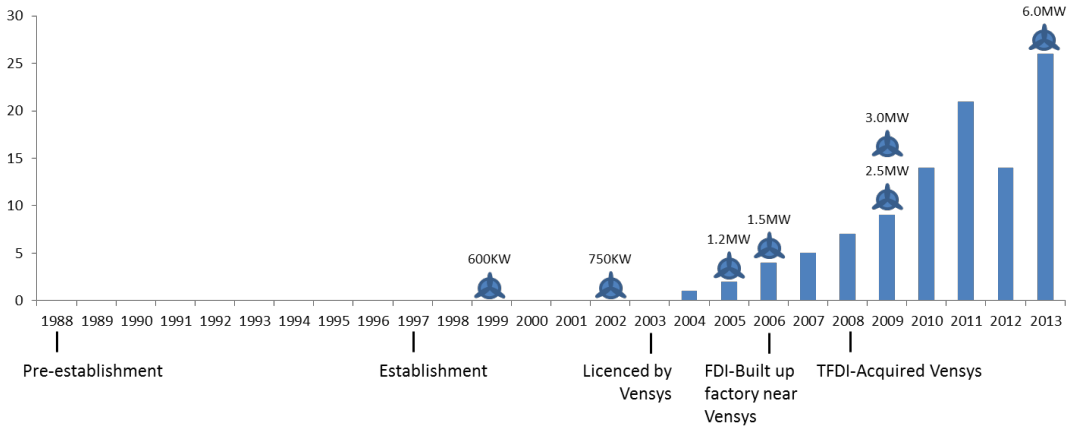

Figure 2. Number of patent applications and new product launches by Goldwind (1988–2013)
Sources: Goldwind website, annual reports and European Patent Office

4.1.2 The learning dynamics in Goldwind's pre- and post-TFDI period

To understand the learning dynamics, we investigate the knowledge, linkages and activities of Goldwind's learning process for innovation during the different stages between 1988 and 2013 (see Table 1).

Table 1: Knowledge, linkages and activities of the learning process in Goldwind (1988–2013)

	Pre-establishment (1988–1997)	Post-establishment and pre-TFDI (1998–2006)	Post-TFDI (2007–2013)
Internal knowledge	• Knowledge mainly about local wind resources	• Knowledge about managing wind farms in different domestic locations • Knowledge about wind turbine assembly • Knowledge about large-scale manufacturing of low-volume turbines	• Knowledge about managing wind farms in different international locations • Knowledge about large-scale manufacturing of high-volume turbines • Certain knowledge about wind turbine design
External knowledge to be sought	• Knowledge about operating wind turbines • Knowledge about managing wind farms	• Knowledge about large-scale manufacturing of high-volume turbine • Knowledge about wind turbine design	• Knowledge about advanced manufacturing • Knowledge about advanced wind turbine design
Linkages	• Local research institution (Xinjiang Institute of Technology, Xinjiang Institute for Energy)	• International technology supplier (Vensys) • International component suppliers (Siemens)	• International component suppliers (GH, Aerodyn, Siemens) • International research institutions and universities

	• International equipment donor (Bonus, Jacobs, RePower)	• Domestic research institutions and universities (Xinjiang Institute for Wind Energy, CAS, Tsinghua University) • Domestic component supplier (Huiteng, Chongqing, Nanjing, Dalian, Nanyang, Zhuzhou, Lanzhou, Yongji, Xiangtang)	(Fachnochschule Saarbrucken) • Domestic research institutions and universities (Zhejiang University, Tsinhua University, China Research Institute for Power Electrics) • Domestic component suppliers (Huiteng, Zhongfu, LM, Nanjing, Chongqing, Yongji, Zhuzhou)
Activities (main ones)	• Installing international donor's product • Human mobility from local research institution • Visiting international wind farm and international equipment manufacturer • Participating in international industry fairs • Visiting and training in domestic research institution	• Importing advanced countries' products and designs • Human mobility from domestic research institutions and competitors • Visiting and training in international technology suppliers' location	• Collaboration with international technology and component suppliers and knowledge infrastructures for co-development of new product • Collaborating with domestic research institutions and universities • Human mobility from domestic and international competitors and collaborators • Training organised by domestic industrial association and firm's international R&D centre

Sources: primary and second-hand data collected by authors from interviews, industrial reports, media reports and the following sources: company website, www.goldwind.com (in Chinese); China wind energy report 2007–2014 (in Chinese); China Renewable Energy Scale-up Program, www.cresp.org.cn (in Chinese); China Wind energy info-net, www.cnwp.org.cn (in Chinese)

Analysing the change of the three learning elements, we can clearly see the learning dynamics of Goldwind's learning process in the pre- and post-TFDI period.

First, Goldwind's internal knowledge has been incrementally upgraded. The externally sought knowledge of previous stage became the internal knowledge of the next stage. Once the external knowledge was integrated into Goldwind's internal system, the company started to seek more complex and sophisticated knowledge. Thus, knowledge has kept being upgraded and translated into innovation in the form of patents and new products.

Second, the linkage with international design technology suppliers is a long-term continual relationship with the same senior managers. It seems to be different relationships with

different companies (Jacob, RePower, then Vensys) but, actually, Goldwind has kept collaborating with the same senior managers when they successively joined these companies. This linkage has become increasingly strong, from a relationship for licensing in the early stages, to collaboration for co-developing and producing, and then to shared ownership. Noticeably, the linkages that Goldwind has had over time include many other domestic and international component suppliers and knowledge suppliers. We see a bigger number of domestic and international knowledge and technology suppliers in the later stages than in the early stages.

Third, the activities for learning become more intense and broader over time. The mode of knowledge transfer changed from one directional knowledge spillover without formal relationship (e.g. visiting international manufacturers and participating in industry fairs) in the early stages, to knowledge spillover with formal relationship (e.g. importing products, training at international collaborators' locations), then to the most interactive learning with formal relationship at the later stages. The sources of learning extended from one domestic research institution to more and more technology and knowledge sources, such as domestic and international knowledge infrastructures, technology suppliers, component suppliers and competitors.

4.1.3 The accelerator role of the TFDI in the learning process for innovation in Goldwind

We argue that the TFDI of Goldwind in Vensys plays a role as an accelerator in their process of learning for innovation. Before conducting TFDI in Vensys, Goldwind had spent 20 years transiting from "learning to produce" to "learning to produce efficiently" through imitating and revising engineering since the late 1980s. Goldwind had already accumulated production technology and large-scale production capacity for the 600kW and 700kW wind turbine model in 2002. But then the company started to move toward "learning to improve a product" and, further, to "learning to develop new products". The 2003 Vensys licensing of the 1.2MW model provided Goldwind with the opportunity of learning to develop new products. After co-developing and producing the 1.2MW model in 2005 and the 1.5MW model in 2006, Goldwind decided to further enhance their collaboration with Vensys. It built a factory near Vensys in 2006 and acquired the company in 2008. The 2006 FDI enhanced the collaboration by a commitment to the partnership. The 2008 TFDI enhanced the collaboration by shared ownership. Without the TFDI in Vensys, Goldwind might still have been able to develop their technological capability via licensing. But with TFDI, the learning process was speeded up.

The accelerator role of the TFDI in its learning process is verified by our interviews at both the Goldwind's headquarters in Beijing and the subsidiary in Germany. In terms of Goldwind's innovation strategy and internationalisation practice, the VP of Goldwind International commented:

> "Goldwind deployed a three-step innovation strategy: importing technology by licencing, co-developing product via collaboration, and integrating the two companies (Goldwind and Vensys) through merge and acquisition. The strategy was very successful. Goldwind's first PMDD wind turbine are

> designed by Vensys … actually even nowadays, all the mainstream models are based on Vensys technology. Without investing in Vensys technology, we would not have been able to launch the PMDD product series so quickly. Without acquiring Vensys, it may take us longer time, let's say 3 to 5 more years, to build up the same technological capability as we have today."

The Vensys senior manager, who had collaborated with Goldwind for over 15 years, commented:

> "Vensys has had collaboration with Goldwind for a long time. Operational, scientific, and design knowledge has been constantly flowing between the two firms … the quality in China side has been increased tremendously. Yet it cannot be said that this is due to the acquisition. Maybe it would have happened anyway because of the good cooperation we already had before … But if you ask about the difference before and after the acquisition, one example is that after the acquisition Goldwind shortly mastered the gearless station technology. Another example is that Vensys started training and qualification of Chinese suppliers for Goldwind. It would not have happened without the M&A."

Evidently, the TFDI enhanced the collaboration between Goldwind and Vensys. It speeded up the learning process for innovation.

4.2 Case B: Envision Energy Co., Ltd.

4.2.1 The rapid learning process in Envision (2006–present)

Envision is a fast-growing newcomer in China's wind energy industry. It was established in 2007. Right after its establishment, in 2008 the company built up an R&D centre in the greater Aarhus area in Denmark with the objective of developing "good and cheap" larger turbines for the global market. The major goal for Envision's R&D centre in Denmark was to design "the future wind turbine". In 2009, Envision successfully developed the world's first 1.5MW turbine with 87-metre rotor blades. According to the informants at the Danish R&D centre, the companies' technological level had reached between advanced and world-leading level in 2010, less than three years from its establishment. In 2012, the company launched the "game changer", a 3.6MW two-bladed rotor with partial pitch combined with direct drive technology, which saves costs on towers, foundations, nacelle, rotor, blades and transportation. It gives a reduction of approximately 8–10% in the cost of energy. The two-bladed turbine has significant advantages in typhoon conditions in conjunction with revolutionary technologies in variable-pitch blades and carbon fibre shafts. Envision's Danish R&D centre has installed most of the electrical components in a "box" outside or beside the turbine near the base. This enables Envision to reduce the cost of replacing a component by approximately 75%. In the same year, Envision launched the world's first 1.5MW low-speed turbine with 93-metre rotor

blades, and in 2013 the world's first 2.1MW turbine with 110-metre rotor blades and its own smart dual-mode electric drive chain technology. Envision is now the biggest offshore wind turbine manufacturer in China and the largest smart energy management company in the world.

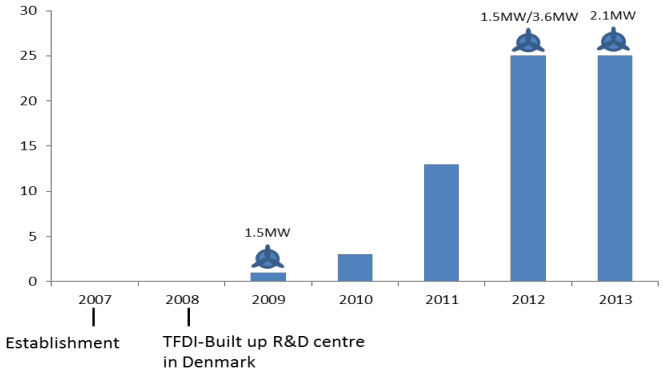

Figure 3. Number of patent applications and new product launches by Envision (2007–2013)
Sources: Envision website, company reports and European Patent Office

4.2.2 The learning dynamics in Envision's pre- and post-TFDI period

To understand the learning dynamics, we investigate the knowledge, linkages and activities of Envision's learning process for innovation between 2007 and 2013 (see Table 2).

Table 2: Knowledge, linkages and activities of the learning process in Envision (2007–2013)

	Post-establishment and pre-TFDI (2006–2007)	Post-TFDI (2008–2013)
Internal knowledge	• Knowledge about industry and technology development trends • Knowledge about star engineers and managers in the industry	• Knowledge about managing wind farms • Knowledge about wind turbine manufacturing • Knowledge about wind turbine design • Knowledge about energy internet
External knowledge	• Knowledge about managing wind farms • Knowledge about wind turbine manufacturing • Knowledge about wind turbine design	• Knowledge about advanced manufacturing • Knowledge about design • Knowledge about advanced smart energy management
Linkage for learning	• International players in the wind energy cluster of Denmark (Gamesa, Vestas, etc.)	• International collaborator (LM) • International supplier (Winergy) • Domestic supplier (Jixin, Guoguang, Fangyuan, Xingcheng, Shuangliang, Chengxi) • Domestic university (Beijing University)
Activities of learning	• Hiring top managers and engineers from	• Human mobility from international and domestic markets

	international competitors • Participating in international industry fairs	• Exchange of training and visiting between headquarters and international subsidiaries • Collaboration in R&D between headquarters and international subsidiaries

Sources: primary and second-hand data collected by authors from interviews, industrial reports, media reports and the following sources: company website, www.envisioncn.com; China wind energy report 2010–2014 (in Chinese); China Wind energy info-net, www.cnwp.org.cn (in Chinese)

Analysing the change of the three learning elements, we can clearly see the learning dynamics of Envision's learning process in the pre- and post-TFDI period.

First, Envision quickly built up an internal knowledge base by internationally sourced top managers and engineers with world-class knowledge and capabilities. At the beginning of its establishment, Envision had almost no accumulated internal knowledge about wind turbine manufacturing. Instead, what Envision had was the knowledge about the business opportunities in the wind energy industry and about where and how to find talent. The founder and CEO of Envision was an energy analyst and energy derivatives manager working in London before he started Envision. He has a great deal of knowledge about global energy markets and the development trends of the energy industry. He and his founding team, which consists of 10 returnees,have a broad international network from which they know where and how to attract the top managers and engineers in the industry.

Second, Envision has had close linkage with the world's leading wind energy clusters since the beginning of its establishment. Envision's first group of employees was hired in Denmark, where the world's leading wind energy cluster is located. The hiring of a former director of Gamesa's office in Denmark was considered to be "a significant input to the decision of investing in Denmark". Most of the personnel in Envision's Danish R&D centre were recruited from the old network of key managers. Most of the personnel had previously worked for wind energy multinationals such as Vestas, Siemens, Gamesa and Suzlon. Starting with the excellent network in the world's wind energy industry, Envision continued to develop its global network by collaborating with international, as well as domestic, component suppliers and knowledge suppliers. The great ambition of competing using technology, rather than low-cost labour, and the talent-orientated strategy have made Envision an attractive employer to domestic and international talent. It has also increased the legitimacy of Envision as a global player in the world's wind energy industry.

Third, the learning activity started from and heavily depends on knowledge acquisition via human mobility from international and domestic wind energy clusters. The experienced key managers are the key resources for learning. They have not only knowledge about technology and industry but also a broad social network in the industry. As the Envision R&D director said, they are able to quickly build up R&D capability through their personal networks. After acquiring international talent, Envision encouraged international R&D centres to collaborate with domestic headquarters so as to transfer knowledge from international centres of excellence back home.

4.2.3 The starter role of TFDI in the learning process for innovation in Envision

We argue that the role of TFDI in the learning process for innovation in Envision is like a starter which quickly built up its innovation capability from scratch. Envision rapidly built up its innovation capability via an aggressive internationalisation strategy. Shortly after the establishment of Envision, the company conducted TFDI in Denmark. Two years later, Envision launched its new product, the world's first 1.5MW turbine with 87-metre rotor blades. Envision only spent less than three years building up capabilities for the whole process of wind turbine manufacturing, from design and protocol testing to large-scale production. All of this achievement depends highly on its talent development strategy of hiring internationally. Over 20% of the company's employees are foreigners and 60% of employees have master's or PhD degrees, which is not common among their competitors in China.

The Harvard Business Review (2014) commented on Envision's talent development strategy:

> *"The CEO and VP of Envision were convinced that many successful executives were searching for a greater sense of meaning in their work—a big and exciting idea to lead the industry forward—and that's what they offered. They wanted employees who could work across cultures and who had an 'open innovation' mind-set, so they confined their recruiting to people with multinational experience. They took their search to global pockets of excellence: to Denmark for engineers with alternative-energy-innovation skills, to the United States for software architects, and to Japan for managers skilled in lean manufacturing techniques. They attracted an exceptionally diverse range of top performers."*

The director of Envision's Danish R&D centre said:

> *"Our CEO started in Jiangyin with the first turbine. He had the vision about a global company from the very beginning and one of the means to make a global company from scratch was to be global … he wanted to own technology by himself rather than buying licences from others … [He hired] experienced people, not the cheapest in the market, and the team was capable of designing turbines … we jumped directly into something in between the advanced and world-leading situation (right after the establishment of the company)."*

The personal linkages of the international employees, particularly the key managers, have played big roles in the success of Envision's TFDI as a powerful starter for its learning processes.

The informant of the Danish R&D centre commented:

> *"I was a colleague of our current director and he hired me when he joined Envision … a lot of us [the managers and engineers in the Envision Danish R&D centre] are employed through the old network …*

that is, people knowing people and knowing somebody who would like to try something else. And that created a team [later] … [Having a long experience of working in the world's lead wind energy companies] our (Danish) director was able to build a team quickly".

Evidently, the TFDI started the learning process for innovation in Envision.

4.3 Contextual theorising of the roles of TFDIs in the case EMNCs' learning processes

We compare the learning dynamics and learning context of the two cases' learning process so as to contextually theorise the roles of their TFDIs in their learning processes.

4.3.1 The comparison of learning dynamics of the two case EMNCs' learning processes

The dynamics of the learning process for innovation, namely the change of knowledge, linkages and activities, also present clear differences between the two cases (see Table 3).

Table 3. Comparison of the learning dynamics in the two cases

Elements	Goldwind	Envision
Knowledge	Incremental knowledge upgrading over time with rounds of integrating external design knowledge and translating it into innovation (patent a new product)	Rapid knowledge accumulation over time by attracting top managers and engineers both internationally and domestically
Linkages	Increasingly strong relation with the same key international collaborators (managers), more and more connection, particularly with both domestic and international knowledge suppliers	Starting with strong international relationships with the world's leading wind energy clusters, quickly developing relationships with domestic and international suppliers and knowledge suppliers
Activities	Increasingly intense and broad, from knowledge transfer through informal relation to knowledge acquisition via in-licensing to interactive learning via collaboration between international R&D subsidiary and domestic headquarters	Starting from knowledge acquisition via hiring and soon moving to interactive learning between international R&D centre and domestic headquarters

The knowledge of the two firms differed significantly prior to investment. Goldwind operated in the industry for almost 20 years before the TFDI; the company has accumulated a great deal of knowledge about wind turbine manufacturing and a certain level of knowledge of design, together with its domestic and international partners. Envision is a later arrival. It conducted TFDI shortly after its establishment. Envision had very limited technological knowledge within the company before TFDI but caught up fast afterwards.

The linkages in the TFDIs of these two case firms are also very different. A continuous collaborative linkage between Goldwind and some key German managers dates back to the

1990s, which played a big role in Goldwind's TFDI. While the old network connections of the key managers in subsidiaries made great contribution to Envision's network linkages after the TFDI.

The learning activities before and after the TFDIs of these two firms are different. Before TFDI, Goldwind's main learning activities started from knowledge spillover through non-market relationships, to knowledge acquisition through importing technology. Envision's main learning activities before TFDI were knowledge acquisition through human mobility. Instead of buying advanced technology, Envision hired engineers with world-class technological capability. After TFDI, both firms have been moving towards more and more interactive learning between international R&D subsidiaries and domestic headquarters. But the learning that happened in Envision seems to have been smoother and closer than that in Goldwind, thanks to the stronger belongingness of the employees in the greenfield R&D centre than in the acquired R&D team.

4.3.1 The comparison of the learning context of the two case EMNCs' learning process

Goldwind's and Envision's learning processes for innovation happened at different stages of the capability-building of China's wind energy industry. We expect the industrial capability-building to have spillover effect on the firms' learning processes.

China's wind energy industry experienced three capability-building stages. The first was the *self-closed indigenous development* stage from the late 1980s to 1997. This started from running small-scale experimental projects supported by public investment and international aid. China's wind energy companies accumulated a basic knowledge of managing wind farms but did not successfully attain manufacturing and design knowledge because of their weak absorptive capacity, which disabled advanced knowledge accumulation from international donors (Wu 1997). The second is the *imitating and collaborating* stage from 1997 to 2007, which started with reverse engineering based on imported wind turbines and then involved joint ventures and collaboration with MNCs investing in China. In the late 1990s and early 2000s, firms began to initiate their own manufacturing of turbines, partly because turbines grew in size, making them inefficient to transport by sea, and partly because of a 70% local content requirement stipulated in sectoral public procurement legislation from 2004 (Lema et al. 2011). The take-off of the domestic Chinese wind energy industry occurred in this period, a phase of the Chinese industrial capability-building and strategy which was concerned with the "breakthrough" from production to innovation (Altenburg, Schmitz and Stamm 2008). It coincided with the strategy of "indigenous innovation" (*zizhu chuangxin*) formulated by the Communist Party of China in 2005 (Gu and Lundvall 2006) and incorporated into the then five-year plan (Lazonick and Li 2013). It was further fuelled by the National Mid-and-long-term Science and Technology Development Plan (2006–2020), in which the research and development of large-scale wind energy facilities was given high priority (Gu et al. 2009). There was a range of policy changes on both the demand side and supply side in the mid-2000s, which created a big push for growth and technological learning. Rapid growth created space for the build-up of R&D departments within the leading manufacturers. Over time, some of the leading firms gained capabilities for engaging creatively with licensed designs in

order to tweak them for cost reductions and small improvements. Ultimately, these firms gained capabilities to produce turbines without licences for architectural designs, based on blueprints developed in house. In this stage, the Chinese wind energy industry built up its production capability and gained a certain level of innovation capability. The third stage is the *internationalisation of R&D* stage, from 2008 to the present. This is an extension of the second stage that has ultimately led firms to further develop technological linkages to leading firms and institutions outside China, by means ranging from contracts for R&D services to technology-seeking acquisitions and greenfield establishment of R&D units in Europe and the USA. In this stage, the companies aggressively conducted TFDI for acquiring core technologies to improve their innovation capability based on their manufacturing knowledge and capacity. China's wind energy industry has fundamentally increased its competitiveness, as demonstrated by a number of technological parameters including turbine size, design, reliability and the cost and development of specialised models for different conditions, wind-speeds, altitudes, temperatures and points of installation (e.g. onshore or offshore). By 2013, China had attained the world's highest-installed wind energy capacity and became the third-biggest investor in wind energy R&D.

Putting the two case EMNCs' learning processes against the contextual background of China's wind energy industry capability-building (see Figure 4), we clearly see the difference: Goldwind is a pioneer and incrementally builds up its innovation capability all the way along the capability-building of the industry, while Envision is a latecomer in the industry but catches up very fast.

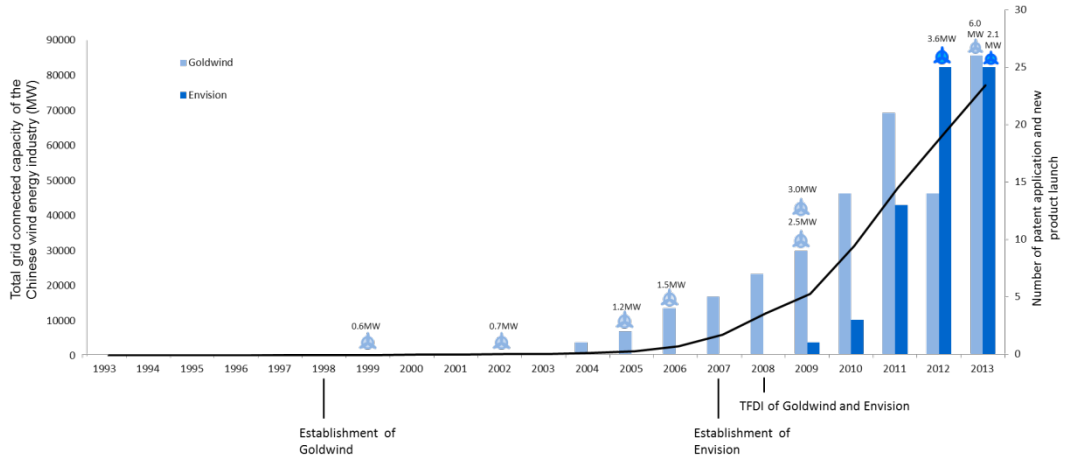

Figure 4. The number of patent applications and new product launches of the case firms and the total grid connected capacity of China's wind energy industry

Sources: company annual report, industrial report and the European Patent Office

The learning context in relation to the firms' establishment and TFDI time are summarised in Table 4.

Table 4. Comparison of the learning context of the two cases

	Self-closed development (1988–1997)	Imitating and collaborating (1998–2007)	Internationalisation of R&D (2008–)

Case firms' establishment and TFDI time	• Goldwind's pre-establishment in 1988	• Goldwind's establishment in 1997 and FDI in 2006 • Envision's establishment in 2007	• Goldwind's TFDI in 2008 • Envision's TFDI in 2008
Industry's production capability	• Weak technologies, knowledge and skills for producing 0.6MW turbine based on reverse engineering and imitating	• Growing technologies, knowledge and skills for producing 0.75–1.5MW based on reverse engineering, imitating and licensing • Greatly increasing number of domestic wind turbine producers • Increasing number of qualified domestic component suppliers	• Strong technologies, knowledge and skills for producing 2.5–6.0MW turbine • Gradually meeting international quality standards
Industry's innovation capability	• Very few number of domestic universities and research institutions specialising in wind energy	• Increasing number of domestic universities and research institutions specialising in wind energy • Emergence of domestic wind turbine design companies	• Increasing international research collaboration with world-leading universities and research institutions • Increasing number of domestic wind turbine design companies

Goldwind hastaken 20 years to gradually accumulate production technology and capacity, and then innovation capability. Goldwind's predecessor, Xinjiang Wind Energy, started in 1988, when China's wind energy industry literally did not exist. As a pioneer of the industry, when there was no production and innovation capability available externally, Goldwind had to develop them internally. Goldwind did not do TFDI until it had accumulated competent production technology and capacity and had convinced the acquired German design company that they were committed and qualified. The TFDI speeded up its innovation activities. The TFDI's accelerator role should be understood under the condition of the internal availability of its already-possessed production technology and production capacity.

Unlike Goldwind's 20-year-long endogenous capability-building, Envision established its production and innovation capability within just a few years. When Envision did TFDI to set up an R&D centre in 2008, at the same time it acquired production technology and capacity from the domestic market. Most of Envision's components were outsourced to the co-located domestic companies, such as Jixing Machine, Guoguang Heavy Machine, Fangyuan Falange, Xingcheng Special Steel, Shuangliang Boiler and Chengxi Ship. Envision shortly established its production and innovation capability by leveraging the local production technology and capacity on the one hand and international innovation capability on the other. The TFDI started its innovation activities. The starter role of Envision's TFDI should be understood in the context of the external availability of the production technology and capacity in the domestic market.

Thus, we summarise that Goldwind's TFDI played an accelerator role in its learning process for innovation when the company accumulated production technology and capacity internally, while Envision's TFDI played a starter role in its learning process for innovation when production technology and capacity were available externally in the domestic market.

5. Conclusion

This paper is a comparative case study investigating the roles of TFDIs in the learning processes for innovation in two leading Chinese wind turbine companies. It develops a dynamic and contextual analytical framework from a learning-based view to understand the firms' learning process for innovation. Based on the analysis and comparison of the learning dynamics and learning context of the two case firms' learning processes for innovation, the paper analyses the influence of TFDIs on the firms' learning processes and contextually theorises the different roles of their TFDIs in their learning processes for innovation.

It is found that the case firms' TFDIs played different roles in the firms' learning processes for innovation. To the pioneer firm, which has accumulated production technology and capacity since the early capability-building stage of the domestic industry, TFDI is an accelerator to boost the firm's innovation by seeking and securing the design technology abroad and by exploiting its already-possessed production technology and capacity in the company. To the newcomer, which was only established when the domestic industry had built up certain levels of production and innovation capability, TFDI is the starter for the firm to quickly acquire design technology internationally and exploit the production technology and capacity not developed within the firm but acquired domestically.

We argue that the capability-building of domestic industry has an important influence on the EMNCs' learning processes and thus on the roles of the TFDIs in the processes. When the domestic industry has not accumulated enough production and innovation capability, the firm has to accumulate the capability internally by themselves. Thus, when conducting TFDI to seek design technology internationally, the firm can exploit its self-developed and already-possessed production technology and capacity. When the domestic industry has accumulated a certain level of production and innovation capability, the firm does not have to develop production technology and capacity internally but can exploit that which is available in the domestic market and at the same time conduct TFDI to seek design technology abroad. Thus, we argue that for emerging countries with ambitions to explore the global knowledge and technology pool, domestic industrial capability-building should not be overlooked.

The contribution of the paper is threefold. First, it develops a dynamic and contextual analytical framework for understanding the EMNCs' learning process for innovation. Second, it contextually theorises the roles of TFDIs in EMNCs' learning processes in the context of the domestic industry's capability-building. Third, it generates policy implications for emerging countries with ambitions to tap into the global knowledge and technology pool.

The conclusion of the paper is drawn upon the limited number of case studies in a specific industry. The wind energy industry is a highly modularised industry. Technology is rather mature and change is slow. Designs and blueprints can be purchased and consultants can help to set up the production line. The specific characteristics of the industry enable fast catch-up. It might not happen in other industries. One should be very careful when applying this conclusion to other industries.

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