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Management
International Review

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The Role of Outward FDI in Creating Korean Global Factories

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Abstract

This study examines Korean foreign direct investment (FDI) in the context of the organization and development of local firms into global factories. Specifically, we explore the relationship between FDI decisions and the nature of Korea's imported and exported goods. We argue that the global factory approach explains the mechanisms by which FDI can lead to technological upgrading. We employ a unique dataset that incorporates information on FDI motive from South Korea, as well as the unit value of traded goods within sectors. Our findings indicate that FDI location and motive vary by trade destinations and trade unit prices; something that has not received attention in existing literature.

Keywords South Korea · Internationalization strategies · Global value chains (GVCs) · Foreign direct investment (FDI) motivation · Location choice · Global factories · Korean multinational firms

1 Introduction

This paper applies the concept of the "global factory" to the development of emerging economies, and seeks to understand how the global factory approach can explain the relationship between FDI motivation, sectoral upgrading, and industrial development.

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By examining the strategic processes of firms, we can achieve a finer grained analysis of aggregate flows of trade and investment. The example of South Korea is particularly interesting here, as is the relatively long time frame we study. During the study period, South Korea transformed itself from an emerging economy characterized by a number of relatively low-tech production activities into an export-intensive economy that leads the field in a number of high-tech products. We argue that the country's FDI decisions have been central to its success. When these are viewed through the lens of the global factory, we gain an understanding of how Korea forged its way to industrial development in a way that many other countries are striving to emulate.

This paper proposes and tests three steps whereby the Korean global factories were created and developed (Buckley & Strange, 2015; Buckley, 2011a). These steps are: (1) Korean firms seek large foreign markets for goods where they possess competitive advantages, (2) the firms relocate the low value-added stages of production at scale to low cost locations via efficiency-seeking FDI, and (3) high value-added technology is obtained by insourcing high value content goods. The combination of these processes provides a springboard for the internationalization and upgrading of Korean MNEs.

We test our hypotheses using a novel combination of data sources for Korean outward FDI and international trade data; these enable FDI motives to be captured on a large scale from 1981 to 2014. We identify the (changing) FDI motives for three of Korea's key industrial sectors that, taken together, reflect the changes in the country's industrial profile. This extension to the global factory approach enables us to develop the theoretical framework with reference to an emerging economy, and formulate a schematic-stages approach to how global factories develop from emerging economies. The established literature on the industrialization of developing or emerging economies traditionally takes one of two perspectives. The first, as expounded for example by Haraguchi et al. (2019), focusses on issues such as institutions and resource endowments. While the second, see for example Dunning et al. (2001) explores the links between inward FDI, outward FDI and development. We argue that that global factory approach extends this understanding by allowing for the endogenous creation of value chains that allow for existing firms to reallocate resources to becoming more technologically advanced. The (endogenous) process involves upgrading both on the supply and demand sides by moving from subcontractor to principal and from commodities to branded goods".

Korea offers an interesting case study because Korean FDI has evolved; it started out as typical of emerging economies (i.e., seeking markets for high volume outputs) before moving onto technology sourcing, and finally, it became a hybrid form that is efficiency-seeking in established markets and market-seeking in high-tech goods. The existing literature on Korean FDI focuses either on how Korea's outward FDI patterns have evolved over time (Driffield et al., 2021) or on how inward and outward FDI have contributed to Korean development (Kim et al., 2018). We argue however that the global factory model, which encompasses developments in trade patterns, outward FDI, and management control, provides a more nuanced understanding of how Korea's FDI and trade patterns have developed.

In this, we follow Gereffi (2001) and Pananond (2015) who argue that the global factory approach adds significantly to the understanding of Korea's FDI and its firms' location decisions. However, we take this further in suggesting that the

global factory concept can explain how FDI penetration of foreign markets, including those of the advanced countries, plays a domestic role in upgrading via technological advances and their international impact (Buckley & Tian, 2017; Buckley, 2011b). In addition, we argue that the approach provides a conceptual structure that, by focusing on the governance of the totality of operations, integrates the relationships between FDI motivation, locations, and the unit values of goods that are traded (as well as trade volume) in the development of Korean global factories. Thus, we seek to extend the existing analysis, which accords newly internationalized firms an essentially passive role within global production systems. We identify when such firms have linked trade and FDI decisions to create new value chains and develop technology, in which they could legitimately be described as having an actively strategic role. Korea offers an interesting test case, having effectively "emerged" during the period of our data. While Korean firms start as emerging economy firms, their FDI patterns, over time, evolve into those more commonly seen in western MNEs.

The dataset used in this paper provides detailed coverage of FDI location choices for specified motives and combines this with an analysis of the unit value of goods to illustrate the relative price gaps between Korea and its partner countries. This indicates how the technological development disparities between Korea and other countries vary over time. Thus, we can show how Korean trade and investment occurs in a widening set of industrial products as the country progresses through the stages of economic development (Buckley & Strange, 2011; Buckley, 2009b, 2010, 2011b). We discuss these data in more detail below, but our analysis is based on three sectors; electronics, textiles, and steel/metal. In terms of the development of Korea and its FDI, these offer an interesting contrast and, more importantly, are representative of Korea's industrial changes. This data combination is, to the best of our knowledge, novel. It also offers insights into the evolution of the Korean economy.

The remainder of the paper is structured as follows. In Sect. 2, we develop the analysis of the global factory in the context of linking this to FDI motivations. In Sect. 3, we review the literature from which we develop our hypotheses. Section 4 presents the research methods. Section 5 discusses the results, and Sect. 6 concludes.

2 The Concept of the Global Factory

The global factory structure of modern, networked MNEs is a response to economic, political, technical, and managerial changes in the global economy (Buckley & Ghauri, 2004). Global factories differ from "traditional" integrated MNEs in their network structure and also in their governance, which allows a strategic mix of routine standardized activities that may be internal, quasi internal, and external. Knowledge sourcing from affiliates is combined with the externalization of routine standardized activities to maximize efficiency, flexibility, and responsiveness. Marketing in global factories is combined with information collection and action coordinated by knowledge transferred throughout the networked system. The lead firm acts as coordinator, allowing a diversity of structures throughout the global factory and this diversity becomes a competitive advantage through strategic relationships that develop over time (Buckley & Strange, 2011, 2015).

This is facilitated by a managerial system that "fine-slices" the "stages" of the operation, making two critical decisions for each stage. These are: (1) where the activity is optimally located and (2) how the operation is controlled and integrated into the global factory, which may be by the market (an outsourcing contract) or by management fiat (internally retained and controlled). The governance of the global factory and its strategic decisions on both trade and direct investment have profound implications for the global economy and for the development of sub-units such as nations, clusters of economic activity, innovation, and public policy (including fiscal policies and taxation revenues) (Buckley & Strange, 2011; Buckley, 2009b, 2010, 2011b). In an interpretation of the global factories literature, Verbeke and Kano (2015) argue that the global factory concept is crucial to understanding the changes in the global economy, and in particular, to how emerging and transition economies develop. They see the global factory approach as consistent with internalization theory since it offers insight into the configuration of value chains and inter- and intra-firm linkages. However, the empirical research has to date been carried out at firm/country levels, which may be affected by the subjective viewpoint of the researcher. A good quality dataset can significantly mitigate such research bias and provide insight into the how a specific FDI motive drives FDI location choice. In addition, the FDI determinants impacting FDI location choice by motivation can be more effectively explored.

A key feature of the global economic reorganization presented in the conceptual model of the global factory is the progressive outsourcing by lead firms in the developed countries of their peripheral, frequently low-value, productive functions to low-cost countries and regions, while retaining control of the core nodes of value creation in their home countries. Despite spatially diverse production systems and the fragmented ownership of different productive functions, these lead firms have continued to dictate the terms and conditions of other firms' participation in GVCs via different types of governance that act upon "at-distance" participants (Buckley, 2009a). Korean headquartered firms thus orchestrate global factories that exploit these opportunities both domestically and internationally.

Thus, we develop a conceptual global factory framework through which we anchor the FDI motivations of South Korean firms to their different location choices, while taking into account the development process of South Korean outward FDI based on a "Korean FDI" model (Kim et al., 2018). This allows for a more granular exploration of how South Korean firms exploit different location advantages at different stages of their internationalization. Specifically, Korea's industrial restructuring has led to a geographical spread of outward FDI beyond the simple relocation of production (Kim et al., 2018). This shift toward further growth occurs for two main reasons. First, increasing domestic costs have forced Korean MNEs to seek cheap inputs in order to reduce overall costs. Second, by locating their facilities in developed countries, Korean MNEs can obtain long-term competitiveness by continued upgrading of their firm specific advantages. Since the explanations behind the investment development cycle (Dunning, 1981) are related to a shift in the industrial structure (Kim et al., 2018), we note, in our consideration of the differences between the various motives for Korean FDI, that key location factors play a particular role in determining the location choice of firms.
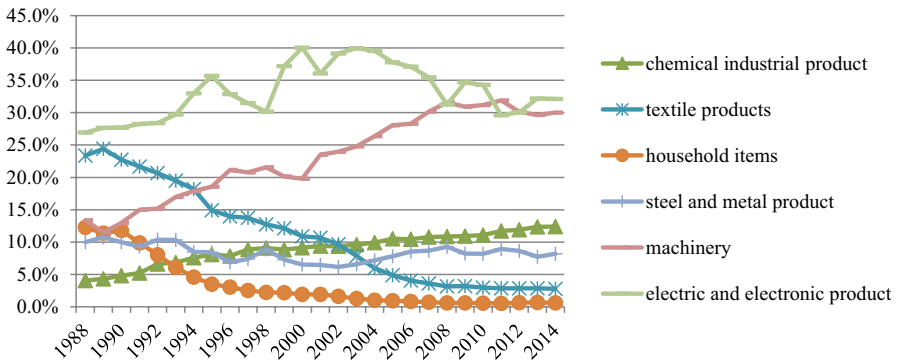
Fig. 1 Export intensity of Korean Industrial Sectors 1988–2014. Source: Authors' calculation from Korea International Trade Association data

The example of Korea illustrates the links between the notions of the global factory and the existing analysis of the emerging market multinationals. At the start of our study period, Korea's largest export sector was textiles while its electronics industry was, by today's standards, in its infancy. Over time, efficiency-seeking FDI relocated virtually all of Korea's export-focused textile manufacturing to low wage economies, while the electronics sector has gone from technology-sourcing FDI to market-seeking as a frontier technology. Korea's steel industry has, by design, played a major role in the country's development, providing the raw materials that are a key input for many other sectors, such as shipbuilding and advanced manufacturing. It is important therefore to consider economic development via technological upgrading in terms of inter-industry effects as well as intra-industry effects.

In the 1980s, Korea traded mainly in low-tech and medium/low-tech commodities. It gradually moved toward investing in higher technology commodities, with the result that Korea's exports are now concentrated in high-tech products such as semiconductors, telecommunications equipment, displays, and so on. Figure 1 illustrates how the contributions of the individual industry sectors to Korea's exports changed drastically from 1988 to 2014. It can be seen that the primary and light industries' share of total exports reduced dramatically, with textiles in particular falling from a high of over one quarter of all Korean exports to less than 5% by 2014. In contrast, the share of high-tech products rose significantly. Interestingly, and importantly in the context of value chains, although Korea's high-tech firms have retained and even increased their output, their production activities are now based in other Asian developing countries (Read, 2002). Thus, for Korean MNEs, although foreign market size remains important, labor costs have become less so as they move up the value chain; furthermore, as they have undertaken technology-sourcing FDI, the unit value of imports has declined.

Specifically, we seek to understand how Korean industry "moved up" the value chain, as Korean industry was re-oriented and upgraded. In turn, we illustrate how this upgrading stimulated the geographical spread of Korean firms, and led sequentially to changes in the patterns of trade. Further, we consider how the nature of

activities (in terms of overall contribution to value-added), determines foreign location decisions, linking domestic and international strategies. Building therefore on Buckley (2014), we consider "fine-slices" of the stages of the operation, which we integrate with an understanding of technological upgrading. This creates a schematic-stages approach that is apposite to Korea's emergence onto the world stage and, as such, represents an important extension of the global factory model.

In Fig. 1, we see an increase in machinery and chemical industrial products, with a decline in textiles and household items; this demonstrates two different patterns of Korean outward FDI that typically apply to host countries at different stages of economic development. It can therefore be seen that in the context of a changing industrial structure where the levels of domestic wages and technological development are linked, the main labor-intensive and knowledge-intensive industries need specific internationalization strategies if they are to extend the geographic scope of their firms' activities. Korean firms view the advanced economies as locations where they can benefit from strategic assets such as advanced technology, and the emerging countries as having cost advantages such as low wages (Kim et al., 2018). However, regarding the interconnections in global factories (Buckley & Strange, 2011, 2015) in the context of South Korea, we examine how industry sectors change their FDI locations in the context of their home country's economic development, from which we can explain Korean firms' internationalization strategies over time.

We find that Korean outward FDI has developed to combine the advantages offered by different locations. Specifically, we identify that knowledge-intensive industries engage in strategic asset-seeking in developed countries and that labor-intensive industries engage in efficiency-seeking in developing countries. We can thus consider the industrial restructuring underlying the Korean FDI model (Kim et al., 2018). Our results suggest that the features of the home country's economic development affect its FDI location choice in terms of motivation over time.

3 The Korean FDI Model

Korea's cost disadvantages, saturated market, and fierce competition prompted its firms to expand their operations overseas to find new markets, to acquire or improve technological advancements, or to fuel research and development (R&D). The symmetrical paths of South Korean outward FDI in developed and developing countries reflect the different FDI motives. These paths are mirrored by Korea's trade flows, with trade flowing from low-cost locations to both the home and third-party countries, facilitated by market-seeking FDI. Korean market-seeking FDI arises as a substitute for exporting; firms invest overseas to avoid trade costs and they therefore establish their production centers closer to their target customers. However, in this study, we argue that one should view FDI, trade flows, and knowledge flows as part of the same system.

Thus, as we demonstrate below, and consistent with the analysis of Verbeke and Kano (2015) and Verbeke et al. (2016), it is essential we identify which activities and technologies Korean firms chose to retain at home, and which were offshored via subsidiaries to other countries (Kim et al., 2016, 2018). This coordination of

value chain activities across geographical space is fundamental to multinational strategy (Mudambi, 2008) and goes far beyond simply swapping the "ownership" for the "control" of activities. For example, relocating a certain sector to a particular host country may reduce or even replace the home country's exports in that sector, if it emerges that FDI is more profitable than exporting. The combination of economic integration of the host country with the specific characteristics of Korean firms is likely to prompt a particular strategic location choice. An example of this is Hyundai's outward FDI to Europe. Production-related FDI initially occurred between 1997 and 2008 and targeted Central and Eastern Europe; however, more recently, sales, service, and the more technical functions have been established in Western Europe. This illustrates the evolution of a global factory network, where activities are carefully separated and their locations are determined accordingly.

We seek to develop this argument in two ways, at both the micro and macro levels. At the start of our time-period (1981), Korea could still be regarded as an emerging economy but by the end of that period, many firms in Korea's high-profile export-oriented sectors were at the global technological frontier. At the micro level, this offers an opportunity to explore how the global factory concept can explain the inter-related patterns of firstly domestic firm internationalization. Subsequently at the macro level one can explore what this means for economic development as part of a wider industrial strategy.

4 Literature Review and Hypotheses Development

MNEs internalize knowledge-based resources and capabilities, whether in innovation or marketing-related activities, within their firm boundaries in order to offset the additional costs incurred by operating in a foreign environment (Caves, 1996; Zaheer, 1995). The traditional approach to exploring these issues is to use internalization theory, which offers an appropriate lens through which to evaluate each of these separate relationships (Rugman & Verbeke, 2003). We argue however that it is necessary to move beyond looking at where a firm is positioned within a (regional) value chain to considering how network relationships develop over time. We argue that the global factory concept offers a framework for doing this because it encompasses the governance and the dynamics of interrelationships across the MNE network.

4.1 FDI Motive, the Global Factory and Location Choice

Our first hypothesis, therefore, concerns the drivers of FDI by Korean firms in terms of their location choices. Consistent with our discussion above, we argue that the initial stage of market-seeking FDI by emerging market firms is to seek out new markets for what are, typically, standardized products. As the standard analysis of emerging market MNEs (for example, Ramamurti, 2008) outlines, the internal advantages possessed by early stage internationalizers from emerging economies typically derive from economies of scale and cash flow generated at home, which

they then seek to exploit in new locations. Therefore, initial market-seeking FDI focuses on the locations where firms can replicate these internalized advantages. Then, as their home country develops, they start to engage in efficiency-seeking FDI.

In terms of the economic development process, Dunning and Narula (1996) posit that as emerging countries achieve advanced country status, they move away from labor- or resource-intensive assets to capital- or knowledge-intensive assets. In doing so, they reduce trade costs (e.g., tariffs) by switching from direct exporting to local overseas production. Thus, in terms of market potential, foreign locations that are surrounded by large markets tend to attract more FDI (Head & Mayer, 2004).

This has led researchers to propose various ideas of the "global factory". For instance, authors such as Gereffi (1989) and Grunwald and Flamm (1985) drew on predictions of the product life cycle (Vernon, 1966) with their concept of the global value chain, where national specialization in distinct industrial sectors drives the growth of foreign assembly facilities. These authors highlighted the fact that MNEs have established offshore assembly operations to meet the competition of low-cost imports. The global factory, as distinct from this GVC concept, centers round a network of firms that is being directed or orchestrated by a single focal firm, typically the brand owner. The ownership of the product remains with the focal firm for all activities, even when outsourced firms use their own assets to add value to the product. The approach taken by global factory theorizing is that the three stages of the Product Life Cycle Hypothesis (Vernon, 1966) are all part of an integrated global strategy and their strict sequential nature is not followed; thus, innovation, the development of exporting and FDI into rational foreign market servicing strategies, and the seeking out of low-cost labor through offshoring investments occur simultaneously and are interlinked. As we shall see, Korean global factories access high level technologies by foreign procurement rather than via in-house innovation, providing another example of the need to look at firm-level strategies rather than just the aggregated flows of trade and investment.

Overall, this suggests that FDI location decisions are driven by the global factory's need to seek large foreign markets for standardized products. This leads to hypothesis 1.

Hypothesis 1: *Korean OFDI in standardized products is aimed at large foreign markets.*

4.2 Global Factories and Technological Development

Our second hypothesis concerns the development of global factories by Korean firms as they move up value chains. As this occurs, firms engage in efficiency-seeking investments, driven by the objective of obtaining cost advantages by operating in different countries. Essentially the MNE is striving to reconfigure its activities internally due to increasing costs in the home country. They try to maximize their efficiency and rationalize their operations by investing in target locations. Firms in sectors where unskilled or semi-skilled labor is a significant factor in the costs of production seek to increase their cost efficiency by setting up in

low-cost locations. Common examples are US investment in Mexico, and north and western European investment in eastern European countries; in both cases, firms wish to take advantage of the cheap labor available abroad. In the case of Korea, the textile industry has been making cost-reduction investments in foreign markets since the 1980s. China was initially the strategic location for efficiency-seeking Korean textile firms. However, as China's wages increased, this location became unviable (Kim et al., 2016) prompting firms such as Hansae, Hyosung, and H&H Textiles to invest in Vietnam and India between 2010 and 2015; firms could thus reduce operating costs and target local markets. However, they kept their higher technology activities at home, where they also diversified away from textiles (e.g., Hyosung's operation in Korea produces transformers).

The global factory approach, we argue, is a feature of both technological upgrading at home and the desire to transfer ownership advantages to low-cost locations. This allows firms to overcome the liability of foreignness abroad (Caves, 1996; Zaheer, 1995), and to invest in knowledge generating assets, such as innovation-related or marketing-related activities at home, this improving international competitiveness. As a result, value chains are finely sliced and activities are dispersed to locations where MNEs can produce most efficiently. This implies that location advantages must be considered more carefully (Azmeh & Nadvi, 2014). As the global economy has become more interlinked, firms from emerging economies have sought to establish new global value chains, distinguishing between their existing locations, new cost locations, and locations for product development. Such firms follow similar but distinct patterns of development to those previously characterized (for example, Mudambi, 2008). Understanding the governance of global value chains is essential to analyzing the methods by which firms from emerging or newly emerged economies gain access to global markets (Gereffi et al., 2005; Johns et al., 2015).

A country's set of locational assets broadens as its economic development progresses. Countries move away from labor- and natural resource-intensive assets to capital-intensive and (eventually) knowledge-intensive assets, as they upgrade from emerging country to advanced country status (Dunning & Narula, 1996). While this has been explored at length at the country level (in terms of economic development) and at the firm level (in terms of technology sourcing and transformation) the role of changes in GVCs has been less scrutinized. The traditional literature argues that global production networks are often driven by "lead firms", who locate their different activities in optimal locations (Gereffi, 1994). Lead firms are the players with the authority and power to dictate the allocation of resources within GVCs (Gereffi, 1994). Value addition is higher at the extremities of the value chain. These are the activities most likely be internalized. Value addition at the upstream end derives from R&D knowledge generated from basic and applied R&D activities. Toward the downstream end, higher value addition is possible when knowledge accumulates through activities such as marketing, advertising, and brand management, as well as logistics and after-sales services (Mudambi, 2007, 2008). Manufacturing and other standardized activities generally do not gain these value-added boosts and are much more likely to be outsourced.

We suggest that the Korean global factories are following the path established by the Japanese global factories of the 1980s and 1990s, who moved their low-cost activities to other parts of Asia. But there is a distinction in that this has occurred alongside technological upgrading at home, facilitated by technology-sourcing FDI elsewhere (Enderwick & Buckley, 2019). Indeed, in this regard, Korean firms' activities differ from the standard models of offshoring carried out by Western firms.

Thus stage 2 of creating the global factory is that Korean firms seek to relocate their low value-added activities abroad. As the firms move up the value chain and labor becomes a smaller component of value-added, this becomes less important.

Hypothesis 2: *Korean OFDI seeks to relocate low value-added activities into low-cost foreign locations.*

4.3 Global Factories and Technology Sourcing

Our final hypothesis concerns creation of the global factory through the motivation for technology sourcing. The traditional GVC literature describes a process where lead firms retain responsibility for knowledge-intensive and higher value-added activities, while the more standardized activities of production are shifted to lower-cost producers in the emerging economies through internationalization strategies that combine offshoring and outsourcing patterns (Contractor et al., 2010; Henderson et al., 2002; Mudambi, 2008). However, the rapid economic development of the past few decades has enabled emerging market multinational enterprises to expand beyond their borders (Pananond, 2015). There is an established literature within international business, and particularly in international economics, that links imports, most notably of high-tech products, to productivity growth at home. This literature (e.g., Coe & Helpman, 1995; Henry et al., 2009) argues that trade, particularly in capital goods, can be transformative in terms of productivity improvements and technological development in the home country.

Building on Kano (2018) and Kano et al. (2015), we seek to infuse our comprehension of FDI flows with an understanding of the importance of *what* is traded within the global factory setting. While GVCs that lack a central coordinator are unstable and transient, Kano (2018) and Kano et al. (2015) argue that a global factory-type network is more likely to emerge when there exists a lead firm who is able to act as a "joint value orchestrator and a social broker". We argue that firms have a greater incentive to play this role if their internationalization is linked to an upgrading strategy that enables them to engage in higher value-added activities. This aspect reinforces the need to integrate asset-accumulation FDI into the upgrading process of firms. Thus, the nature of the goods that are internationally traded becomes crucial to (our understanding of) the global factory setting.

Extending this, and building on the work of Buckley (2011a, 2011b) and Buckley and Strange (2015), we argue that the nature of the importing firm's firm-specific or ownership advantage is also critical. Lee and Gereffi (2015), looking at absorptive capacity, point to the importance of moving up value chains and argue that, for emerging economy firms, this mobility remains elusive. It can, however, be achieved by firms that have sufficient firm-specific advantages, which may be acquired in the

short-term by importing high value products. The literature on international knowledge sourcing assumes that importing high value products not only leads to productivity improvements at home, but also to technological upgrading. While this process is described in the development economics literature (Ponte et al., 2014) it is seldom explored in depth, a notable exception to this being the recent work of Kee and Tang (2016) on China, which points to the extent to which Chinese firms have undergone this technological transformation and thereby increased the value of their exports.

We offer an extension to this proposition by exploring the outcomes of these knowledge flows and how the MNE evolves over time. We demonstrate that the global factory model can explain trade flows as well as knowledge flows, in that technological upgrading at home will lead to the relocation of activities.

Against this background, we argue that one must not focus simply on the process of how international trade facilitates technology, nor on the characteristics and determinants of knowledge-seeking behavior; one must also consider the importance of what is traded, and how changes in these trading patterns may facilitate technology upgrading at home.

This leads us to the third stage of creating the global factory, where Korean firms source technology by controlling and managing the imports of high value goods. It must be noted here that these imports have started to decline as Korean firms have developed and become less reliant on sourcing technology from abroad.

Hypothesis 3: *Korean OFDI is associated with technology in-sourcing by importing high value added goods.*

5 Hypothesis Testing

Our empirical approach relies on a dataset that is unique in the precision with which it identifies FDI motive and the unit value of traded goods. These two attributes enable us to distinguish between high- and low-value imports within sectors, allowing us to link foreign investment strategy to what these firms trade. Therefore, our empirical analysis considers the relationship between outward FDI destinations by motive and trade destinations by unit value. In their analysis of value chains, Mudambi and Puck (2016) argue that the need to understand GVCs "as implied by resource- and knowledge-based perspectives" highlights the need for further research on the interaction between internationalization and technological development, in the context of the location of different activities. We consider the concept of the global factory to be at the crux of this research stream, since it incorporates Mudambi and Puck's (2016) suggestion of gaining insights from both "internal and external value chains" and extends, for example, Schmeisser (2013).

In order to test our hypotheses, we use two baseline models to investigate the drivers of FDI patterns by motive and industrial sector. We also interact key variables with a time trend to explore whether the importance of certain phenomena has changed over time. As we explain in detail below, we make use of a unique official data set that includes specific details about the motivation of firms for undertaking

FDI. Thus, we can link our conceptual analysis regarding the emergence of Korean dominated global factories to the empirics of FDI motivation. As Fig. 1 demonstrates, South Korean labor-intensive and knowledge-intensive industries need specific internationalization strategies to extend the geographic scope of their firms' activities, given the changing industrial structure, linkages to domestic wage level, and technological development. We therefore choose three main industries that represent features of Korea's economic development and correspond to the country's economic development history. These industries are textiles (whose share of total exports reduced dramatically during the study period), electric and electronic products (which has highest share over all other industries), and the steel industry (which increased steadily to remain stationary at around 10% of Korea's exports[1]).

Our models draw on traditional approaches for modelling FDI flows, based on ownership and location advantages, linking firm level variation to the well-known gravity model of FDI (Leamer & Storper, 2014), as applied empirically by Bhaumik et al. (2010) and Driffield and Munday (2000); it also takes into account the changing nature of Korean firms (Kim et al., 2016).

The models test for the motives/industrial sectors of outward investment and host location attractiveness. Our control variables build on the standard literature, being labor force ability proxied by average wage and education levels, and research and development (R&D). R&D expenditure captures the resources allocated to innovation activities, and is an important control for explaining technology-sourcing (e.g., Driffield & Love, 2007). Market size variables, such as GDP and GDP per capita (Grosse & Trevino, 1996; Kyrkilis & Pantelidis, 2003; Stone & Jeon, 1999) are also included. We extend these standard control variables by including the unit price value of traded goods, specific to the sector concerned.

Thus, our final model is developed from the standard gravity approaches to modelling FDI empirically (e.g., Chen et al., 2019; Witte et al., 2017), extended to differentiate FDI by motive. We examine the outward FDI of three South Korean sectors that are, taken together, representative of the country's industrial restructuring points. Our focus on Korea's textile, steel/metal, and electric/electronics sectors explores the salient ways in which they change over time. Thus, the dependent variables are the FDI flows across three industrial sectors, differentiated by FDI motive, modelled as the total FDI flows of industrial sector s in country c in year t.

$$FDI_{ct}^{s} = f(\text{GDP ct, GDPPC ct, WAGE ct, R\&D ct, EDU ct,}$$
$$EXPORT_{ct}^{s}, EXUNIT_{ct}^{s}, IMPORT_{ct}^{s}, IMUNIT_{ct}^{s}) \tag{1}$$

The dependent variables are FDI_{ct}^{s}, representing FDI of motive type s (efficiency-seeking, market-seeking, technology-sourcing). GDPPC denotes GDP per capita; WAGE is the wage level of the host country; R&D is R&D expenditure total (% of GDP); EDU is tertiary education (% of labor force); EXPORT measures the total value

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[1] Korea's leading steel firm, POSCO, was created by the Korean government in the 1960s with the specific objective of making Korea self-sufficient for steel. It is currently the world's fourth largest steel producer, and is listed in the top 150 in the Fortune Global 500.

Table 1 Description of variables

Name	Description
TXFDI	(Log of) FDI of textile industry
STFDI	(Log of) FDI of steel and metal industry
ELFDI	(Log of) FDI of electric and electronics
MKFDI	(Log of) market-seeking FDI in electric and electronics
TECHFDI	(Log of) strategic asset-seeking (tech-seeking) FDI in electric and electronics
EFFDI	(Log of) efficiency-seeking (low wage) FDI in electric and electronics
GDP	(Log of) total GDP in US dollars PPP
GDPPC	(Log of) GDP per capita in US dollars PPP
WAGE	(Log of) average wage in US dollars PPP
R&D	(Log of) R&D expenditure total (% of GDP)
EDU	(Log of) tertiary education (% of labor force)
TX EXPORT	(Log of) export total value of textile items between Korea and the host country (US dollars PPP)
EXUNIT	(Log of) export unit price of textile items between Korea and the host country (export total/weight)
IMPORT	(Log of) import total value of textile items between Korea and the host country (US dollars PPP)
IMUNIT	(Log of) import unit price of textile items between Korea and the host country (import total/weight)
ST EXPORT	(Log of) export total value of steel items between Korea and the host country (US dollars PPP)
ST EXUNIT	(Log of) export unit price of steel items between Korea and the host country (export total/weight)
STIMPORT	(Log of) import total value of steel items between Korea and the host country (US dollars PPP)
ST IMUNIT	(Log of) Import unit price of steel items between Korea and the host country (import total/weight)
EL EXPORT	(Log of) export total value of electronics items between Korea and the host country (US dollars PPP)
EL EXUNIT	(Log of) Export unit price of electronics items between Korea and the host country (export total/weight)
EL IMPORT	(Log of) import total value of electronics items between Korea and the host country (US dollars PPP)
EL IMUNIT	(Log of) import unit price of electronics items between Korea and the host country (import total/weight)

of exports to each country; EXUNIT measures the export unit price of each sector's items from Korea to the host countries; IMPORT measures the total value of imports from each country; and IMUNIT measures import unit price of each sector's items from the host countries (see Table 1).

In addition, we are able to relate this empirically to FDI destinations by motive. For the electronics sector, we are able to distinguish FDI motive, and we thus estimate three distinct models with the dependent variables being the FDI totals for three different

motives in the electronics sector: efficiency-seeking (low wage locations), market-seeking, and strategic asset-seeking (technology). Thus:

$$
\begin{aligned}
FDI^i_{ct} = f(&GDP\ ct, GDPPC\ ct, WAGE\ ct, R\&D\ ct, \\
&EDU\ ct, EXPORT\ ct, EXUNIT\ ct, IMPORT\ ct, IMUNIT\ ct)
\end{aligned}
\tag{2}
$$

Finally, in order to capture changes that have occurred over time, we interact our three main variables of interest (wage costs for efficiency-seeking FDI, GDP for market-seeking FDI, and the unit value of imports) with a time trend to explore whether the importance of these effects have changed as Korean firms have developed. Consistent with Korea's outward FDI development (Kim et al., 2018), our empirical analysis investigates the role that key location factors play in the configuration of global factories. In doing so, we seek to link OFDI to both the volume and unit value of exports and imports. This allows us to capture the importance of what precisely is traded internationally, in terms of explaining the locations of, say, market-seeking or technology-seeking FDI.

We have unique data derived from official sources, the first of which is the Korean Exporting Import Bank (EXIM[2]). EXIM manages international capital data from Korean firms that participate in foreign investment. Korean foreign exchange legislation dating back to 1968 states that any company wishing to engage in foreign direct investment must submit documents to the Korean Banks that include details of the exact location of its subsidiaries, the total amount of FDI, its investment motivations, industrial area, and so on. Thus, data from EXIM show the total FDI amounts and the number of local subsidiaries, and these are categorized by motive, host country, and industry sector. The data are then aggregated by EXIM to sectoral level, such that for each sector we have detailed information on FDI location, volume, and motive for the period 1980–2017. Since the data on motives map directly onto the typology of Dunning (1993), we are able to identify Dunning's FDI motives: market-seeking, resource-seeking, efficiency-seeking, and technology-seeking at sectoral level across time.

The second dataset comes from the Korean International Trade Association (hereafter called KITA). KITA manages international trade data from South Korean firms that participate in international trade to all other countries from 1980s to date. The data show the total amounts of exportation from and importation to South Korea. The dataset also includes the unit value of what is traded at sector level, allowing us to capture, by product classification, whether high value or low value activities are imported or exported by the firms engaged in FDI. We present the summary statistics and correlations between the variables in Table 4, Appendix 1 and Table 5, Appendix 2.

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[2] EXIM data have been collected in a consistent manner since 1968, and crucially include stated FDI motive data by sector. As the stated motive influences neither the level of support the firm might receive nor its ability to obtain finance or credit, there is no reason for the firm to misrepresent its intentions. Although EXIM collects these data at the level of the investment, they are reported at the sectoral level. This allows us to link data directly to other sectoral data.

Variants of the models presented in Eqs. (1) and (2) are relatively standard within the outward FDI literature that seeks to explain variations in FDI at the firm level. While our focus in terms of the hypotheses is on the trade variables, variables such as GDP, GDP/head, human capital, and innovation are standard controls in such models (see for example, Cheng & Kwan, 2000; Belderbos & Carree, 2002; Head & Mayer, 2004; Kang & Lee, 2007). However, these models present a number of econometric problems. Firstly, the trade variables are potentially co-determined with the FDI term, in that one may consider engaging in efficiency-seeking FDI in a country when importing is easier, or one may engage in resource-seeking in a country from which one already imports resources. We therefore need an estimator that allows for this potential endogeneity.[3]

According to Roodman (2006), the system GMM may be used to improve efficiency of estimators as well as to avoid the finite sample biases that result from a weak instrument. Roodman also states that the system GMM is useful in situations where there are short time periods and a large number of samples, distributed fixed individual effects, endogenous regressors, and heteroscedasticity and serial correlation of individual disturbances. He adds that the two-step GMM estimator is efficient and robust to any patterns of heteroscedasticity. Arellano and Bond (1991) have also noted that while the two-step GMM results in an apparent gain of precision, this precision may reflect a downward finite sample bias. Blundell and Bond (1998) suggest that the asymptotic standard error in the two-step GMM can have severe downward bias in small samples. We therefore adopt the approach suggested by Windmeijer (2005)[4] to address this issue. The issue of instrument validity we discuss below.

6 Results

The results in Table 2 show drivers of FDI by Korean firms across sectors of interest While there is some variation across the models, to which we will return in due course, the control variables behave very much as expected, and the findings are consistent with the literature discussed above. GDP is largely significant in explaining FDI location, and labor costs deter efficiency-seeking FDI even though human capital typically attracts FDI. The results however highlight certain characteristics of South Korean firms' foreign investments.

The results suggest that GDP is important for the textile and steel/metal sectors, and is also important overall for electronics although as one would expect, "market size" as measured by GDP is not significant for efficiency-seeking FDI or technology-sourcing FDI. Total volumes of exports and imports are significant in explaining FDI in textiles, suggesting that trade and FDI in this sector are complements. This suggests that it is openness and existing trade relationships, rather than value,

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[3] While standard tests for endogeneity marginally fail to reject the hypothesis of weak exogeneity, we retain this estimator to avoid over-stating the potential effects.

[4] Windmeijer (2005) showed that in a Monte Carlo panel data study, this generated a more accurate estimate of the correct variance, leading to more accurate inferences.

Table 2 FDI from South Korea from 1981 to 2014 by sector

FDI	Industry		
	Textile product	Steel and metal product	Electricand electronic product
GDP	1.32*** (0.27)	1.46*** (0.11)	−0.40 (0.40)
GDPPC	−0.98*** (0.24)	−0.33*** (0.11)	0.14 (0.30)
WAGE	−1.12 (0.95)	0.38 (0.67)	−2.49 (1.98)
R&D	−0.23 (0.25)	−1.72*** (0.31)	−1.36 (0.85)
EDU	2.55*** (0.53)	−0.60 (0.52)	2.22*** (0.67)
EXPORT	0.25*** (0.03)	−0.07*** (0.03)	0.26 (0.22)
EXUNIT	0.06 (0.04)	−0.18*** (0.05)	−6.89 (40.75)
IMPORT	0.14** (0.06)	−0.01 (0.02)	0.90*** (0.35)
IMUNIT	0.01 (0.03)	0.07** (0.03)	−22.77** (11.45)
_cons	1.41 (10.72)	−26.88*** (8.89)	50.93 (38.93)
No of observations	312	327	328
Number of groups	27	27	27
AR(1) (p value)	−1.739 (0.082)	−2.309 (0.021)	−2.835 (0.005)
AR(2) (p value)	−1.729 (0.084)	−1.240 (0.215)	−0.628 (0.534)
ID test	17.067	14.747	15.615
No of instruments	108	141	206

Dependent variable: FDI outflows from Korea for the given sector

that drives FDI decisions. The results from the steel/metal products sample however also highlight certain characteristics of FDI for the market-seeking motive. FDI in this sector is aimed at new markets rather than current export destinations, and in locations from which Korea imports steel products of higher value. As we discuss in the theory section, this is illustrative of the global factory approach, with technology-sourcing FDI augmenting efficiency-seeking FDI, but across space.

Korean FDI in electronics products seeks locations where the import unit price is significantly lower than elsewhere, indicating efficiency-seeking FDI with the core technology being developed and retained at home. We now move on to exploring this in more detail.

We have support for hypothesis 1 (Korean OFDI in standardized products is aimed at large aggregate markets, which maps onto Creating the Global Factory Stage 1: seeking large markets) in that FDI by Korean textile and steel/metal firms is positively related to GDP in the host country, with the results also suggesting that higher GDP per capita does not attract FDI from Korea in these sectors. In contrast, overall GDP is not significant in explaining FDI in electronics. These results support our argument that Korean firms with standardized products look for location advantages associated with economies of scale and efficiency, while high-tech firms seek higher levels of human capital. It is also interesting to note that our results suggest that these effects have remained stable throughout the period, as the time trend when interacted with GDP is not significant.

The results reported in Table 3 suggest that efficiency-seeking FDI in electronics is attracted to low wage, low income, and low R&D countries. This in itself

Table 3 Electronics FDI from South Korea from 1981 to 2014 by motivation

FDI	Electric and electronic FDI motives		
	Market	Technology	Efficiency
GDP	1.28*** (0.32)	0.57*** (0.12)	0.44*** (0.04)
GDPPC	−0.05 (0.07)	−0.40*** (0.05)	−0.15*** (0.03)
WAGE	2.05*** (0.58)	2.23*** (0.37)	−0.72*** (0.27)
R&D	−2.48*** (0.48)	−0.21* (0.12)	−0.48*** (0.08)
EDU	−0.20 (0.59)	−0.27 (0.19)	0.31*** (0.09)
EXPORT	0.14** (0.06)	0.02 (0.02)	0.13*** (0.02)
EXUNIT	−8.73 (5.86)	−13.69*** (4.18)	−11.84*** (2.86)
IMPORT	0.17 (0.16)	0.25*** (0.04)	0.01 (0.02)
IMUNIT	0.06 (4.60)	1.54*** (0.40)	−0.25 (0.54)
_cons	−39.57*** (7.23)	−17.93 (2.87)	13.75*** (4.88)
No of observations	328	328	328
Number of groups	27	27	27
AR(1) (p value)	−2.130 (0.033)	−2.275 (0.023)	−2.000 (0.046)
AR(2) (p value)	0.136 (0.892)	0.169 (0.866)	−0.269 (0.789)
ID test	14.469	18.239	12.545
No of instruments	91	112	95

Dependent variable: FDI outflows from the Korean electronics sector, by motivation

is unsurprising, but our results go on to show that Korean electronics firms have engaged in FDI in countries from which Korea has a high volume of low-value-per-unit imports. This suggests that efficiency-seeking FDI in electronics is concerned with relocating low value-added activities abroad, potentially keeping high value activities in the home country and extending the value chain in low-cost locations. This provides support for our hypothesis 2 (Korean OFDI seeks to relocate low value-added activities in low-cost foreign locations, which maps onto Creating the Global Factory Stage 2: relocation of low value-added activities). Korean firms seek locations where they can capture economies of scale in their low value activity. Even after controlling for this, we show that Korean firms who export low value products move their low value-added activities abroad while retaining their higher value activities at home, thereby moving their home activities up the value chain. The interaction between wage levels in the host country and the time trend is revealing here. At the start of the period, our results suggest that an increase of two standard deviations in host country wages would lead to a 14% decline in efficiency-seeking FDI. However, by the end of the period, a similar increase would generate only a 4% reduction. This shows that Korean efficiency-seeking was becoming less sensitive to wage differences between home and host, as the sector develops and value-added at home increases.

Extending this analysis, we are able to explore the drivers of FDI by type of motivation for the electronics sector, and we present these results in Table 3. We can trace the evolution of FDI in this sector, which went started out as purely market-seeking and was transformed, via technology-sourcing, into efficiency-seeking FDI.

The results in Table 3 indicate the relationships between FDI motive and the nature of the goods that Korea trades. Technology-seeking FDI in the electronics sector is negatively related to unit value of export, so where firms are exporting higher value goods in electronics, they are less likely to undertake FDI for a technology-seeking motive. In market-seeking FDI in electronics, exports tend to lead to FDI. The steel/metal industry is negatively linked to both export volume and export unit value. In terms of the relationship between imports and FDI for this sector, FDI generates imports, which is evidence of efficiency-seeking FDI by steel companies, and the movement abroad of certain parts of the supply chains. The results thus far show that steel FDI is linked to high value imports. In other words, it is the most valuable part of the supply chain that is moved abroad for technology-seeking FDI reasons. The tendency of this form of outward FDI to go to high-tech locations contrasts with the results for efficiency-seeking FDI, which indicate that firms are attracted to host country locations where the levels of GDPPC, wages, and R&D are low. In other words, efficiency-seeking firms are simply looking for low cost locations to capture economies of scale.

Finally, our results support hypothesis 3 (Korean OFDI is associated with technology in-sourcing by importing high value added goods, which maps onto Creating the Global Factory Stage 3: sourcing technology by controlling and managing high value goods imports). Table 3 presents the results from an estimation process similar to that described above, but with the electronics sample divided by motivation. Efficiency-seeking and market-seeking FDI are related to export volume, while technology-sourcing FDI is located in areas from which Korea imports high value goods. This suggests that technology-sourcing linked to home production can not only improve productivity but can, through the upgrading of technology, move firms up the value chain. This generates increased value-added at home through import substitution and international technology transfer back to the home country. This contributes not only to firm development but to also to economic development more generally. However, the time trend results are particularly interesting in this context. They suggest that at the start of the period, an increase in the unit value of imports was associated with an increase in FDI, and this is particularly strong for efficiency-seeking firms in that Korean firms who imported higher cost components were more likely to engage in efficiency seeking. However, mid-way through the period, this pattern reversed, with firms who imported more expensive components being less likely to undertake efficiency-seeking FDI. This is because as firms develop, technology-sourcing through imports becomes less important. This is consistent with the arguments that we articulate above (Buckley & Strange, 2011, 2015) concerning the development of competitive advantage over time. As Korean firms moved up the value chain, technology was developed at home, and this reorientation toward domestic highly technologically-intensive production drove efficiency-seeking FDI. This result also holds for textiles and steel, as Korean global factories move into higher quality segments of these industries.

Taken together, the results clearly support our hypotheses and are indicative of an upgrading process, not merely at the firm level, but also at the levels of entire sectors and the Korean economy. The location of Korean FDI not only facilitates

technological development at home but has also, through Korean firms' creation of their own value chains, facilitated the relocation of low value-added activities, allowing comparative advantage in high-tech activities to become competitive advantage at the level of individual Korean firms.

We present here the most robust estimates based on the econometric literature, see for example Blundell and Bond (1998), Roodman (2006), and Windmeijer (2005). However, given the empirical nature of the gravity model it is important to check the robustness of these results. To this end, we adopted the following procedure:

1. Different lag lengths of variables/different lag lengths of the number of instruments. The results reported here are robust to truncating the lag length of instruments, and to adding lagged variables on the right hand side. The latter can only be increased to three, due to degree of freedom constraints, but qualitatively the inferences from the explanatory variables presented here do not change.
2. Alternative estimators. As a robustness check, we also employed standard static panel estimators. Although these produce results similar to those reported here, we cannot reject the hypothesis of endogeneity, hence our preferred instrumental variables approach.
3. The standard errors from the Blundell-Bond estimator are known to be biased in small samples. While our data has a relatively long time trend, the number of groups is relatively small. As such, we report the robust standard errors (which are slightly larger than the Blundell-Bond standard errors).
4. Inclusion of the lagged dependent variable. Gravity models are often estimated using fixed effects only, so the dynamic nature of the data does not arise. However, it is well known that there is a high degree of persistence in FDI decisions, especially when considers investment occurs over a number of years. As a result, our estimator facilitates a lagged dependent variable, though the inferences regarding the other explanatory variables are unchanged. The impact of GDP is reduced, but still significant when one includes a lagged value of FDI.
5. Multicollinearity. The table of correlations is presented below. Not surprisingly, some of the country level variables are correlated, such as R&D intensity and GDP/head. In addition to the standard VIF tests, we conducted a number of variable addition/deletion tests. The results are robust to this, with no qualitative differences in our findings. It should also be remembered that the estimator involves the estimation of the model in differences, where the correlation disappears.
6. Inclusion of other variables. We experimented with other "standard" gravity equation variables, such as measures of geographic and cultural distance. However, all the recipient countries are fairly similar to each other, with Korea as the outlier, so these variables are insignificant.

7 Conclusion

This paper has illustrated that the overarching global factory model can provide a unified approach for theorizing on Korea's development path by integrating Korean OFDI (and its motives) with technological upgrading, insourcing

of foreign technology, and orchestrating the value chain under the aegis of Korean-controlled global factories. It represents an extension of the application of the global factory model that is innovative in its identification of the stages of development of global factories from emerging economies—an approach that can be generalized to other growth situations. Using the Korean case is particularly informative, as it was the most advanced of the emerging economies and is now an OECD member. Its case offers an indication of the direction of travel of other Asian economies as their firms internationalize. Industrial restructuring has led to a geographical spread of outward FDI to a number of host countries, reflecting differing motives for doing so. Korea's transition from an emerging economy to an advanced economy affords the opportunity to conduct longitudinal FDI analysis, yielding important insights into key international business questions concerning FDI from Asia. This study presents a detailed characterization of how Korean outward FDI, differentiated by industrial sector and motive, has changed over time, and how this has facilitated Korea's improving international competitiveness.

We extend the empirical literature on how emerging market firms internationalize and manage their value chains, considering the role of trade and outward FDI. We are thus able to explore for the first time (at least as far as we are aware) how the development of Korean global factories has facilitated the country's dominance in certain sectors. The industrial transformation of Korea in the context of the investment development cycle has been understood for some time, but our analysis highlights the role that global factories play, both on a firm's initial place in the chain and in how upgrading that position impacts on economic development. The essential condition for an economy to successfully move up the value chain is the ability to acquire and assimilate knowledge from abroad. In this context, the importance of technology-sourcing FDI by emerging market firms has been acknowledged for some time, as has the role that imports (such as capital goods) play in fostering economic development. However, we have illustrated that there is a need for a more unified approach to exploring the overall development path, and we believe that the global factory concept offers important insights. Market-seeking FDI and technology-sourcing FDI have contributed enormously to the development of the Korean economy, with MNEs simultaneously exploiting and augmenting their firm specific advantages. This has allowed Korean firms to not only capture greater shares of the pre-existing western-dominated value chains, but also to generate their own highly successful value chains.

Global factory analysis is therefore an important extension to the existing evidence base concerning the development of emerging market economies and their multinationals. It is important we do not lose sight of the fundamental concepts of IB theory, and internalization and the existence of ownership advantages remain at the heart of our analysis. Korean firms may have started out with what are thought of as efficiency advantages (Bhaumik et al., 2016), but these were rapidly developed into technological leadership at home, even as these firms sought out low-cost locations and economies of scale elsewhere. The global factory concept can unify these previously disparate elements. Using the global factory framework, we extend theory by showing that the aggregation of the activities of global factories in exports,

imports, and FDI, produces effects that were predicted by Vernon's (1966) Product Cycle Hypothesis, and that the sequence of these events (stages) are not the same for emerging economies like Korea as they are for developed economies such as the US. This gives a satisfying multi-level explanation of the dynamics of FDI.

8 Limitations and Areas for Subsequent Analysis

It is important first of all to recognize the limitations of our work. Firstly, while we are, to the best of our knowledge, the first to link official data on FDI motivations to subsequent economic performance, we use data that, although collected at the level of the investment, are subsequently aggregated to sector level. Secondly, it is important to recognize that this is a single country study, albeit one that is based on a particularly informative example. Other countries that are on a similar journey or adopt similar approaches to technological upgrading may adopt different strategies, or not be as successful in supporting individual firms in their innovation and internationalization goals. Equally, Korea has a network of business groups that have been able to overcome missing or poorly functioning markets for capital, labor, and knowledge; other countries, lacking these complex networks, may find it hard to replicate Korea's results.

However, our work also suggests some further avenues of research. We have demonstrated how firms employ the concept of the global factory to capture a greater share of value-added in the overall value chain and improve overall industrial performance. What we have not considered here is the extent to which this has had a polarizing effect at home. As fewer low-skill activities take place in the home country, so the demand for low-skill workers declines. In the Korean FDI model, as in the developed countries, South Korean firms have employed FDI for technology-seeking and export promotion motives, thus increasing firm performance and, potentially, the demand for skilled workers. It is clear that as Korea has developed, firms and skilled workers have made significant gains from this upgrading and technological development, but it is also clear that less skilled workers may have lost out to cheaper competition elsewhere. This is a pattern familiar in the west, though less explored in the context of Asian business. We suggest that there is scope for applying the concept of the global factory more generally, not merely to enhance our understanding of the importance of international business for economic development as scholars, but also as a means of assisting firms and policy makers. While Korea is the first emerging economy to have completed Dunning's development path, our ideas are applicable to other countries seeking to capture higher proportions of global value-added. At the same time, firms can apply this model to make optimal location decisions, as well as to understand the boundaries of the firm.

Appendix 1

Table 4 Summary of variables

Variable	Obs	Mean	Std. dev	Min	Max
Country	891	17	9.527252	1	33
Year	891	2001	7.793256	1988	2014
TXFDI	891	1.772121	1.96524	1.098612	11.72553
STFDI	891	1.98882	2.498655	1.098612	11.50212
ELFDI	891	3.248764	3.4342	1.098612	14.25882
MKFDI	891	1.816699	2.096195	1.098612	12.22648
TECHFDI	891	1.588561	1.839841	1.098612	12.79665
EFFDI	891	1.307649	1.065812	1.098612	9.059285
GDP	630	12.69472	1.571518	8.627216	16.66716
GDPPC	619	5.418324	0.999401	0	6.418365
WAGE	749	10.43237	0.380248	9.109193	11.02267
R&D	464	− 4.18576	0.567358	− 5.80914	− 3.19418
EDU	463	− 1.39961	0.367032	− 2.36446	− 0.43541
TX EXPORT	867	8.404856	2.851879	1.791759	15.07685
EXUNIT	850	− 3.92091	0.641442	− 11.291	− 0.98083
IMPORT	867	6.543862	2.683455	1.791759	12.80815
IMUNIT	826	8.996813	2.736373	0	14.70926
ST EXPORT	867	10.02478	2.606178	1.791759	15.74391
EXUNIT	855	− 6.3534	0.789743	− 9.61624	− 1.90056
IMPORT	867	10.45921	2.58244	1.791759	16.41146
IMUNIT	858	− 6.2671	1.066149	− 9.14648	− 1.09861
EL EXPORT	867	12.03583	2.265366	4.844187	16.78813
EXUNIT	867	1.107097	0.008639	1.098748	1.191585
IMPORT	867	10.55516	2.989239	1.791759	16.54492
IMUNIT	867	1.132291	0.046471	1.098612	1.568945

Appendix 2

Table 5 Correlations matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. GDP	1																
2. GDPPC	0.34	1															
3. WAGE	0.38	0.85	1														
4. R&D	0.22	0.69	0.69	1													
5. EDU	0.05	0.54	0.53	0.50	1												
6. TX EXPORT	0.81	0.34	0.47	0.39	0.22	1											
7. EXUNIT	−0.01	0.48	0.32	0.21	0.28	−0.13	1										
8. IMPORT	0.77	0.14	0.09	0.00	−0.23	0.46	0.01	1									
9. IMUNIT	0.83	0.15	0.13	0.02	−0.24	0.59	−0.03	0.93	1								
10. ST EXPORT	0.82	0.44	0.40	0.23	0.21	0.68	0.14	0.66	0.71	1							
11. EXUNIT	−0.19	−0.11	−0.14	0.01	−0.10	−0.31	0.05	−0.10	−0.19	−0.35	1						
12. IMPORT	0.75	0.52	0.56	0.57	0.41	0.77	0.15	0.46	0.52	0.71	−0.07	1					
13. IMUNIT	−0.06	0.30	0.13	0.06	0.05	−0.17	0.24	0.01	−0.04	0.02	0.23	−0.09	1				
14. EL EXPORT	0.84	0.27	0.24	0.15	0.06	0.71	−0.12	0.66	0.69	0.77	−0.16	0.62	−0.06	1			
15. EXUNIT	0.07	0.28	0.20	0.13	0.19	−0.06	0.23	−0.03	−0.07	0.06	0.17	0.06	0.17	0.20	1		
16. IMPORT	0.82	0.55	0.54	0.51	0.26	0.76	0.06	0.53	0.58	0.71	−0.05	0.74	0.10	0.79	0.27	1	
17. IMUNIT	−0.16	0.06	0.05	−0.05	0.15	−0.02	0.11	−0.31	−0.24	−0.11	−0.04	−0.12	0.08	−0.09	0.22	0.10	1

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