

**[Article title]** Spillovers from FDI and Local Networks: The Importance of Transactional linkages and Vertical Keiretsu in Japan

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## **Structured Abstract:**

### **Purpose**

The purpose of this paper is to explore the importance of host country networks and organisation of production in the context of international technology transfer that accompanies foreign direct investment.

### **Design/methodology/approach**

The empirical analysis is based on unbalanced panel data covering Japanese firms active in two-digit manufacturing sectors over a seven year period. Given the self-selection problem affecting past sectoral level studies, employing firm level panel data is a prerequisite to provide robust empirical evidence.

### **Findings**

While Japan is thought of as being a technologically advanced country, the results show that vertical productivity spillovers from FDI occur in Japan, but that they are sensitive to technological differences between domestic firms and the idiosyncratic Japanese institutional network. FDI in vertically organised keiretsu sectors generates inter-industry spillovers through backward and forward linkages, while FDI within sectors linked to vertical keiretsu activities adversely affects domestic productivity. Overall, our results suggest that the role of vertical keiretsu is more prevalent than that of horizontal keiretsu.

### **Originality/value**

Japan's industrial landscape has been dominated by institutional clusters or networks of inter-firm organizations through reciprocated, direct and indirect ties. However, interactions between inward investors and such institutionalised networks in the host economy are seldom explored. We investigate the role and characteristics of local business groups, in the form of keiretsu networks in determining the scale and scope of spillovers from inward FDI to Japanese establishments. This conceptualisation depends on the institutional mechanism and the market structure through which host economies absorb and exploit FDI.

**Keywords:** Spillovers, FDI, Transactional Linkages, Keiretsu

**Article Classification:** Research

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*For internal production use only*

**Running Heads:**

## **Spillovers from FDI and local networks: the importance of transactional linkages and vertical keiretsu in Japan**

### **Introduction**

The purpose of this paper is to explore the importance of host-country networks and the organisation of production in the context of international technology transfer that accompanies foreign direct investment. There are growing research interests in the mechanisms and channels by which inward foreign investors coordinate and assimilate

localised network and knowledge (Uzzi and Gillespie, 2002; Giroud and Scott-Kennel, 2009; Cantwell and Mudambi, 2011). However, this perspective is rather divorced from empirical tests of international technology transfer by the multinational, which tend to focus on attempting to determine the existence of spillovers, within a relatively narrow framework. This literature takes into account the nature of the domestic sector, in terms of competitiveness and absorptive capacity, and, in the context of geographically defined clusters, the organisation of production. However, there is, to the best of our knowledge, no attempt to relate the gains from FDI at the sector level to pre-existing networks or business groupings. It is the assertion of this paper that such networks are an important, and a hitherto unexplored, dimension within the networking and spillovers literature.

Japan offers a unique position from which to study this. Firstly, Japan's industrial landscape has been dominated by keiretsu – institutional clusters or networks of inter-firm organizations through reciprocated, direct, and indirect ties (Sambharya and Banerji, 2006). Keiretsu are forms of corporate structure and groupings in which a number of independently managed organisations link together in a hierarchical spider's web. Their networks are often reinforced by governance mechanisms such as interlocking ownership ties, personnel exchanges, and presidents' councils. However, over the past decades, these have become associated with institutional failure and systematic decline in the face of economic downturn, a series of substantial regulatory reforms (i.e. changes in accounting rules and corporate governance), and financial consolidations (Lincoln and Shimotani, 2010). Japan is now more open to inward investment than at any time in its history, and these keiretsu enterprises have gradually become more outward looking than typical Japanese firms (McGuire and Dow, 2009; Dow *et al.*, 2011).

However, interactions between inward investors and such institutionalised networks are seldom explored. Thus, we investigate the role and characteristics of local business groups,

in the form of keiretsu networks, in determining the scale and scope of spillovers from inward FDI to Japanese establishments. Our paper, therefore, makes both theoretical and empirical contributions by developing a model that integrates institutional network perspectives (Dyer and Singh, 1998; Gulati *et al.*, 2000; Dyer and Hatch, 2006; Cantwell *et al.*, 2010) with FDI spillovers. This conceptualisation depends on the institutional mechanism and the market structure through which host economies absorb and exploit FDI.

We postulate that the moderating effects of vertical keiretsu are salient in facilitating FDI spillovers as these networks allow more product-oriented, cooperative, and flexible relations among affiliated firms. In examining this, we also distinguish between vertical keiretsu, which are structured around a core manufacturing firm and its network of buyer-supply linkages in the same industry, and horizontal keiretsu, which are conglomerate centred on financial institutions spanning numerous unrelated industries (Sambharya and Banerji, 2006). Conceptually, one would expect such networks to be important determinants of spillovers. Such network linkages promote knowledge transfer from the perspectives of both transaction costs and knowledge-based views. Previous literature posits that knowledge transfer is facilitated with decreased opportunisms within a firm (Williamson, 1985) whilst the latter argues that firms encompass interpersonal networks and a social technology that enable transmission of tacit knowledge across borders (Kogut and Zander, 1993).

### **International business theory, spillovers and keiretsu**

The early spillovers literature is extensively reviewed in Blomstrom and Kokko (1998), Gorg and Greenway (2004), Crespo and Fontoura (2007), and Smeets (2008). It is meta-analysed in Görg and Strobl (2001), Meyer and Sinani (2009), and Iršová and Havránek (2013).

While these review papers highlight a number of issues in the literature, they all discuss the importance of the precise nature of the relationships between the inward investors and the

domestic firms, and the high degree of heterogeneity that exists in these relationships. They also suggest that opening the black box is crucial in explaining why existing studies have often produced mixed and inconclusive results. Furthermore, these mixed results are attributed to differences in the types of firm, the home/host country characteristics controlled for, the time period of the analysis, and the estimation techniques employed.

Despite these mixed results, Driffield *et al.* (2010) highlight that there are still certain necessary conditions for inward FDI to generate spillovers. These are:

- inward investors must have some form of ownership or productivity advantage that can be assimilated by domestic firms;
- knowledge is transferred first from a parent company of a MNE in an advanced home base to its foreign affiliates; and
- this knowledge then in some sense leaks out to local firms.

These conditions, therefore, suggest that a degree of interaction between inward investors and domestic firms is required to facilitate the knowledge transfer process. There have been numerous attempts to categorise or identify this effect, using various typologies. Shaver *et al.* (1997) and Shaver and Flyer (2000), for example, focus on the agglomeration effects of collocation between foreign affiliates and domestic firms, as do Markusen and Venables (1999), although in a different context. Others have focused on links between FDI and financial markets (Alfaro *et al.*, 2006).

From a practical point of view, there is no guarantee that intra-firm technology transfer and technology spillovers will take place since MNEs often attempt to internalise their knowledge and avoid leakages of their frontier technology to third parties (Driffield *et al.*, 2010). The consensus in the literature is that transactional linkages through buyer-supplier relationships are found to be a key channel of FDI spillovers (Görg and Strobl, 2001;

Javorcik, 2004; Kugler, 2006; Haskel *et al.*, 2007) and can make an important contribution for domestic firms' technical, managerial, and organisational capabilities (Dunning, 1993; Cantwell, 2009). Productivity spillovers from backward linkages are likely to occur through several channels. First, domestic suppliers benefit from direct knowledge transfers by foreign customers. Second, foreign multinationals impose higher requirements for product quality and rigid time delivery, which cause a greater incentive for domestic suppliers to upgrade their technology and management practices. Third, foreign entries increase the demand for intermediate products by introducing new and specialised input varieties, which allows local suppliers to benefit from economies of scale. Forward linkages where MNEs supply higher quality inputs with competitive prices to domestic end-producers appear to be crucial but are addressed less frequently in empirical research. MNEs can formally or informally assist or provide effective guidelines to improve final products they offer. It is unlikely that independent organizations will be able to replicate complex and tacit knowledge in full, as foreign firms and local recipients have different configurations of knowledge, technologies, organizational practices, and strategies (Spencer, 2008).

De Propris and Driffield (2006) show that domestic firms that belong to clusters appropriate greater spillovers from a foreign presence than firms outside clusters, facilitating spillovers of tacit knowledge. This is attributed to the networking and learning effects that occur in clusters, but distinct from the linkage effects reported elsewhere. Equally, inward investors gain more from technology sourcing when they engage with clusters, and, indeed, in the case of Italy, clusters are important attractors of inward investment. The most effective way to augment existing proprietary knowledge is to coordinate a network of value creating activities and develop relational capabilities of the firm and institutional assets (Cantwell *et al.*, 2010). Therefore, competitive advantages of firms have become increasingly network based rather than firm specific.

Given the increasing importance of such diffusions of foreign technology through buyer-supplier linkages, vertical keiretsu networks are likely to be embedded with inward investors and generate potential knowledge spillovers in the Japanese context. Affiliated keiretsu firms hosting inward investors should be able to absorb new practices, and to fit them into the local context, which has been found to be an important determinant of technology creation and diffusions (Girma, 2005).

Vertical keiretsu are formed for the supply chain operations that cluster around core firms (i.e. manufacturing assemblers) and are integrated through first-tier suppliers and distributors. Production is organised through vertical networks where intermediate goods and services are supplied through an extensive set of sub-contracting arrangements. Generally, sectors that exhibit this type of inter-firm organizational structure are located in the consumer electronics and the automotive industries (Sambharya and Banerji, 2006). A strategic network perspective suggests that relatively codified knowledge can be transmitted to firms through both direct and indirect contacts through inter-firm networks (Gulati *et al.*, 2000). These networks provide a firm with access to potential information, resources, markets, value-chains, and technologies through organisational learning and practices for their strategic objectives (Atallah, 2002; Matsuura *et al.*, 2003; Ito, 2004). Vertical keiretsu affiliations in particular appear to be associated with knowledge sharing and technology spillovers (Suzuki, 1993; Branstetter, 2000) as firms are increasingly allying to gain access to specialised resources and complex capabilities that are not available internally.

On the other hand, horizontal keiretsu consist of member firms operating in unrelated sectors, which are organized in a socially- and historically-embedded network centred on large financial institutions. They are cemented in these multidimensional relationships through membership in presidents' clubs, equity, and capital ties (McGuire and Dow, 2003). Within these keiretsu networks, firms are often encouraged to cooperate and innovate through

sharing technology and personnel exchanges (Cowling and Tomlinson, 2002). Underlying the keiretsu system is a well-known mechanism that can facilitate the interchange and the flow of information between firms. The horizontal keiretsu group may perform the role of an internal market resource allocator and interchange for information flows (Kim *et al.*, 2004). On the other hand, horizontal keiretsu membership may also lock firms into unproductive relationships or preclude cooperating and exploiting opportunities with firms outside of the keiretsu group (Gulati *et al.*, 2000).

MNEs adapt their global strategies and business practices to local contexts, subject to institutional constraints imposed by the availability of resources in the host market (Meyer *et al.*, 2011). Given the significance of both horizontal and vertical keiretsu in the Japanese context, we next develop hypotheses with regard to how keiretsu influence spillovers from FDI in Japan.

## **Hypotheses**

### *Vertical and horizontal keiretsu and spillovers*

It is important to distinguish between vertical and horizontal keiretsu groupings as the structure and function of both types of keiretsu differ (McGuire and Dow, 2003). Vertical keiretsu offer firm-level stability and build trust through repeated interactions. They also facilitate exchange of technical knowledge across firm boundaries (Dyer and Singh, 1998; Branstetter, 2000; Sambharya and Banerji, 2006). By sharing complementary resources, network linkages between suppliers and downstream firms can improve the efficiency of the manufacturing process and reduce transaction costs and opportunism from information asymmetries. Moreover, local firms in vertical keiretsu-dominated sectors are likely to integrate and coordinate foreign technologies along their supply chains and distribution networks, optimising the overall performance of domestic firms. Vertical keiretsu, therefore,



potentially provide affiliation benefits and mechanisms that would aid the assimilation of imported foreign technology. Branstetter (2000) and Suzuki (1993), for example, provide supporting empirical evidence that vertical keiretsu affiliation can effectively promote knowledge spillovers and the innovative activities of Japanese manufacturing industries. Such externalities are generated not only for keiretsu-affiliated firms but also for unaffiliated firms.

*Inter-industry spillovers from FDI in the presence of vertical keiretsu*

Keiretsu may also share broadly similar features with cluster networks and Marshallian industrial districts in terms of networking and information sharing (Cowling and Tomlinson, 2000; Ozawa, 2003). Gugler and Brunner (2007) find evidence that highly dynamic clusters generally gain productivity spillovers from inward FDI. Thus, keiretsu do enhance the sharing and exchanging of complementary technological information so that suppliers and downstream firms will be able to improve the productivity of their manufacturing processes (Atallah, 2002; Ito, 2004). These potential benefits arise from the more effective adaptation of new technologies and resource allocation through extensive keiretsu networks in the form of dedicated global learning.

In a similar vein, keiretsu firms that possess distinctive information sharing and networking ability are likely to be able to not only react more efficiently to FDI but also promptly recognise the benefits of FDI, thereby capturing positive spillovers. Such positive productivity shocks from working with multinationals are generated through the domestic firm's own effort to access complementary knowledge from foreign firms or simply by the firm's motivation to develop new business relationships and enhance global learning through links with foreign investing firms. In general, domestic firms in keiretsu-intensive sectors are in a better position to assimilate foreign knowledge with their own economic activities

through transactional linkages. Backward and forward linkages are regarded as essential channels through which interactive learning, information, and technology can be exchanged or jointly exploited for the purpose of productive activities. This implies that interactions between vertical keiretsu and foreign-affiliated firms are likely to stimulate the process of positive spillover occurrences. The indigenous firms embedded in such a mechanism would, thus, benefit from the exploitation of knowledge spillovers and the accumulation of capability through learning from demonstration effects. In conclusion, the vertical keiretsu system can be regarded as a potentially efficient method of stimulating transnational linkages between buyers and suppliers in keiretsu-dominated sectors, and are, therefore, a potential source of intangible assets for wealth creation. We therefore offer our first hypothesis:

*H1: Inter-industry spillovers from FDI are greater in the presence of vertical keiretsu.*

#### *Crowding-out effects of horizontal keiretsu and inward FDI within the same sectors*

Unlike vertical keiretsu, horizontal keiretsu usually span diversified and unrelated business activities, with member firms potentially located in every major industrial sector. The processing and adaption of more dispersed and distant knowledge acquired from outside the member firms (foreign and domestic) is costly and involves integration efforts and managerial complexity. Therefore, adjustment and adaption costs involved in network integration associated with external foreign resources would be greater. As a result, the benefits of spillovers to the Japanese economy might be less significant compared to those from vertical keiretsu. Knowledge spillovers may be impeded as a result of cognitive limits to assimilate resources across diverse activities.

Furthermore, horizontal keiretsu have much stronger historical and traditional roots and socially-embedded institutions than transaction-oriented vertical keiretsu and multiplex ties are created with normative pressures (Lincoln and Shimotani, 2010) (Lincoln *et al.*, 1996),

which limits openness to build new relationships and cooperation with outsiders. In such context, a newly entering MNE may face network constraints to develop the local network connections needed to access knowledge more easily. This is congruent with the concept of ‘industrial complex’ where club membership is effectively closed for outsiders in the concentrated market structure (McCann and Mudambi, 2005, p. 1868; Tallman and Chacar, 2011). Given the idiosyncratic nature of such inter-firm networks, it is plausible that it will be difficult for new foreign entrants to assimilate and transfer more distanced, tacit, and codified knowledge. This suggests our second hypothesis:

*H2: Sectors dominated by horizontal keiretsu experience declines in productivity due to crowding out from inward investment.*

The within-sector effect of FDI also needs to be considered in the keiretsu context. Anecdotal evidence suggests that keiretsu have deterred inward investment into Japan (Czinkota and Kotabe, 2000) through informal entry barriers that such groupings can create. As such, where successful inward investment occurs in the presence of vertically-linked keiretsu, the domestic sector is likely to experience significant crowding-out effects (Spencer, 2008). This phenomenon is likely to be more pronounced within sectors than across them, and may be exacerbated by competition between firms in labour markets. In a recent study, Bloom *et al.* (2013) also demonstrate that R&D intensive firms that are close competitors in product markets negatively affect productivity of rival firms due to a market stealing effect, particularly in the short term. This is because the existing firms’ technology and knowledge become rapidly obsolete as a result of new technological developments by rival firms. Furthermore, implementing new technology and substituting products increases integration and adjustment costs.

This effect is exacerbated because the interaction effects of horizontal corporate groups with foreign presence within the same sector are likely to be weaker. Horizontal keiretsu are organised with diversified and multiplex linkages; and the benefits of affiliations are historically more intangible and tacit (i.e. information sharing and networking) and less open to outsiders, which makes it difficult for foreign investors to transverse boundaries (Dow *et al.*, 2011; Lincoln and Shimotani, 2010). We therefore argue that agglomerating foreign presence and vertical keiretsu, which share common resources and knowledge within the same sector, outweigh any positive network externalities. Such negative interaction effects are greater than that of horizontal keiretsu whose technological capabilities and resources differ from foreign investors. Thus, our final hypothesis is that:

*H3: Crowding-out effects within sectors are greater where the domestic sector is dominated by vertical keiretsu rather than horizontal keiretsu networks.*

## **Data and methodology**

### *Sample*

The empirical analysis in this paper is based on unbalanced panel data with 4,047 observations of 1,413 cross section units covering Japanese firms active in 22 two-digit manufacturing sectors (NACE Rev. 1.1 Classification Codes 15 to 36) during the period of 1997-2003. Given the self-selection problem affecting past sectoral level studies (i.e. FDI goes to the more productive sectors), employing firm- or plant-level panel data is a prerequisite if we wish the productivity spillover analysis to provide robust empirical evidence (Görg and Greenaway, 2004; Crespo and Fontoura, 2007). The firm-level data to estimate Total Factor Productivity (TFP) is drawn from the commercial database ORBIS compiled by Bureau van Dijk. The database contains the necessary financial information on the volume of gross revenue, the number of employees, the cost of intermediate inputs, and

the value of tangible and intangible fixed assets. All nominal monetary values are deflated using the relevant price indices at the two-digit industry level obtained from the System of National Account (SNA) (see Appendix). Sector-specific variables for intra-FDI and inter-FDI spillovers (backward and forward linkages) are constructed using two data sources. The sales share of foreign establishments is obtained from *Heisei 9~15 Nen Kigyo Katsudo Kihon Chosa Hokokusyo: Sogo Tokeihyo* (Results of the Basic Survey of Japanese Business Structure and Activities 1998-2004: Volume 1 Summary Report) available from the Research and Statistics Department, Economic and Industrial Policy Bureau, Ministry of Economy, Trade, and Industry (METI). The linkage coefficients are taken from the annual extended Input-Output table published by the Research and Statistics Department, Economic and Industrial Policy Bureau, METI. The three-digit FDI data are then aggregated to the two-digit level to match the Input-Output table. Finally, information on keiretsu is taken from "*Sales Ranking*" from Money & Market Nikkei Net and "*Nippon no Kigyo Gurupu 2003*" (Corporate Groupings in Japan) from Toyo Keizai Shinposhya.

#### *Dependent variable*

As discussed in detail in both review and empirical papers (Blomstrom and Kokko, 1998; Görg and Strobl, 2001; Driffield and Love, 2007; Haskel *et al.*, 2007), the search for spillovers from FDI flows is based fully on empirical literature. Typically, this is based on the work of Caballero and Lyons (1989; 1990; 1992), and the critique that followed [see for example Griliches (1992) and Griliches and Mairesse (1995)]. In order to have confidence in the apparent results, one has to consider a number of important factors.

Firstly, one must have a measure of total factor productivity, not a proxy such as labour productivity. The essential approach taken by all of the literature is to start with a

relatively simple production function. One starts by obtaining an estimate of total factor productivity by estimating the following:

$$tfp_{it} = \ln Q_{it} - \hat{\beta}_L \ln L_{it} - \hat{\beta}_K \ln K_{it} \quad (1)$$

where  $Q$ ,  $L$ , and  $K$  represent output, labour, and capital of the firm. The estimates of the  $\beta$  terms are derived either through estimation or (more commonly) simply from the relative factor shares of the two inputs. Ideally, the measure of total factor productivity should allow for the endogeneity of the investment decision by the firm, in the face of potential changes in productivity. Therefore, we employ the semi-parametric approach suggested by Levinsohn and Petrin (LP) (2003), which is an extended and modified version of the Olley and Pakes (OP) estimator (1996) (For recent empirical applications on LP see (Blalock and Gertler, 2004; Driffield *et al.*, 2008; Temouri *et al.*, 2008; Altomonte and Pennings, 2009). This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time by controlling for the endogeneity of input selections (Javorcik and Spatareanu, 2008).

Secondly, one must employ firm-level data. As Gorg and Strobl (2001) show, many industry-level studies have overstated the apparent spillover effects, due to the fact that more productive sectors are more likely to attract inward investment, perhaps motivated by technology sourcing (Driffield and Love, 2007). As such, while a correlation between inward investment and productivity growth can be established at the industry level, this is not necessarily indicative of spillovers.

Thirdly, one must have panel data, not merely a cross section. This allows the researcher to not only distinguish between mere correlation (more productive sectors attracting FDI), but to also impose a dynamic element to the specification, thereby allowing FDI in one year to have an impact on total factor productivity in subsequent years, for example. Panel data also

allows for firm-level heterogeneity, which has been shown to have a significant impact on the results for estimating (productivity) growth models (Lee *et al.*, 1998).

Fourth, one must allow for both within- and across-industry effects and not merely rely on within-industry effects to capture spillovers. An extension to this, highlighting the requirement for longitudinal data, is the requirement to capture the interactions between inward investors and domestic firms, and also to allow heterogeneity in this within the domestic sector. In this context, as well as being worthy of study themselves, keiretsu offer additional information, capturing the interaction between these dominant firms, the industries in which they operate, and the inward investors attracted to these sectors.

Given these considerations, the estimate of total factor productivity can then be regressed against the externality terms within a fixed-effects model, including a time trend (or alternative measure of exogenous technical progress) and other explanatory variables:

$$\ln tfp_{it} = \alpha + \sum_{p=1}^r \mu_p X_{it} + \omega_{it} \quad (2)$$

where the  $X_{it}$  term captures all of the spillover terms and measures inter-industry and intra-industry effects, interaction terms, and control variables. The specification is estimated with firm-level data (with firms indexed by  $i$ ) within a fixed-effects framework<sup>1</sup>, controlling for both firm- ( $i$ ) and time-specific effects ( $t$ ), while our measures of potential FDI spillovers are measured at the industry level ( $j$ ). Time dummies are included to allow for period-specific effects on the productivity shock that is common to all firms but not attributable to explanatory variables in the equation, while firm dummies allow for cross-firm variation in TFP levels.

### *Spillover variables*

Foreign presence within sectors (horizontal spillovers) is measured as the proportion of sales accounted for by foreign entities (that is where foreign firms hold more than 33.4 percent of the equity in a firm), as seen below:

$$INTRA\_FDI_{j,t-1} = \frac{Y_{jt}^F}{Y_{jt}^{D+F}} \quad (3)$$

Our prime interest is to examine transactional linkage effects of a foreign presence across different sectors. Therefore, vertical spillovers are constructed with backward and forward linkages between foreign-invested firms and indigenous firms. The former are the linkages where domestic firms supply the intermediate inputs used by foreign-invested firms in downstream industries. The latter are the linkages where domestic firms purchase the intermediate inputs from foreign firms in upstream industries. To obtain these coefficients, sectoral sales/purchase to each sector is divided by the total intermediate inputs sold/purchased in the domestic market in the row/column vectors of the “Use” and “Make” matrices. These coefficients are then multiplied by foreign presence vectors derived from Formula (1) to yield the backward and forward spillover variables below. The symmetrical transaction matrix distinguishes between the intra-industry transactions as the leading diagonal and the inter-industry transactions as the off-diagonal measure of FDI intensities.

$$INTER\_BACK_{j,t-1} = \sum_{k, j \neq k} \alpha_{jk} * INTRA\_FDI_{kt} \quad (4)$$

where  $\alpha_{jk}$  is the proportion of sector  $j$ 's outputs supplied to sector  $k$ . The proportion  $\alpha_{jk}$  is calculated based only on inputs supplied locally, that is the products supplied for final consumption and imported intermediate inputs are excluded. The inputs supplied within sectors are excluded in order to isolate the effects of vertical spillovers (INTRA\_FDI).

Similarly, our measure of forward linkages is:



$$INTER\_FORWARD_{j,t-1} = \sum_{k, j \neq k} \beta_{jk} * INTRA\_FDI_{kt} \quad (5)$$

where  $\beta_{jk}$  is the proportion of material inputs purchased by sector  $j$  from sector  $k$ . As before, the inputs purchased within sectors are excluded, since this effect is already captured by the INTRA\_FDI variable. The greater the value of these coefficients, the greater the proportion of outputs supplied to/by foreign sectors. Hence positive coefficients signify the presence of knowledge spillovers between foreign multinationals and locally-owned firms in terms of supplier-buyer linkages. The details of the construction of the linkage variables are illustrated in Driffield *et al.* (2002, p. 351) among others (Javorcik, 2004; Jabbour and Mucchielli, 2007; Blalock and Simon, 2009; Liu *et al.*, 2009). All spillover variables are lagged one year in order to control for potential endogeneity (Altomonte and Pennings, 2009)

#### *Control variables*

At the firm level, market share of a domestic firm  $MS_{it}$  denotes the market share of a domestic firm  $i$  in terms of revenues in sectors  $j$  and year  $t$ . This control variable enables us to separate the effects on productivity from market-stealing effects [1] of foreign firms as well as the monopoly power of domestic firms, see recent empirical models (Keller and Yeaple, 2005; Todo, 2006; Haskel *et al.*, 2007). Another important factor explaining technology diffusion is firm-specific assets (Kiyota, 2006; Todo, 2006; Murakami, 2007), measured as the value of intangible fixed assets  $RD_{it}$ . Veugelers and Cassiman (2004) point out that such specific assets allow firms not only to better scan and screen external technology but also increase the absorptive capacity of the organisation, thereby allowing it to internalise external knowledge within their own innovative projects. To take into account Japan's idiosyncratic industrial organisation, vertical and horizontal keiretsu are also included in the specification.  $VK_{jt}$  is the vertical keiretsu intensity defined as the proportion of

industry sales accounted for by sales to the largest eight firms in keiretsu-dominated sectors.

$HK_{jt}$  is the horizontal keiretsu intensity defined as sales share of firms belonging to the Presidents' Clubs of the Big Six keiretsu: Mitsui, Mitsubishi, Sumitomo, Fuyo, Sanwa, and DKB. The members of Presidents' Clubs consist of representatives of the largest companies affiliated with each of the Big Six keiretsu, which are comprised of city banks, trust banks, insurance companies, general trading firms, and major manufacturing firms from unrelated industries. Executives of these Presidents' Clubs participate monthly in a CEO meeting to share and exchange information with each other in order to gather resources that will benefit the firm. Theoretically, we believe this better captures the socially-embedded nature of group affiliation in Japan.

Our baseline model includes the essential measures of vertical keiretsu and horizontal keiretsu, as well as the measures of both inter-industry and intra-industry FDI. Our augmented model further includes interactions between these two variables and each of the inter- and intra-industry spillovers variables. This allows examination of whether the presence and structure of keiretsu moderate the relationship between inward FDI and productivity performance of Japanese firms, and, if so, whether this is more important for vertical or horizontal spillovers, and, in turn, whether horizontal keiretsu or vertical keiretsu gain more through the interactions with inward investors than other firms. In turn, this will enable us to extend the existing debate on the types of firms that are best positioned to gain from inward investment. Table I provides the definitions and summary statistics for all variables used in our analysis.

[Table I Here]

## Results

Table II sets out the estimation results for the baseline model (1) and the augmented model (2) using a fixed-effects specification with lagged spillover regressors.

[Table II Here]

Focusing first on the baseline model for the full sample in column (1), the model performs well, and confirms the existing literature. Inter-industry spillover effects are more significant than within-industry effects. The coefficient on backward linkages across different sectors (INTER\_BACK) is positive and statistically significant so that foreign involvement across downstream industries plays an important role in improving the productivity of domestic firms. The coefficient on forward linkages across different sectors (INTER\_FOR) is positive and statistically significant, highlighting the importance that forward linkages play in FDI spillovers. Moreover, the baseline model also illustrates that, *ceteris paribus*, as vertical keiretsu presence increases in an industry, firms have lower productivity. This is not surprising, and is often the case for dominant firms, who, *inter alia*, face less competition.

The results for the augmented regression, which includes interaction terms between FDI spillovers and keiretsu presence, are reported in the second column of Table II. Confirming *H1*, inter-industry spillovers through both backward and forward linkages in vertically-organised keiretsu-intensive sectors (INTER\_BACK\*VK and INTER\_FOR\*VK) are positively and significantly correlated with higher domestic productivity. On the other hand, similar interaction terms for horizontal keiretsu are insignificant (INTER\_BACK\*HK, INTER\_FOR\*HK), therefore, *H2* is not supported. This highlights the role that inward investment has in introducing frontier technology to Japan, and the role that vertical keiretsu have in transferring this technology up and down the value chain. The results suggest that domestic firms in vertical keiretsu-intensive sectors gain more from productivity externalities through a foreign presence in both downstream and upstream sectors than horizontal keiretsu.

Turning to *H3*, we see that it is supported by the results from the augmented model. As the negative and statistically significant coefficient for INTRA\_FDI\*VK indicates, vertically-linked keiretsu presence intensifies the negative effects on productivity associated

with crowding out or market stealing. Foreign and indigenous firms compete for the same customers and resources. Inward FDI, then, in certain cases, generates significant market pressures, particularly when the investment is undertaken to serve the local market within the same sector. An increase in foreign share reduces the output of domestically-owned establishments which consequently reduces the productivity performance of high-tech domestic firms in the short run. This is in line with the findings of Aitken and Harrison (1999), who suggest that the competition effect outweighs any positive technological effects. Crowding out occurs when the MNE increases competition in local product, labour, or financial markets in a way that is intense enough to disadvantage local enterprises (Spencer, 2008). From the supplier's perspective, the increased openness of the Japanese economy to foreign entrants may make access to a stable group customer base less attractive.

Foreign-invested firms are able to draw demand away from their indigenous counterparts through the introduction of new innovative products. As a result, a foreign presence pushes up the domestic firms' average cost curve by the crowding-out effect. The increasing efficiency associated with rises in the foreign ownership negatively affects domestic firms who face fierce competition. Moreover, the market-stealing effect may also occur when domestic firms develop valuable technology and brands, but a foreign investor acquires these assets and thus no longer generates the value to the domestic-owned sector. Thus our results suggest that the market-stealing and competition effects are severe for high-tech domestic firms in vertical keiretsu sectors when FDI takes place within the same sector. As a result, negative effects offset any positive externality.

## **Conclusions and Discussions**

This paper explores the relationship between inward FDI and domestic productivity in Japan, after linking this with the role played by the keiretsu system. Our results show that spillover effects from inward FDI through transactional linkages are not only contingent upon the

existence of keiretsu structures, but also the type of keiretsu mechanism. Potential productivity spillovers are generated from backward and forward linkages where Japanese firms supply/purchase the intermediate inputs to/from foreign firms. Thus, while firms in industries with higher vertical keiretsu presence have lower productivity than the average Japanese firm, there are nonetheless productivity benefits for domestic firms in vertical keiretsu-intensive sectors because of backward and forward linkages. Thus, local suppliers/buyers that are aided by the prevalent role of information sharing and networking from keiretsu appear to be efficient in assimilating foreign knowledge with their own economic activities. By contrast, intra-industry spillovers from inward FDI appear to be reduced as vertical keiretsu networks become stronger, which is evidenced by the productivity levels of local firms, thereby suggesting adverse competition and crowding-out effects.

The empirical findings obtained from this study suggest some useful policy implications. In general, the Japanese government's recent initiatives to improve the investment climate and to promote foreign investment appear to be appropriate policy prescriptions to boost economic growth. We suggest that the policies could be more selective and targeted to specific types of inward FDI. It would be sensible to provide fiscal and financial incentives for foreign entrants located in the intermediate product market since they are more likely to generate productivity externalities through transactional linkages. This also suggests some additional avenues of research, including the gathering of further evidence on the nature of the relationships between inward investors and domestic firms, in both keiretsu-dominated sectors and non-keiretsu sectors. Typically, for example, keiretsu have been seen as deterring FDI, but our results suggest that this finding is not robust and, in fact, there is a more subtle distinction regarding the nature of keiretsu. Equally, if keiretsu are an effective vehicle for technology transfer, it may be the case that this deters inward investment by firms

who seek to prevent technology leakage. As little is known about the nature of FDI into Japan, its motivation, and the types of technology that it embodies, further case study evidence would shed more light on these results. Finally, the mechanisms by which the apparent productivity spillovers occur warrant further investigation. It is argued that the strong transactional linkages and externalities in keiretsu-dominated sectors efficiently foster the diffusions of skills and expertise, but it is, as yet, unknown what role inward investment into Japan can play in this.

**Notes**

1. This effect takes place when market share of domestic firms is taken away from technologically advanced foreign MNEs (Aitken and Harrison 1999). The argument is that as a result of increased competition, domestic firms are forced to produce less output with increased unit costs.

## **Appendix**

This appendix provides supplemental information on the construction of variables and data sources used in the analysis. Output (Y) is defined as real total gross revenue (in millions of Japanese yen) deflated by 93SNA (System of National Account) output price deflators.

Capital (K) is expressed as the real value of tangible fixed assets (in millions of Japanese yen) deflated by 93SNA GDP deflators. Material (M) is the real cost of intermediate input defined as the cost of goods sold (in millions of Japanese yen) deflated by 93SNA input price deflators. Labour (L) inputs are based on man-hours measured as the number of employees multiplied by average sectoral working hours. Real value added (VA) is real output less real material. Technology (RD) is expressed as the real value of intangible fixed assets using 93SNA GDP deflators. An alternative proxy for technology that is frequently used in empirical studies is an input indicator of R&D expenditures. However, given the large number of missing values on this data in ORBIS, output indicators of intangible fixed assets are used in our analysis. All firm-level data are obtained from ORBIS, compiled by Bureau van Dijk. All price indices (2000=100) to deflate nominal monetary values and sectoral working hours are taken from SNA, Economic and Social Research Institute (ESRI) from the Cabinet office of the Japanese government.



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<sup>i</sup> Empirically, this means testing the restriction of fixed effects over the more general random effects specification using a Hausman test. In our case, the Hausman test fails to reject a fixed effects specification.