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Clustering of Foreign Direct Investment and Enhanced Technology Transfer: Evidence from Hong Kong Garment Firms in China

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Summary. — Separately, both foreign direct investment (FDI) and industry clusters have each received considerable and growing attention in development literature. Each is broadly thought to affect economic growth positively through facilitation of knowledge and technology transfers. But FDI and industry clusters in conjunction have not hitherto been empirically considered specifically with regard to such transfers. This paper does so by examining the proposition that FDI within geographical industry clusters should transfer technology more than FDI that is geographically dispersed. Data are drawn from a quantitative survey of Hong Kong garment firms with manufacturing investments in Mainland China. Clustered FDI is shown to be significantly better than dispersed FDI at transferring technology in certain respects, implying that industry cluster and FDI policies should be considered in tandem rather than separately if developmental benefits from both are to be optimized. © 2002 Elsevier Science Ltd. All rights reserved.

Key words — foreign direct investment, industry clusters, technology transfer, multinational business, development, China, Hong Kong, garment industry

1. INTRODUCTION

The role of foreign direct investment (FDI) has long been a topic attracting wide attention in development literature. Old fears that FDI might sustain, or even accentuate, home and host country income differentials to recipients' disadvantages (Evans, 1979; Hymer, 1970, 1976; Moran, 1978; Santos, 1970) have mostly given way to recognition that FDI can fuel and facilitate economic development (Balasubramanyam, Salisu, & Sapford, 1996; Halverson, 1991; Poon & Thompson, 1998; Rana & Dowling, 1988). The agents of FDI, multinational corporations (MNCs), can not only supply capital that mobalizes labor and land productively, they can also act as conduits of technology transfer (Gereffi, 1992; Harrison, 1994; Heraud, 1996; Kay, 1991; Lee, 1984; Ostry & Gestrin, 1993; Quinn, 1969; Sölvell & Zander, 1998). Of course, MNCs can transfer "hard," patentable forms of technology, but they also create positive externalities by transferring "soft" technologies, such as managerial skills, and by stimulating competition within their particular and adjacent sectors (Chen, 1996; Dunning, 1994, 1996; Thompson & Poon, 1998). The intra- and inter-industry linkages by which such "soft" technologies spillover from MNCs into local economies are broadly similar to many of the knowledge transfer mechanisms identified in the newer and burgeoning literature on industry clusters and development (Altenburg & Meyer-Stamer, 1999; Bell & Albu, 1999; Chari, 2000; Knorringa, 1999; McCormick, 1999; Nadvi, 1999; Rabellotti, 1999; Schmitz, 1995; Schmitz, 1999; Scott, 1994; Tewari, 1999; Visser, 1999; Weijland, 1999).

Given that both FDI and industry clusters respectively and separately enhance development through some common mechanisms, it might reasonably be anticipated that FDI, from any given industry sector, that is itself clustered in a geographically concentrated area ought to transfer technology more extensively than same-sector FDI that is geographically dispersed. Should this prove to be the case, it would have important implications for both

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FDI and industry cluster policies. The hypothesis that clustered FDI should be more effective than dispersed FDI at transferring technology has not been either formally postulated or empirically tested in prior studies. To test the hypothesis, this paper uses survey data gathered directly from Hong Kong garment firms with manufacturing investments in Mainland China that are respectively located within and without geographical clusters of FDI. The mechanistic commonalities between FDI-derived technology transfer and industry cluster development enhancement are first briefly discussed and propositions suggested, prior to detailing method and results.

2. TECHNOLOGY TRANSFER, FDI AND CLUSTER LINKAGES

At its narrowest and most easily measurable, technology can be regarded as patentable blueprints, plans, mechanisms, formulae and the like (Enos, 1989), and its transfer can be regarded simply as the new use of such technology either within a particular MNC or by a host country firm after contractual exchange with a foreign firm or other organization (Smith, 1980). However, although more difficult to quantify, a broader conception of technology transfer is more useful and common when considering MNCs as its agent (Wu, 2000). Technology is perhaps better regarded as any knowledge that can improve economic efficiency. Hence, it can include not only the "hard," possibly patentable, aspects of production, like the specifications of goods and the mechanistic details of their manufacture, but other, less tangible factors. These are the "soft" aspects of business processes, such as organizational, marketing and other managerial knowledge and skills that potentially can spillover not just into a specific sector (Chuang & Lin, 1999; Stewart, 1977; Westney, 1989), but more broadly as positive externalities into an economy as a whole (Das, 1987; Enos & Park, 1988). Consequently, the transfer of such broadly defined technology need not be formal and contractual alone, but can include all the conduits by which managerial know-how and techniques can be passed on, such as on-the-job learning, informal discussion, imitation and so on (Ahiakpor, 1990). The vertical and horizontal, intra- and inter-industry mechanisms of "soft" technology transfer are in many cases precisely the same as those associated with developmental benefits accruing within industry clusters.

Horizontal, *intra-industry spillovers* from FDI have been suggested to occur through a number of mechanisms (Blomström & Persson, 1983; Sölvell & Zander, 1998). These include spillovers directly through straightforward emulation by firms within the same industry; via human capital shifting employment from MNCs to local firms in the same and other industries; by informal exchange between managers meeting in trade associations and other industry fora, such as trade fairs (Bennett, 1998; Sako, 1996; Swan & Newell, 1995), and even social functions (Coleman, 1988); and indirectly by the stimulation of intensified competition within the same industry (Hirschman, 1958). *Vertical*, *inter-industry spillovers* from FDI may occur through some of these ways, plus by direct vertical linkages with suppliers and buyers in up- and down-stream industries (Asanuma, 1989; Belderbos, Capannelli, & Fukao, 2001; Cooke & Morgan, 1993; Egan & Mody, 1992; Lundvall, 1993). Inter-industry spillovers can also take place indirectly through the stimulus MNCs can provide for new entrants into supplier industries, which thereby increases competition and drives up performance in those industries (Lall, 1980; Lim & Pang, 1982).

These horizontal and vertical technology and knowledge transfer mechanisms have long been implicitly (Marshall, 1920), and, more recently, explicitly at the core of literature on the economic efficiencies and competitive advantages of industry agglomeration and firm clusters (Harrison, 1992; Keeble & Wilkinson, 1999; Murray, 1999; Oakey, 1985; Porter, 1990; Porter & Sölvell, 1998; Saxenian, 1985; Scott, 1987). Literature examining the effect of industry clusters on development has particularly focused on horizontal and vertical linkages as mechanisms of knowledge and technology transfers that upgrade competitiveness and efficiency (Porter, 2000; Schmitz & Navdi, 1999). Tewari (1999), for instance, discusses the positive impact of vertical linkages between yarn suppliers and their buyers in an Indian woollen knitwear cluster. The same study also examines the impacts of horizontal spillovers via a pool of mobile, multiskilled labor and through interfirm rivalry. In another paper, Tewari (1998) discusses the beneficial impact of another form of horizontal linkage, active manufacturers' associations, within industry clusters. Knorringa (1999) examines the effects of backward and

forward vertical linkages between buyers and suppliers in an Indian footwear cluster. Studying another footwear cluster in Brazil, Schmitz (1999) finds a positive correlation between increased backward vertical linkages with suppliers and individual firm performance within the cluster, although the study finds little beneficial effect from the horizontal linkages also investigated. Rabellotti (1999) also examines horizontal and vertical linkages, finding that both have a positive impact on performance of firms within a Mexican footwear cluster. Investigating industry clusters in Africa, McCormick (1999) uses an analytical framework em-bodying consideration of the same kinds of vertical and horizontal linkages, as does Weijland (1999) when looking at industry clusters in Indonesia.

3. EFFECTIVENESS OF CLUSTERED VERSUS DISPERSED FDI AT TRANSFERRING TECHNOLOGY

Given that the technology and knowledge transfer benefits of FDI and industry clusters are facilitated by many of the same vertical and horizontal spillover mechanisms, it seems reasonable to suggest that FDI into pre-existing or forming new geographical industry clusters should transfer technology more effectively than FDI in the same sector but which is geographically dispersed. Support for such a proposition is lent by Visser (1999) who found that indigenous garment firms in Peru that were within a tight geographical cluster performed better than those that were dispersed, predominantly because the operation of vertical and horizontal spillover mechanisms was better facilitated within the cluster. Further support is offered by Altenburg and Meyer-Stamer (1999) who suggest that clusters of foreign MNCs should create positive externalities and attract supplier and complementary service firms.

(a) *Vertical spillovers*

In terms of backward vertical spillovers, MNCs investing within clusters might be anticipated to create and derive advantage from greater positive externalities than might MNCs with dispersed investments. A concentration of MNCs in a cluster might be predicted to attract greater numbers of materials, component and services suppliers. These could, because of their greater numbers, be expected to compete with one another to provide the better supplies that MNCs might be expected to demand as they play various suppliers off against each other. MNCs might be anticipated to find it easier to oblige or induce such suppliers to work more closely with them in order to match specified input criteria. Resultantly, it might be expected that suppliers to clustered MNCs should provide better value for money than suppliers to MNCs with dispersed investments.

(b) *Horizontal spillovers*

In terms of intra-industry horizontal spillovers, MNCs investing in clusters might be expected, due to their closer proximity, to prompt local competitors to be more efficient than MNCs with dispersed investments. This might be expected to be evidenced in greater effort by local competitors within clusters than those without to imitate production and managerial practices. Knowledge of what and how to imitate could be anticipated to be more greatly facilitated by clustered than by dispersed MNCs due to the greater number of, and ease of joining, local industry associations likely to exist within the smaller geographical areas in which clusters form.

Greater opportunity to emulate MNCs within clusters might also be evident in a higher propensity to hire factory managers and workers from MNCs within clusters than from MNCs without. It might further be hazarded that both factory managers and workers from clustered MNCs will show a greater tendency to shift employment for the reason that they have more potential geographically proximate alternative employers to choose from than employees of MNCs with dispersed investments.

4. METHODOLOGY

To examine the proposition that clustered FDI is more effective than dispersed FDI at transferring technology via certain vertical and horizontal spillover mechanisms, data were collected from Hong Kong garment manufacturers with manufacturing investments in Mainland China. The Hong Kong garment industry, still the largest manufacturing sector in Hong Kong, has shifted its geographical scope through extensive vertical integration via FDI into Mainland China almost solely for the purpose of export production (Thompson, 2000). This population makes a particularly

compelling case for analysis because Hong Kong businesses generally account for nearly 60% of total investments in China by value during 1979–92 (Leung, 1996; Wei, 1996; Zhan, 1993). More specifically, survey data suggest the garment industry itself accounts for the largest sectoral proportion, some 20%, of Hong Kong derived FDI to China by number of investing firms (Eng & Lin, 1996; Wei, 1995).

(a) *Sample*

The initial sample comprised all the firms listed as members of the Federation of Hong Kong Industries that were categorized under woven and knitted garment sectors in its 1998 directory. This directory was selected because it has in previous years been used by the Federation itself as the basis for its own postal surveys on investment in China (Federation of Hong Kong Industries, 1992, 1993, 1995). These three surveys constitute some of the only empirical research covering FDI by Hong Kong garment firms and have been widely analyzed and cited (Berger & Lester, 1997; Eng & Lin, 1996; Leung, 1996). Inquiry with the Federation suggested that their membership is broadly representative of Hong Kong garment firms, with perhaps a slight bias toward larger companies. Data gathered from the same population in a recent, separate survey (Thompson, 2000), indicate that the FDI they have made in China covers predominantly self-manufacture of garments—rather than outsourced assembly—packaging of finished garments, warehousing, and sample making. Hence, the processes of technology transfer examined do not relate primarily to those associated with outsourced piece-work (Deardorff & Djankov, 2000). According to discussions with industry participants, attendant with all of these activities is a high degree ofquality control through intensive on-the-spot management of all processes that have been vertically internalized, plus close managerial relationships with textile and other suppliers.

(b) *Procedure*

Based on discussions with senior industry managers, a questionnaire was devised and pilot tested via telephone. A letter was then sent to the whole sample, announcing the research and stating that a survey instrument would arrive with recipients shortly. Recipients were generally managing directors, chief executives or general managers. In total, 307 firms were sent the introductory letter. Then, between one and two weeks later, instruments were administered to the same individuals. Three weeks after that, a reminder and duplicate instrument were sent to non-respondents. Second and third reminder letters, together with duplicate instruments, were then sent to remaining non-respondents at two weekly intervals thereafter.

Of the original 307 recipients, six replied to say they were not in fact garment manufacturers and were thus not appropriate to complete the questionnaire. Instruments proved to be undeliverable to another 24 firms. It is likely that more were not received by prospective recipients, but it is not possible to quantify how many failed attempted deliveries went unnotified. From an assumed final sample of 277 recipient firms, however, 107 completed and useable instruments were returned, 39 from the first administration, 42 from the second, 11 from the third, and 15 from the final administration. Hence, a final response rate of over 38% was achieved. After four waves of instrument administration, it was decided that checking for nonresponse bias would be a fruitless exercise, so the profile and responses of returns from the first, second, and combined third and fourth instrument deliveries were compared. No significant differences were found. Of the 107 responses, 84 were found to be from Hong Kong firms with manufacturing plants in Mainland China, just under 80%.

(c) *Isolating samples of clustered and dispersed firms*

What represents a cluster in terms of geographical concentration has been argued to vary by industry (Birkinshaw & Hood, 2000), and there is no commonly accepted method for cluster identification (Feser & Bergman, 2000; Hill & Brennan, 2000). Of the 84 firms with investments in China, 34 reported having manufacturing investments in Dongguan, 14 had plant in Shenzhen, 11 in Guangzhou, 4 in Jiangmen, and 1 in Huizhou, the main locations of garment manufacturing investments reported by the Federation of Hong Kong Industries (1992, 1993, 1995). Thirty-three firms reported investments elsewhere, dispersed not just around Hong Kong's neighboring Guangdong province, but throughout the rest of Mainland China. By eliminating all respondents reporting investments in any known or possible clusters, a subsample of 22 firms with dispersed

investments was isolated. To obtain a subsample of firms with investments located within a very narrowly defined and geographically tight cluster, those reporting manufacturing plants in Dongguan were used. Dongguan is a relatively small town with a population between 100,000 and 200,000, where local Chinese garment manufacturers are also clustered. Interviews with Hong Kong firms indicate that both local Chinese and Hong Kong garment firms started to cluster in Dongguan concurrently beginning in the mid-1980s. The prime reason suggested for locating there in the first place was close proximity to, and good transportation links with, Hong Kong, and greater and cheaper availability of land compared to either nearby Shenzhen or Guangzhou. The prior existence of domestic garment firms was not suggested as an initial reason why Hong Kong garment firms located there. As most of the dispersed sample appeared to comprise firms with single manufacturing plants, respondents reporting investments in Dongguan plus other locations were eliminated from the clustered investment sample, thus rendering a sample totalling 25 firms with single investments only within a single geographical cluster. In consequence it was possible to compare two samples of firms that displayed no significant differences across a series of dimensions other than the clustered or dispersed locations of their FDI (Table 1).

(d) *Measures*

Objectively measuring technology transfer, particularly the "softer" forms of technology, is beset with difficulties (López-Eguilaz & Pérez, 1997). As researchers of technology transfer to China generally observe, lack of reliable secondary data in Mainland China exacerbates such difficulties (Andreosso-O'callaghan & Qian, 1999; Chen, 1994). Accordingly, the measurement precedents set by two of the very few empirically-based quantitative studies of technology transfer to China, one by Ball, Zhang, and Pearson (1993), the other by Lan and Young (1996), were followed to obtain primary, quantitative data. Both these studies use interval measures to gauge, across a range

Table 1. *Sample profile: number of employees in China, annual turner HK$, number of product lines, and length of time in China*

	All firms	Clustered firms	Dispersed firms		
Mean number of employees in China	634.1	727.5	530.3		
Standard deviation	755.9	779.0	737.4	t statistic 0.80	$p = 0.43$
Annual turnover HK$m					
< 10	4	3	1		
10–50	10	3	7		
51–100	10	7	3		
101–500	16	7	9		
501–1000	3	3			
> 1000	1	1			
n	44	24	20	χ^2 8.15	$p = 0.15$
Number of product lines					
1	6	1	5		
2–5	23	15	8		
6–10	9	4	5		
11–50	3	2	1		
> 100	1	1			
n	42	23	19	χ^2 5.9	$p = 0.21$
Years invested in China					
< 2	2	1	1		
2–4	8	5	3		
5–7	17	8	9		
8–11	13	7	6		
> 11	7	4	3		
n	47	25	22	χ^2 4.79	$p = 0.19$

Source: Author's survey.

of technology transfer-related items, the perceptions of executives from foreign firms investing and doing business in China. For this study, alongside appropriate categorical parameters, the instrument posed statements to which respondents were asked to state their degree of agreement or disagreement on a five-point interval measure.

This approach has the merit of having already been used by the above researchers specifically regarding technology transfer to China. Moreover, the use of interval measures of perceptions also has a broad acceptance across a range of recent development and business related studies of cluster and related effects in which statistical soundness has been demonstrated (Nadvi, 1999; Piercy, Kaleka, & Katsikeas, 1998; Schmitz, 1999; Sim & Ali, 1998). The approach might be criticized because it quantifies perceptions that, sometimes, can be subjective. Hence, to see if this was in fact the case, it was decided to test the objectivity and accuracy of responses insofar as was possible. This was done by asking about the most sensitive and hubris-prone subject that it is possible to query business managers about—levels of profitability. In the initial survey instrument, respondents were asked to indicate the profitability of their firm relative to competitors on a five-point interval measure ranging from significantly lower to significantly higher. Roughly two months after initial responses had been received, all identifiable respondents were sent a supplementary questionnaire asking them to state what they estimated or assumed to be the average gross margin on sales in the garment sector generally and what their own firms' gross margin actually was. If the sample respondents had a reasonable and objective knowledge of competitors and were also accurate in statements about their own firms, one would expect the mean of assumed sector gross margins to be very similar to the mean of stated individual firm gross margins. On the other hand, if the sample managers were prone to hubris- or ignorance-driven exaggerations of their particular firms' relative profitability, one might expect the mean of assumed general sector gross margins to be somewhat lower than the mean of stated individual firm gross margins.

Fifty-nine of the original respondents replied. The mean of assumed sector average gross margin on sales was 15.612%, which corresponded very, very closely with the mean of stated individual firm gross margin on sales of 15.864%. This result strongly indicates that respondents appear to be both accurately knowledgeable about competitors and not prone to exaggerate their own firms' attributes relative to competitors.

To check if responding managers are also consistent, responses to the original questionnaire item about relative profitability were compared to the supplementary questionnaire item about gross margin on sales for individual firms. While profitability and gross margin are not necessarily precisely synonymous, one would expect them to be correlated if the survey respondents are reasonably consistent. A small but significant correlation was found ($r = 0.23$, $p < 0.10$), suggesting that respondents are not just reasonably objective but also consistent in assessing their own firms against competitors'.

The implication of these tests is that, while caution is still needed, the overall survey results can certainly be regarded as relatively accurate and objective. Moreover, although findings might be argued to be subjective in an absolute sense, such criticism in no way negates the objectivity of comparisons between one subsample and another, in this case responses from firms with manufacturing investments within a geographical industry cluster relative to firms with geographically dispersed investments.

(i) *Technology possession*

In an effort to check that both clustered and dispersed FDI is undertaken by MNCs embodying similar levels of technology, perceived degrees of hard and soft technology possession were gauged. Following prior researchers (Ball *et al*., 1993; Chen, 1998; Lan & Young, 1996), respondents were asked to rate their own firms relative to those of Mainland China competitors. For hard technology, direct assessments of comparative technological advancement were sought. Soft technology, taken essentially as management know-how, was measured through a series of comparative items suggestive of degree of managerial advancement, including managerial skill requirements and overall efficiency.

(ii) *Transfer mechanisms*

Backward vertical, inter-industry linkages were assessed using items relating to impact of investing firms on suppliers through active cooperation, and vertical spillovers in the form of externalities were assessed using items suggestive of increased supplier competition. Spill-

overs via horizontal linkages were assessed using a range of variables, including affect on human capital, perceived impact on mainland competitors, and extent of formal associability in terms of membership of Mainland China trade associations. Forward vertical linkage spillovers were not addressed. Doing so would make little sense as both clustered and dispersed firms have less than 5% of their turnover derived from the domestic Mainland market, with over 75% generated from North American, European, Japanese and other advanced economy markets. Hence, greater competition for local markets could not be expected to prompt horizontal spillovers. Moreover, the clustered or dispersed nature of firms' FDI is unlikely to have any differential impact on technology upgrading and competitiveness spillovers as a consequence of the exacting demands of buyers in these export markets (Porter, 1990; von Hippel, 1984).

(e) *Analysis*

Non-parametric statistical procedures were used for three reasons: (i) the unequal size of the two subsamples for some variables, (ii) the small size of the sub-samples, and (iii) the results of Levene's test for equality of variances that showed some significant differences between the two subsamples' variances. Accordingly, to compare subsample mean scores for variables, Mann–Whitney U tests were performed to derive z statistics. Intervariable correlations were derived using Spearman's *rho*. Some qualitative discussion with industry managers helped elaborate and clarify quantitative findings.

5. RESULTS AND ANALYSIS

(a) *Technology possession*

Overall, no significant differences were found between clustered and dispersed firms in terms of perceived levels of technology possession (Table 2). When asked how relatively technologically advanced their Mainland China manufacturing plants were, both clustered and dispersed firms were broadly neutral that they are any more technologically superior than either their pre-existing or remaining Hong Kong plants. The means for these items (Items 1 and 2, Table 2) are close to the neutral point, 3.00, indicating that the investments made by both clustered and dispersed firms are of a similar level of technological advancement as their Hong Kong plants.

Both clustered and dispersed firms strongly agree that their own Mainland investments are more technologically advanced than pre-existing Mainland competitors' plants, each scoring a mean of around 3.80 (Item 3, Table 2). Both types of firms also agree that their investments are more technologically advanced than new Mainland competitors' plants, although not so strongly, with means of 3.36 and 3.56 for, respectively, clustered and dispersed firms (Item 4, Table 2). These perceptions are supported by the view of both clustered and dispersed firms that their own Mainland plants are more capital-intensive than those of local Mainland competitors, with means for this item of 3.68 and 3.45, respectively (Item 5, Table 2).

Reflective to some extent of hard, but particularly of soft technology possession, both clustered and dispersed firms strongly indicate that their own Mainland plants require higher skilled managers than those of local Chinese competitors, with means of around 3.80 each (Item 6, Table 2). Similarly reflective of hard, but particularly soft, technology, each type of firm regards their plants as being more efficient than local competitors', although only moderately so given the means each records of around 3.45 (Item 7, Table 2). As might be predicted, the necessity for higher skilled managers and greater efficiency correlate quite strongly and significantly with being more capital intensive, as can be seen from the Spearman intervariable correlation coefficients in Table 2.

As subjective assessments by possibly biased managers, caution needs to be used in viewing such results. But, given the objectivity shown by the lower means scored for the new as opposed to pre-existing Mainland competitor plants (Items 3 and 4, Table 2), the responses ought not to be dismissed out of hand. Moreover, most business managers make it their business to assess accurately the nature of competitors. Discussion with industry managers of Hong Kong firms supported this. Consequently, notwithstanding hubris, there is every reason to believe that both clustered and dispersed FDI in China by Hong Kong garment firms introduces garment manufacturing that is probably more advanced than Mainland competitors'. Certainly, the investments of both clustered and dispersed firms appear to be of a roughly equal degree of hard and soft technological advancement. Hence, the question of

Table 2. *Hard and soft technology possession indicators: means, standard deviations, z statistics and Spearman correlation coefficients for clustered and dispersed firms*[a]

Variables	Clustered firms			Dispersed firms			z[b]	Variables[c]						
	n	Mean	S.D.	*n*	Mean	S.D.		1	2	3	4	5	6	7
Your Mainland China manufacturing investment(s) are generally more technologically advanced than:														
1. The plant in Hong Kong they replaced when you set them up	22	3.05	0.95	19	3.11	0.81	−0.29		*0.67***	*−0.23*	*−0.05*	*0.12*	*0.44***	*0.04*
2. Your plants remaining in Hong Kong, if any	18	2.89	0.90	16	2.94	0.85	−0.18	0.46**		*−0.09*	*0.07*	*−0.09*	*0.19*	*−0.24*
3. Pre-existing, local Mainland China competitors' plants	22	3.82	0.73	18	3.83	0.62	−0.06	0.48**	0.17		*−0.04*	*0.36**	*−0.04*	*0.40**
4. New Mainland China competitors' plants	22	3.36	0.73	18	3.56	0.62	−1.21	0.01	−0.01	0.24***		*0.30*	*0.30*	*−0.08*
Generally, your Mainland China manufacturing investment(s):														
5. Are more capital intensive than your Mainland competitors' plants	22	3.68	0.72	20	3.45	0.69	−1.05	−0.24	−0.26	0.29	0.13		*0.52****	*0.40***
6. Require higher skilled managers than your Mainland competitors'	24	3.75	0.53	20	3.85	0.59	−0.75	−0.36**	−0.22	0.00	0.30*	0.30*		*−0.13*
7. Are more efficient than your Mainland China competitors' plants	23	3.48	0.67	19	3.42	0.69	−0.06	−0.12	−0.32	0.18	−0.24	0.56***	0.22	

Source: Author's survey.

[a] Interval measure: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

[b] Mann–Whitney *U* test.

[c] Clustered firm coefficients are shown in the bottom left half of the correlation matrix, dispersed firm coefficients in the upper right half in italics.

* Significant at the 10% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

** Significant at the 5% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

*** Significant at the 1% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

which type of firm might be a better transferor of technology can reasonably be examined solely on the basis of which demonstrates the strongest vertical and horizontal spillovers without concern that either clustered or dispersed firms might possess objectively differing levels of technology.

(b) *Backward vertical, interindustry spillovers*

The results of items in Table 3 relating to backward vertical interlinkages with suppliers suggest that clustered FDI does indeed transfer technology more effectively than that which is dispersed. Clustered FDI would seem to attract more suppliers than does dispersed FDI and these suppliers to clustered firms are reportedly upgrading their products and services as a result of Hong Kong MNCs' demands. Clustered firms agree strongly, with a mean 3.74, that suppliers to their plants are more numerous than previously, while dispersed firms agree only moderately that this is the case, with a mean of 3.44 (Item 1, Table 3). The mean difference for this item approaches significance ($z = -1.56$), and Spearman coefficients for clustered firms indicate that more numerous suppliers correlates quite strongly and significantly with items relating to improved products and services, close cooperation in producing those products and services, and the provision of better value for money (Items 2–4, Table 3). For clustered firms, coefficients are between $r = 0.36$ and $r = 0.52$ with significances of $p < 0.05$ or $p < 0.01$. For dispersed firms, on the other hand, there is predictably no significant correlation between more numerous suppliers and each of these other items.

Firms with clustered FDI agree significantly more strongly than firms with dispersed FDI that their Mainland suppliers are upgrading their products and services as a result of their demands, with mean scores of 3.78 and 3.44, respectively ($z = 1.75,\ p < 0.10$). For clustered firms, this item (Item 2, Table 3) correlates strongly and significantly with close, cooperative efforts to improve supplier products and services, and the provision of better value for money for such supplies (Items 3 and 4, Table 3, $r = 0.66,\ p < 0.01$ and $r = 0.51,\ p < 0.01$, respectively). For dispersed firms, however, there is no significant correlation between demand-driven supplier improvement and close, cooperative efforts to improve supplies, and there is only a weaker, less significant correlation between demand-driven supply improvement and better value for money for supplies ($r = 0.43,\ p < 0.05$).

Table 3. *Backward vertical spillovers: supplier responses and linkages*[a]

Variables	Clustered firms			Dispersed firms			z[b]	Variables[c]			
	n	Mean	S.D.	*n*	Mean	S.D.		1	2	3	4
Mainland suppliers to your plant(s) in China are generally:											
1. More numerous than they used to be	23	3.74	0.62	16	3.44	0.63	−1.56		*0.29*	*−0.05*	*0.18*
2. Upgrading their products/services as a result of your demands	23	3.78	0.52	18	3.44	0.62	−1.75*	0.36**		*0.30*	*0.43***
3. Working closely with your firm to improve their products/services	23	3.65	0.71	18	3.61	0.61	−0.54	0.52***	0.66***		*0.60****
4. Providing better value for money than they used to be	22	3.45	0.74	17	3.65	0.61	−0.75	0.42**	0.51***	0.67***	

Source: Author's survey.

Means, standard deviations, z statistics and Spearman correlation coefficients for clustered and dispersed firms.

[a] Interval measure: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

[b] Mann–Whitney U test.

[c] Clustered firm coefficients are shown in the bottom left half of the correlation matrix, dispersed firm coefficients in the upper right half in italics.

* Significant at the 10% level, two-tailed z-statistic, one-tailed Spearman coefficient.

** Significant at the 5% level, two-tailed z-statistic, one-tailed Spearman coefficient.

*** Significant at the 1% level, two-tailed z-statistic, one-tailed Spearman coefficient.

There are no significant differences in the means scored by clustered and dispersed firms for the items relating to working closely with suppliers and the provision of better value for money. Both moderately agree. But, while both clustered and dispersed firms show strongly significant correlations between working closely with suppliers and the provision of better value for money for supplies, the correlation is greater for clustered firms.

Taken together, these survey findings, and discussion with industry managers, lend support to the proposition that clustered FDI is a more effective transferor of technology via backward vertical spillovers than dispersed FDI. Suppliers appear to be attracted to FDI clusters and actively upgrade their products and services as a result of Hong Kong MNCs' demands that are reportedly conveyed by working in close cooperation—something which is easier to do within the geographical context of an industry cluster than without.

(c) *Horizontal spillovers via emulation and human capital*

Clustered firms agree more strongly than dispersed firms that their Mainland investments have prompted local Chinese competitors to be more efficient, with respective means of 3.65 and 3.47 (Item 1 Table 4), although the mean difference is not statistically significant ($z = -0.82$). Clustered firms also agree more strongly than dispersed firms that their Mainland competitors attempt to emulate both their production and management techniques and practices, although the difference in means is not statistically significant (Items 2 and 3, Table 4). Some caution should be used in viewing these results about Mainland competitor reactions, bearing in mind their perceptual nature. The moderate agreement that both clustered and dispersed firms have that Mainland-owned competitors like particularly to hire their own factory managers and workers (Items 4 and 5,

Table 4. *Horizontal intraindustry spillovers: competitor responses. Means, standard deviations, z statistics and Spearman correlation coefficients for clustered and dispersed firms*[a]

Variables	Clustered firms			Dispersed firms			z[b]	Variables[c]				
	n	Mean	S.D.	*n*	Mean	S.D.		1	2	3	4	5
Wholly Mainland-owned firms in your sector:												
1. Have been prompted by your China investments to be more efficient	23	3.65	0.65	17	3.47	0.51	−0.82		*−0.11*	*−0.04*	*−0.34*	*−0.23*
2. Try to copy your production processes/techniques	19	3.47	0.90	17	3.29	0.59	−0.76	−0.02		*0.17*	*0.62****	*0.43**
3. Attempt to learn your managerial practices/style	20	3.40	0.75	17	3.35	0.79	−0.02	−0.26	0.73***		*0.57****	*0.39**
4. Like particularly to hire your factory managers	22	3.23	0.87	15	3.20	0.77	−0.05	0.14	0.46**	0.59***		*0.77****
5. Like particularly to hire your factory workers	22	3.36	0.79	16	3.56	0.73	−1.01	0.24	0.45**	0.58***	0.84***	

Source: Author's survey.

[a] Interval measure: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

[b] Mann–Whitney *U* test.

[c] Clustered firm coefficients are shown in the bottom left half of the correlation matrix, dispersed firm coefficients in the upper right half in italics.

* Significant at the 10% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

** Significant at the 5% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

*** Significant at the 1% level, two-tailed *z*-statistic, one-tailed Spearman coefficient.

Table 5. *Annual staff turnover*

Turnover per annum	Clustered firms (%)	Dispersed firms (%)
Less than 5%	4	22
6–39%	77	72
40% or more	18	6

Source: Author's survey.

Table 4) can be considered less likely to be subjective as employers generally make an effort to monitor destinations of ex-employees. The mean differences are not significant for these items. It is interesting to note, however, that, for clustered firms, the items relating to emulation of production and managerial technology both correlate quite strongly and significantly with a reported preference by Mainland competitors for hiring Hong Kong firms' factory managers *and* workers. The correlation between attempting to learn managerial practices and preferring to hire factory workers is strong and highly significant for clustered firms ($r = 0.58$ $p < 0.01$), but weaker and much less significant for dispersed firms ($r = 0.39,\ p < 0.10$).

Assuming that the correlation between these items can be taken to indicate that technology learned by workers in Hong Kong-owned factories is sought and sourced by Mainland-owned competitors by hiring such workers, it might be hazarded that MNCs with clustered FDI are more effective transferors of technology via this mechanism than MNCs with dispersed FDI. Factory workers are needed in relatively high numbers, are expensive to recruit across large geographical distances and are not particularly mobile. Hence, it is much easier and cheaper for Mainland firms to hire Hong Kong firm workers within the cluster of FDI than from Hong Kong plants that are geographically dispersed. For factory managers, this reasoning is less likely to hold true as relative transaction costs involved in hiring much smaller numbers of much more skilled and more expensive managerial personnel are lower. Hence the similarly strongly significant degree of correlation between attempting to learn managerial practices and preferring to hire factory managers for both MNCs with clustered and non-clustered FDI (Items 3 and 4, Table 4).

Interviews with industry managers support the suggestion of the above data. Mainland competitors tend to be in a better a position to tap into and emulate Hong Kong firms' soft managerial and production technology and knowledge by hiring their workers and managers if those firms are within, rather than outside, industry clusters. It was particularly suggested that firms within clusters experienced higher levels of staff turnover simply because there are plenty of alternative employment opportunities, not just among other Hong Kong plants, but among Mainland competitors and suppliers. This qualitative assertion is substantiated by the figures in Table 5 that show MNCs with clustered FDI as having a higher annual staff turnover than MNCs with dispersed FDI. Only 4% of clustered firms reported a turnover of less than 5% a year, whereas fully 22% of dispersed firms reported this very low level of staff turnover. Conversely, 18% of clustered firms reported a staff turnover of more than 40% a year, against just 6% of dispersed firms reporting this high degree of staff turnover.

Clearly, whatever knowledge, skills and technology that MNCs with clustered FDI impart to their factory workers, they get transferred elsewhere via staff turnover relatively more quickly than they might from MNCs with dispersed FDI. This begs the question of whether or not such employees gain much useful knowledge by working in either type of firm. To address this, respondents were asked about the training they give to employees. Clustered firms agree very strongly that they train their factory workers, with a mean of 4.08 (Table 6). This is somewhat higher than the mean scored by dispersed firms, 3.86, even though it is not statistically significant ($z = 1.06$). The reason for the higher training given by clustered firms would seem to be because they are significantly more likely to recruit generally inexperienced workers than MNCs with dispersed FDI. Clustered firms moderately agree, with a mean of 3.33, that their factory workers have no prior experience working in commercially run factories (Item 2, Table 6). This is significantly the opposite to

Table 6. *Training and experience of Mainland factory workers: Means, standard deviations, z statistics*[a]

Variables	Clustered firms			Dispersed firms			z
	n	Mean	S.D.	n	Mean	S.D.	
Factory workers in your Mainland plant(s) generally:							
1. Get training by your firm	24	4.08	0.58	21	3.86	0.79	−1.06
2. Have no prior experience working in commercially run factories	21	3.33	1.02	19	2.79	0.92	−1.68*

Source: Author's survey.

[a] Interval measure: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

* Significant at the 10% level.

dispersed firms which in fact disagree that their factory workers have no such prior experience, with a mean of 2.79 ($z = -1.68,\ p < 0.10$).

Discussion with industry managers suggests that MNCs with clustered FDI face greater competition for experienced factory workers, not just from fellow Hong Kong garment firm investors in the cluster, but from local competitors and other sectors, too. In consequence, they are obliged to recruit inexperienced employees, often from without the cluster. This does not appear to be the case for MNCs with dispersed FDI. Indeed, if anything, dispersed firms seem to be as much knowledge and technology *absorbers from*, as *transferors to*, the wider Mainland economy. Whereas MNCs with clustered FDI might be regarded as significantly transferring technology through the training of inexperienced labor that, in turn, displays a relatively high propensity to transfer that technology elsewhere by shifting employment, MNCs with dispersed FDI do almost the reverse. Relatively speaking, dispersed firms take experienced workers from the wider Mainland economy and do a much better job of retaining that experience and whatever human capital upgrading they undertake through training, judging by their lower staff turnover rates.

Clustered firms also appear to be better transferors of managerial technology than MNCs with dispersed FDI via the training and subsequent spillover to Mainland firms of managerial employees. MNCs with clustered FDI agree more strongly than MNCs with dispersed FDI that they train their managers, with means of, respectively, 4.04 and 3.86 (Item 1, Table 7). While the mean difference may not in fact be statistically significant for training between the two types of firms, the training that MNCs with clustered FDI undertake does spillover significantly more to Mainland firms. MNCs with dispersed FDI disagree quite strongly that their Mainland managers often

Table 7. *Training and horizontal spillover of Mainland managers: means, standard deviations, z statistics and Spearman correlation coefficients for clustered and dispersed firms*[a]

Variables	Clustered firms			Dispersed firms			z[b]	Variables[c]		
	n	Mean	S.D.	n	Mean	S.D.		1	2	3
Mainland managers in your Mainland plant(s) generally:										
1. Get training by your firm	24	4.04	0.62	21	3.86	0.85	−0.57		*−0.40**	*−0.10*
2. Often leave to work in Mainland owned factories/ businesses	21	2.76	0.54	14	2.36	0.74	−1.90*	0.04		*0.42**
3. Sometimes leave to set up their own garment-sector related firms	22	3.18	0.59	12	3.08	0.79	−0.32	0.35*	0.26	

Source: Author's survey.

[a] Interval measure: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

[b] Mann–Whitney U test.

[c] Clustered firm coefficients are shown in the bottom left half of the correlation matrix, dispersed firm coefficients in the upper right half in italics.

* Significant at the 10% level, two-tailed z statistics, one-tailed Spearman coefficient.

leave to work in locally-owned factories and businesses, with a mean of 2.36 (Item 2, Table 7). The same item mean for MNCs with clustered FDI is significantly different, at 2.79 ($z = -1.90,\ p < 0.10$). This difference might be even more pronounced than the data suggest because it appears from the low number of dispersed firm respondents on this item, just 14, that perhaps some did not respond as the event is possibly so completely inapplicable to them. While these data do not suggest that managers from MNCs with clustered FDI are particularly likely to leave to work in Mainland owned businesses, they do mean they are more likely to do so than those in MNCs with dispersed FDI. This is supported by the significant negative correlation between manager training and leaving to work in Mainland owned businesses for MNCs with dispersed FDI ($r = -0.40,\ p < 0.10$).

MNCs with clustered FDI also seem to find the training they give their managers spilling over more into the wider Mainland economy through such individuals leaving to set up their own garment sector-related businesses than do MNCs with dispersed FDI. Clustered firms agree slightly that their managers do this, while dispersed firms are more or less neutral—respective means being 3.18 and 3.08, although the very low number of responses from dispersed firms, just 12, suggests that a lower mean may well have been recorded had respondents not felt this item also to be inapplicable to them (Item 3, Table 7). For clustered firms, there is a significant correlation between manager training and managers sometimes leaving to set up in business ($r = 0.35,\ p < 0.10$), whereas there is no correlation for dispersed firms. Discussion with industry managers of Hong Kong firms indicates that trained managers in clustered firms are able relatively easily to see and fill supplier market niches that are made potentially viable because of the number of possible buyer firms, both local and foreign, within the cluster that are not apparent to trained managers in MNCs with dispersed FDI. This entrepreneurial "incubator" function has been noted in clustering literature (Visser & Tamara, 1995).

(d) *Horizontal spillovers through associability*

Of those respondents answering the survey questions about business association memberships—only around 80% from both types of firm—few indicated that they belonged to any formal or informal Mainland business groups. But, as expected clustered firms were more likely to be members of such organizations. Some 28% of reporting MNCs with clustered FDI indicated membership of general, non-sector-specific Mainland business associations, against only 16% of MNCs with dispersed FDI. Less than 10% of each type of firm reported membership of a sector-specific trade association. No respondents reported membership of informal groupings, such as roundtables, dining clubs and the like. Discussion with industry managers suggests that membership of general business organizations is primarily to learn the "technology" of how to deal with local governmental authorities and to meet potential suppliers. So, while considerable further research in this area is necessary, it might tentatively be suggested that such associations facilitate vertical, interindustry linkages as much as, and possibly more than, horizontal linkages.

6. DISCUSSION

(a) *Limitations*

This research and analysis tends to support with quantitative data the previously unexamined contention that same-sector FDI which is clustered is more effective at transferring technology than that which is dispersed. But, while the research casts systematic empirical light where there has not previously been any, some caution should be exercised in viewing its results. First, due to the use of interval measures, the findings cannot say much about absolute levels of technology transfer and can only reveal hypothesized relative differences between the clustered and dispersed FDI populations examined. Second, the respective samples of clustered and dispersed FDI are small and allow only nonparametric statistical procedures to be used. While from a statistical perspective this is not a problem, larger samples would perhaps reveal more statistically, and so hence practically, significant differences. Third, as with much quantitative research, it cannot attempt to say much about the more qualitative aspects of technology transfer. Such qualitative aspects of technology transfer become particularly important when examining the precise mechanistic nature of vertical linkages with suppliers. Qualitative data are also especially germane when considering horizontal spillovers and linkages that comprise "active" cooperative

behavior between industry participants (Schmitz, 1999; Visser, 1999). Fourth, the data are drawn only from Hong Kong garment firms with investments in China. Hence, they may not necessarily be representative either of (i) other Hong Kong direct investors from other sectors, (ii) direct investors from garment firms elsewhere than Hong Kong, or (iii) direct investment in clusters outside of China.

(b) *Further research*

The limitations of this research suggest that further quantitative research might usefully be undertaken to explore its generalizability beyond rather narrow sector and country bounds. This is particularly important as recent evidence suggests that FDI from MNCs from different countries transfers technology to varying degrees depending on the level of host-country development (Xu, 2000) and prevailing macroeconomic circumstances (Thompson, 2001), much as scholars like Kojima (1973) have long argued. Additional qualitative research is also indicated so as to contextualize and assess the nature, extent and precise mechanistic operation of technology and knowledge transfers. The case study approach of marrying quantitative and qualitative data in cluster research advocated by Austrian (2000) suggests itself as a potentially fruitful way forward in this regard.

The research also raises further questions about the interrelationship between FDI and clusters that, while outside the scope of this particular study, might usefully be addressed in future investigations. One of these is the impact that FDI into pre-existing host-country clusters has on the development of those clusters in terms of enhancing through a "dynamizing" effect—or, possibly, diminishing—technology and knowledge transfers. A further question that follows from this research is that of the extent to which it is the clustering of FDI itself or the location of FDI in previously existing host-country clusters that enhances technology transfer. This research makes it clear that clustered FDI in what has now become a cluster of both foreign and local firms transfers technology more effectively than dispersed FDI. It would, however, be illuminating to compare, should it be possible to find suitable subsamples, FDI that is clustered in already extant host-country industry clusters with FDI that is clustered but not in pre-existing host-country clusters. In the garment industry in China generally an easy opportunity to conduct such a study is not offered because it is very hard to disentangle the effect of foreign and domestic firms in the emergence of clusters. Dongguan, for instance, only emerged as a recognisable garment cluster during the 1980s and early 1990s when both domestic Chinese and Hong Kong firms began to locate there simultaneously. But it may be possible to find discrete samples of same-sector purely foreign-firm and mixed foreign- and domestic-firm clusters in other industries and in other countries. Even then, however, controlling for the effects of cluster size and age—given that a purely foreign-firm cluster might well be anticipated to attract, as a positive externality, domestic suppliers and thus, subsequently, same-sector domestic competitors—might prove infeasible.

(c) *Conclusions*

Despite the limitations of this quantitatively oriented study and the need for further investigations, the research findings nevertheless suggest that the hitherto untested hypothesis that clustered FDI will be better at transferring technology than dispersed FDI is broadly correct. In terms of vertical effects, as proposed, clustered FDI appears to attract more suppliers than dispersed FDI. Such suppliers seem to compete hard with one another for custom and upgrade their products and services as a result of clustered MNCs' demands and through a process of close cooperation with such MNCs.

In terms of horizontal effects, clustered FDI facilitates technology and knowledge spillovers more than dispersed FDI, as predicted. While this may occur to some extent through informal contacts within formal business associations, this would not seem to be a major mechanism. Indeed, such formal associability may predominantly be a mechanism of vertical rather than horizontal spillover. The prime way in which clustered FDI transfers technology and knowledge horizontally more effectively than dispersed FDI is via the agency of labour. In clusters, MNCs seem to recruit, train and then lose to other parts of the economy previously relatively inexperienced personnel. They also seem more likely to train potential new entrepreneurs. On the other hand, dispersed MNCs seem in fact to soak up experienced labor from other parts of the economy which they are then better at retaining in their employ, possibly in fact *reversing* or at least slowing technology and knowledge transfers.

(d) *Policy implications*

The nature of this research perhaps suggests that further investigation, both of a more extensive quantitative and more focused qualitative nature, might usefully be undertaken prior to drawing extensive policy implications. The results are sufficiently indicative, however, to make the tentative suggestion that developmental policy analysts might review the potential merits of attempting deliberately to combine cluster and FDI enhancement programs. If further research demonstrates the above results to be generalizable, it would seem reasonable to suggest that policy makers should seriously consider the possibilities and advantages of formulating programs that bring cluster and FDI development strategies together rather than treat them as separate entities. This might particularly be advantageous to China as its policy makers seek to attempt to attract FDI to less developed western provinces. A key point of consideration might, for instance, be the identification of natural or historical domestic industry clusters, or of potentially suitable locations for the nurturing of new clusters, prior to making concerted attempts to induce foreign firms to make investments in such places rather than encouraging them to make investments more disparately.

REFERENCES

Ahiakpor, J. C. W. (1990). *Multinationals and economic development*. London: Routledge/Chapman and Hall Inc.

Altenburg, T., & Meyer-Stamer, J. (1999). How to promote clusters: policy experiences from Latin America. *World Development, 27*(9), 1693–1713.

Andreosso-O'callaghan, B., & Qian, W. (1999). Technology transfer: a mode of collaboration between the European Union and China. *Europe—Asia Studies, 51*(1), 123–142.

Asanuma, B. (1989). Manufacturer–supplier relationships in Japan and the concept of relation-specific skill. *Journal of Japanese and International Economics, 3*, 1–30.

Austrian, Z. (2000). Cluster case studies: the marriage of quantitative and qualitative information for action. *Economic Development Quarterly, 14*(1), 97–110.

Balasubramanyam, V. N., Salisu, M., & Sapford, D. (1996). Foreign direct investment and growth in EP and IS countries. *Economic Journal, 106*, 92–105.

Ball, D. F., Zhang, R., & Pearson, A. W. (1993). Perceptions of United Kingdom exporters in transferring technology into the People's Republic of China. *R&D Management, 23*(1), 29–41.

Belderbos, R., Capannelli, G., & Fukao, K. (2001). Backward vertical linkages of foreign manufacturing affiliates: evidence from Japanese multinationals. *World Development, 29*(1), 189–208.

Bell, M., & Albu, M. (1999). Knowledge systems and technological dynamism in industry clusters in developing countries. *World Development, 27*(9), 1715–1734.

Bennett, R. J. (1998). Business associations and their potential to contribute to economic development: reexploring an interface between the state and market. *Environment and Planning A, 30*(8), 1367–1387.

Berger, S., & Lester, R. K. (1997). *Made by Hong Kong*. Hong Kong: Oxford University Press.

Birkinshaw, J., & Hood, N. (2000). Characteristics of foreign subsidiaries in industry clusters. *Journal of International Business Studies, 31*(1), 141–154.

Blomström, M., & Persson, H. (1983). Foreign investment and spillover efficiency in an underdeveloped economy: evidence from the Mexican manufacturing industry. *World Development, 11*(6), 493–501.

Chari, S. (2000). The agrarian origins of the knitwear industrial cluster in Tiruppur, India. *World Development, 28*(3), 579–599.

Chen, C. H. (1996). Regional determinants of foreign direct investment in Mainland China. *Journal of Economic Studies, 23*(2), 18–30.

Chen, E. K. Y. (1994). Introduction: transnational corporations and technology transfer to developing countries. In E. K. Y. Chen (Ed.), *Technology transfer to developing countries*. London: Routledge.

Chen, T. J. (1998). *Taiwanese firms in Southeast Asia: Networking across borders*. London: Edward Elgar.

Chuang, Y. C., & Lin, C. M. (1999). Foreign direct investment, R&D and spillover efficiency: evidence from Taiwan's manufacturing firms. *The Journal of Development Studies, 35*(4), 117–137.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*, S95–S120.

Cooke, P., & Morgan, K. (1993). The network paradigm: new departures in corporate and regional development. *Environment and Planning D: Society and Space, 11*(5), 543–564.

Das, S. (1987). Externalities and technology transfer through multinational corporations—a theoretical analysis. *Journal of International Economics, 22*(1–2), 171–182.

Deardorff, A., & Djankov, S. (2000). Knowledge transfer under subcontracting: evidence from Czech firms. *World Development, 28*(10), 1837–1847.

Dunning, J. H. (1994). Re-evaluating the benefits of foreign direct investment. *Transnational Corporations, 3*(1), 23–51.

Dunning, J. H. (1996). Globalisation, foreign direct investment and economic development. *Economics and Business Education, 4*(14), 46–51.

Egan, M. L., & Mody, A. (1992). Buyer–seller links in export development. *World Development, 20*(3), 321–334.

Eng, I., & Lin, Y. (1996). Seeking competitive advantage in an emerging open economy: foreign direct investment in Chinese industry. *Environment and Planning A, 28*(6), 1113–1138.

Enos, J. L. (1989). Transfer of technology. *Asian-Pacific Economic Literature, 3*, 3–37.

Enos, J. L., & Park, W. H. (1988). *The adoption and diffusion of imported technology in the case of Korea*. London: Croom Helm.

Evans, P. (1979). *Dependent development: The alliance of multinational, state and local capital in Brazil*. Princeton, NJ: Princeton University Press.

Federation of Hong Kong Industries. (1992). *Hong Kong's industrial investment in the Pearl River Delta: 1991 survey among members of the Federation of Hong Kong Industries*. Hong Kong: Industry and Research Division, Federation of Hong Kong Industries.

Federation of Hong Kong Industries. (1993). *Investment in China: 1993 survey of members of the Federation of Hong Kong*. Hong Kong: Industry and Research Division, Federation of Hong Kong.

Federation of Hong Kong Industries. (1995). *Investment in China: 1994 survey of members of Federation of Hong Kong Industries*. Hong Kong: Industry and Research Division, Federation of Hong Kong.

Feser, E. J., & Bergman, E. M. (2000). National industry cluster templates: a framework for applied regional cluster analysis. *Regional Studies, 34*(1), 1–19.

Gereffi, G. (1992). New realities of industrial development in East Asia and Latin America. In R. P. Appelbaum, & J. Henderson (Eds.), *States and development in the Asian Pacific Rim*. London: Sage.

Halverson, K. (1991). Foreign direct investment in Indonesia: a comparison of industrialized and developing country investors. *Law & Policy in International Business, 22*(1), 75–105.

Harrison, B. (1992). Industrial districts: old wine in new bottles? *Regional Studies, 26*, 469–483.

Harrison, A. (1994). The role of multinationals in economics development: the benefit of FDI. *Columbia Journal of World Business, 29*(4), 6–11.

Heraud, J. A. (1996). Transfer of technology and managerial skills: the possible role of foreign direct investment in the development of the East. In P. Gummett *et al*. (Eds.), *Military R&D after the cold war: Conversion and technology transfer in Eastern and Western Europe* (pp. 147–151). Boston and London: Kluwer Academic.

Hill, E. W., & Brennan, J. F. (2000). A methodology for identifying the drivers of industrial clusters: the foundation of regional competitive advantage. *Economic Development Quarterly, 14*(1), 65–96.

Hirschman, A. O. (1958). *The strategy of economic development*. New Haven: Yale University Press.

Hymer, S. H. (1970). The multinational corporation and the law of uneven development. In J. Bhagwati (Ed.), *Economics and world order*. New York: World Law Fund.

Hymer, S. H. (1976). *The international operations of national firms: A study of direct foreign investment*. Cambridge, MA: MIT Press.

Kay, C. (1991). Reflections on the Latin American contribution to development theory. *Development and Change, 22*(1), 31–68.

Kojima, K. (1973). A macroeconomic approach to foreign direct investment. *Hitotshubashi Journal of Economics, 14*, 1–21.

Keeble, D., & Wilkinson, F. (1999). Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe. *Regional Studies, 33*(4), 295–303.

Knorringa, P. (1999). Agra: an old cluster facing the new competition. *World Development, 27*(9), 1587–1604.

Lall, S. (1980). Vertical inter-firm linkages in LDCs: an empirical study. *Oxford Bulletin of Economics and Statistics, 42*, 203–226.

Lan, P., & Young, S. (1996). Foreign direct investment and technology transfer: a case-study of foreign direct investment in North-East China. *Transnational Corporations, 5*(1), 57–83.

Lee, C. H. (1984). Direct foreign investment and industrial development in the Pacific Basin. In R. Benjamin, & R. T. Kudrle (Eds.), *The industrial future of the Pacific Basin* (pp. 191–209). Boulder: Bowker.

Leung, C. K. (1996). Foreign manufacturing investment and regional industrial growth in Guangdong Province, China. *Environment and Planning A, 28*(3), 513–536.

Lim, L. Y. C., & Pang, E. F. (1982). Vertical linkages and multinational enterprises in developing countries. *World Development, 10*(7), 585–595.

López-Eguilaz, M. J., & Pérez, S. (1997). The measurement of technology transfer: situation in Spain. *International Journal of Technology Management, 13*(2), 153–164.

Lundvall, B. A. (1993). User-producer relationships, national system of innovation and internationalization. In D. Foray, & C. Freeman (Eds.), *Technology and the wealth of nations*. New York: Pinter.

Marshall, A. (1920). *Principles of economics*. London: Macmillan.

McCormick, D. (1999). African enterprise clusters and industrialization: theory and reality. *World Development, 27*(9), 1531–1551.

Moran, T. H. (1978). Multinational corporations and dependency: a dialogue for dependentistas and non-dependentistas. *International Organization, 32*, 79–100.

Murray, E. P. (1999). Industry study: cluster-based development strategies: lessons from the plastic industry in North Central Massachusetts. *Economic Development Quarterly, 13*(3), 266–280.

Nadvi, K. (1999). Collective efficiency and collective failure: the response of the Sialkot surgical instrument cluster to global quality pressures. *World Development, 27*(9), 1605–1626.

Oakey, R. (1985). High-technology industry and agglomeration economics. In P. Hall, & A. Markusen (Eds.), *Silicon landscapes*. Boston: Allen & Unwin.

Ostry, S., & Gestrin, M. (1993). Foreign direct investment, technology transfer and the innovation-network model. *Transnational Corporations, 2*(3), 7–30.

Piercy, N. F., Kaleka, A., & Katsikeas, S. (1998). Source of competitive advantage in high performing exporting companies. *Journal of World Business, 33*(4), 378–393.

Poon, J. P. H., & Thompson, E. R. (1998). Foreign direct investment and economic growth: evidence from Asia and Latin America. *Journal of Economic Development, 23*(2), 141–160.

Porter, M. E. (1990). *The competitive advantage of nations*. London: Macmillan.

Porter, M. E. (2000). Location, competition, and economic development: local clusters in a global economy. *Economic Development Quarterly, 14*(1), 15–34.

Chandler, A. D., & Sölvell, Ö. (1998). The role of geography in the process of innovation and the sustainable competitive advantage of firms. In A. D. Chandler, P. Hagström, & Ö. Sölvell (Eds.), *The dynamic firm: The role of technology, strategy, organization, and regions*. New York: Oxford University Press.

Quinn, J. B. (1969). Technology transfer by multinational companies. *Harvard Business Review, 47*(6), 147–161.

Rabellotti, R. (1999). Recovery of a Mexican cluster: devaluation bonanaza or collective efficiency? *World Development, 27*(9), 1571–1585.

Rana, P. B., & Dowling, J. M. (1988). Foreign capital and Asian economic growth. *Asian Development Review, 8*, 77–102.

Sako, M. (1996). Suppliers' associations in the Japanese automobile industry: collective action for technology diffusion. *Cambridge Journal of Economics, 20*(6), 651–671.

Santos, T. D. (1970). The structure of dependence. *American Economic Review, 60*, 231–236.

Saxenian, A. (1985). The genesis of Silicon Valley. In P. Hall, & A. Markusen (Eds.), *Silicon landscapes*. Boston: Allen & Unwin.

Schmitz, H. (1995). Small shoemakers and Fordist giants: tale of a supercluster. *World Development, 23*(1), 9–28.

Schmitz, H. (1999). Global competition and local cooperation: success and failure in the Sinos Valley, Brazil. *World Development, 27*(9), 1627–1650.

Schmitz, H., & Navdi, K. (1999). Clustering and industralization: Introduction. *World Development, 27*(9), 1503–1514.

Scott, A. (1994). Variations on the theme of agglomeration and growth: The gem and jewellery industry in Los Angeles and Bangkok. *Geoforum, 25*(3), 249–263.

Scott, A. (1987). Industrial organization and location: division of labour, the firm, and spatial process. *Economic Geography, 63*, 214–231.

Sim, A. B., & Ali, Y. (1998). Performance of international joint ventures from development and developed countries: an empirical study in a developing country context. *Journal of World Business, 33*(4), 357–377.

Smith, C. H. (1980). *Japanese technology transfer to Brazil*. Ann Arbor: UMI Research Press.

Sölvell, Ö., & Zander, I. (1998). International diffusion of knowledge: isolating mechanisms and the role of the MNE. In A. D. Chandler, P. Hagström, & Ö. Sölvell (Eds.), *The dynamic firm: The role of technology, strategy, organization, and regions*. New York: Oxford University Press.

Stewart, F. (1977). *Technology and underdevelopment*. London: Macmillan.

Swan, J. A., & Newell, S. (1995). The role of professional associations in technology diffusion. *Organization Studies, 16*(5), 847–874.

Tewari, M. (1998). Intersectoral linkages and the role of the state in shaping the conditions of industrial accumulation: a study of Ludhiana's manufacturing industry. *World Development, 26*(8), 1387–1411.

Tewari, M. (1999). Successful adjustment in indian industry: the case of Ludhiana's woolen knitwear cluster. *World Development, 27*(9), 1651–1671.

Thompson, E. R. (2000). Business integration across the Hong Kong–Chinese border: patterns and explanations in the garment industry. In D. E. Andersson, & J. P. H. Poon (Eds.), *Asia in transition*. London: Macmillan.

Thompson, E. R. (2001). Multinational firm responses to an Asian-crisis comeback: evidence from European transnationals. *The Pacific Review, 14*(2), 269–287.

Thompson, E. R., & Poon, J. P. H. (1998). Determinants of US, UK and Japanese foreign direct investment in East and Southeast Asia. *Journal of Asian Business, 14*(3), 15–39.

Visser, E. J. (1999). A comparison of clustered and dispersed firms in the small-scale clothing industry of Lima. *World Development, 27*(9), 1553–1570.

Visser., E. J., & Tamara, J. I. (1995). Gammara al garete. Consorcio de Investigaciones Economicas/ DESCO, Lima.

Hippel, E. (1984). Lead users: a source of novel product concepts. *Management Science, 32*, 791–805.

Wei, S. J. (1995). Attracting foreign direct investment: has China reached its potential? *China Economic Review, 6*(2), 187–199.

Wei, S. J. (1996). Foreign direct investment in China: sources and consequences. In T. Ito, & A. O. Krueger (Eds.), *Financial deregulation and integration in East Asia. NBER–East Asia seminar on economics* (pp. 77–106). Chicago and London: University of Chicago Press.

Weijland, H. (1999). Microenterprise clusters in rural Indonesia—industrial seebed and policy target. *World Development, 27*(9), 1515–1530.

Westney, E. (1989). Transfer of organizational technology. *International Trade Journal, 4*, 27–59.

Wu, X. D. (2000). Foreign direct investment, intellectual property rights, and wage inequality in China. *China Economic Review, 11*(4), 361–384.

Xu, B. (2000). Multinational enterprises, technology diffusion, and host country productivity growth. *Journal of Economic Development, 62*(2), 477–493.

Zhan, X. J. (1993). The role of foreign direct investment in market-oriented reforms and economic development: the case of China. *Transnational Corporations, 2*(3), 121–148.