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1

The Local Content of Japanese Electronics Manufacturing Operations in Asia

René Belderbos, Giovanni Capannelli, and Kyoji Fukao

1.1 Introduction

Foreign direct investment (FDI) may increase host country productivity through improved resource allocation, increased competition, and expansion of local capabilities through a transfer of (technological) know-how (e.g., Caves 1995; Wang and Blomström 1992). Expansion of local capabilities occurs if FDI introduces superior organizational practices and technologies and if this know-how spills over to and is assimilated by local suppliers and customers, the local workforce, and local rival firms. The scope for such spillovers depends on the underlying innovative capabilities of the investing firm, the degree to which these are transferred to the foreign venture, and the extent of integration of the foreign firm into the host economy. In addition, a condition for substantial spillovers is sufficient "absorptive capacity" of the local economy, for example, the sophistication of local suppliers and the skill level of the workforce (Cohen and Levinthal 1990; Capannelli 1997a, 1997b). Integration in this context is the degree of interaction with the local workforce, local suppliers, customers, government institutions, industry associations, educational institutions,

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and research centers (Turok 1993; De Arcos et al. 1995; Lall 1995). Since integration is achieved through country-specific investments in building relationships with the local economy, highly integrated foreign firms are less likely to divest in the future and the long-term viability of FDI increases.

The empirical literature on spillovers and productivity growth has produced mixed evidence on the impact of FDI. Industry-level studies have generally shown positive effects of FDI on labor productivity (Globerman 1978) and product and process innovations (Bertschek 1995). Firm- and establishment-level studies have given less support. Haddad and Harrison (1993) did not find evidence of productivity-increasing technology spillovers from foreign-owned subsidiaries to local firms in Morocco.[1] Aitken, Hanson, and Harrison (1997) found evidence of a more limited form of spillover from multinational investment in Mexico. The presence of exporting multinational firms was found to increase the probability that domestically owned firms start export activities, suggesting the presence of spillovers in the form of informational externalities and access to overseas distribution channels. Okamoto (1997) and Chung, Mitchell, and Yeung (1996) failed to find a direct impact on the productivity of North American car component suppliers from their forward linkages with Japanese assemblers.[2] These two studies did show substantial improvements in the productivity of U.S.-owned component suppliers (partly as a result of inventory reductions), suggesting that Japanese FDI had an indirect positive effect on productivity by increasing competition.[3] However, another recent study of the impact of Japanese FDI on the productivity of locally owned Chinese firms found almost opposite effects (Kinoshita 1996). Here the results did not support indirect spillover effects of FDI on local firms' productivity but provided evidence that direct buyer or supplier linkages with foreign firms led to higher productivity levels.

The debate about spillovers and other benefits from FDI appears to be particularly intense where it concerns Japanese FDI in Asia, which is the

1. Although this conceivably may have been due to a relative lack of absorptive capacity of local firms.

2. Okamoto (1997) failed to find productivity-increasing effects of supplier relationships with Japanese assemblers located in the United States throughout the 1980s but did obtain weakly significant coefficients in the early 1990s.

3. The findings may also be taken to indicate that U.S.-owned firms have been able to increase productivity by actively introducing organizational practices such as "just in time" delivery systems pioneered by Japanese automobile producers. It is conceivable that introduction of these practices was facilitated by the "demonstration" effect of plants set up by Japanese assemblers and suppliers, which is a particular form of spillover. Similarly, Oliver and Wilkinson (1992) found that a majority of U.K. firms in their sample had successfully introduced such "Japanese" manufacturing management practices as just-in-time delivery, quality circles, and flexible manufacturing techniques by the early 1990s. The U.K. firms were able to emulate these practices after Japanese plants set up in the United Kingdom in the mid-1980s had demonstrated that they could be successful in the U.K. environment.

subject of this paper. One reason is the perception that Japanese FDI is somehow less likely to generate spillovers to local economies because of the idiosyncratic behavior of Japanese multinational firms. Another reason is the economic importance of the activities of Japanese multinational firms in Southeast Asian countries. As shown in table 1.1, Japanese manufacturing affiliates play a principal role in East Asian economies. In three ASEAN countries (Indonesia, Philippines, and Malaysia), Japanese firms are responsible for almost a third of employment in the electronics and transport machinery industries.

In the discussion of the role of Japanese FDI, two contrasting views can be discerned. The positive view of Japanese FDI holds that it promotes economic development in Asia because the production processes and know-how transferred correspond closely to the absorptive capacity of the Asian economies. Products and components manufactured with the most standardized and mature technologies are produced in the ASEAN countries and, more recently, China, where cheap and low-skilled labor is relatively abundant. Goods of intermediate technology are produced in the newly industrialized economies (NIEs), where labor is more expensive but also more skilled. The most technologically advanced and capital-intensive production takes place in Japan. In this "flying wild geese" representation of Japanese FDI, Japan's technological leadership pulls along the industrialization of other Asian economies (e.g., Yamazawa et al. 1993; Urata 1991). The specialized nature of Japanese FDI in different Asian countries in accordance with differences in comparative advantage promotes intraregional and intraindustry trade. In this view, an important role is played by the "regional core networks" established by the larger Japanese multinational firms: networks of interrelated manufacturing plants for final goods and components, with different capital, labor, and skill intensities (Belderbos and Sleuwaegen 1996; Gold, Eonomou, and Tolentino 1991).

A contrasting and less benign view of Japanese FDI points out that the centralized nature of management in Japanese multinational firms and the reliance of Japanese firms on long-term dedicated supplier relationships discourages substantial integration in local economies. Japanese firms exercise strict control over overseas ventures (Mason and Encarnation 1994), are slow in appointing local staff to managerial positions (Westney 1996; Belderbos 1997), and are among the least internationalized in terms of overseas R&D activities (Patel 1995). A number of studies have presented evidence of relatively closed supply chains. Japanese affiliates in the United States rely more on imported components from their parent companies than do other foreign investors (Graham and Krugman 1990; Froot 1991; Murray, Wildt, and Kotabe 1995), and Japanese affiliates in Australia rarely use open tenders for machinery procurement but routinely buy from long-standing suppliers in Japan (in contrast with European and

Table 1.1 **Share of Japanese Manufacturing Subsidiaries in Host Country Employment, 1995**

Country	Electrical Machinery			Transport Machinery			All Manufacturing[a]
	Total Employment	Employment of Japanese Subsidiaries	Japanese Share (%)	Total Employment	Employment of Japanese Subsidiaries	Japanese Share (%)	Japanese Share (%)
South Korea	436,385	12,740	2.9	314,000	7,908	2.5	1.2
Taiwan	377,877	34,780	9.2	127,764	22,825	17.9	3.6
Singapore	100,111	38,809	38.7	34,672	1,243	3.6	13.5
Indonesia	132,484	49,373	37.3	123,842	42,510	34.3	1.8
Philippines	118,560	45,106	38.0	n.a.	26,515	n.a.	3.6
Malaysia	452,422	127,475	28.2	45,487	14,051	30.9	8.8

Source: Authors' calculations based on MITI (1998a) and Asian Development Bank (1998).

[a]Shares in all manufacturing are for 1997.

U.S. affiliates; Kreinin 1992). Evidence on Japanese subsidiaries in the Malaysian electronics industry shows that Japanese firms buy an overwhelming share of local components from Japanese-owned component suppliers, including those within the same corporate group or vertical *keiretsu* (Capannelli (1993, 1997b).[4] In a recent paper, Hackett and Srinivasan (1998) argued that Japanese firms face higher supplier-switching costs because of their intensive use of cooperative subcontractor relationships with established Japanese suppliers, in particular, suppliers within vertical *keiretsu.* This implies that Japanese firms are less eager to switch to local suppliers for their overseas manufacturing operations. Hackett and Srinivasan's empirical evidence suggesting that Japanese firms are less inclined than U.S. firms to invest in countries that impose strict local content requirements on foreign investors is consistent with the hypothesis of higher switching costs. However, it appears to be an open question whether differences in investment and procurement behavior are due to the idiosyncratic organization of Japanese multinational firms or are a temporary phenomenon due to a "vintage effect": the relatively late internationalization of Japanese firms (Mody and Srinivasan 1997; Westney 1996; Belderbos 1997, chap. 10).

In this paper, we contribute to the discussion by examining the determinants of Japanese firms' decisions to establish vertical linkages in Asian economies. Vertical linkages, that is, the local content of manufacturing operations, have been a focal point of host country concern. Several Asian countries have instituted formal local content requirements for foreign investors; others have made preferential investment status conditional on local content or have put informal pressure on foreign investors to extend their vertical linkages (Japan Machinery Center for Trade and Investment 1997; Commission of the European Communities 1998). Local content rules exist because increased local content is believed to provide a number of benefits to the host economy. If increased local content is achieved by sourcing materials and components from local suppliers, it may involve transfer of know-how to, and promote growth of, the local supplying industry. If local content is increased, on the other hand, through greater vertical integration of manufacturing operations (by producing more components in-house), it may be associated with an upgrading of employee skills, in particular, if the production of components is more technology and know-how intensive. In either case, increased vertical linkages are likely to enhance the local employment and trade balance effects of the investment project. In addition, the increased cost of divestment associated with greater investment and linkages to the local economy may positively affect the longevity of FDI.

In this paper we analyze procurement behavior at the micro level, that

4. Capannelli (1997b, 172–73) estimated that a mere 6.4 percent of local procurement was from Malaysian-owned firms in 1995.

is, at the level of individual firms, using subsidiary-level data from the Ministry of International Trade and Industry's (MITI's) 1992 survey of Japanese multinationals. We develop an empirical model that aims to explain the local content of Asian manufacturing operations by Japanese subsidiaries in the electrical and electronics industry. The model specifies determinants at the parent, subsidiary, and host country levels. Three main determinants, among others, are included: the presence of local content rules, the role of dedicated supplier linkages in vertical *keiretsu,* and the vintage effect. The effect of local content rules is measured at the subsidiary level, by utilizing a question in the MITI survey that inquires whether such regulations were applied. The effect of supplier relationships within vertical *keiretsu* is measured directly by estimating for each parent firm the intensity of transactions within the vertical *keiretsu* in Japan. The vintage effect is taken into account by including a variable for the operating experience of the subsidiary in the country of investment. The data set used contains information on 157 Asian subsidiaries in the electronics industry. The electronics industry is the largest Japanese investor in Asia and makes extensive use of subcontracting relationships outside and within vertical *keiretsu.* However, empirical research on Japanese subcontracting relationships to date has focused almost solely on the automobile industry.

Our main interest in this paper is the potential benefits of Japanese FDI for host economies that are derived from extended vertical linkages. The empirical analysis therefore focuses on the local (host country) content of electronics manufacturing subsidiaries in Asia. Local content includes both the value added of manufacturing subsidiaries (in-house production of components) and the value of components and materials sourced from local (Japanese and third country owned, as well as locally owned) suppliers. We chose not to focus on procurement alone because ignoring intra-subsidiary value added could lead to biased results: there is conceptually little difference between in-subsidiary production of components (value added) and procurements from nearby component plants of affiliated firms belonging to the same vertical *keiretsu.* The difference could merely be one of legal subsidiary boundaries. On the other hand, a distinction between procurements from locally owned suppliers and those from related suppliers would be useful because the former are likely to be associated with greater technology transfer and the stimulation of local entrepreneurship (e.g., Lim and Fong 1983). Unfortunately, our data do not allow us to estimate the importance of local procurement from locally owned firms.[5]

5. The MITI data do contain information on procurement from subsidiaries owned by the same parent firm ("intragroup procurement" in the MITI terminology), which is a narrower definition than intra-*keiretsu* procurement. However, no distinction is made among procurements from third country, Japanese, and locally owned suppliers, and the question on intragroup procurement has a low response rate.

The remainder of the paper is organized as follows. Section 1.2 briefly reviews the literature on subcontracting and supplier relationships of Japanese firms and previous work on vertical linkages of foreign-owned affiliates. Section 1.3 develops hypotheses concerning the determinants of the local content ratio of Japanese manufacturing operations in East Asia and describes the empirical model and data. Section 1.4 presents the empirical results. Section 1.5 summarizes our findings and offers concluding remarks.

1.2 Previous Literature: Vertical Linkages, Japanese Supplier Networks, and Local Content Rules

We are not aware of any recent systematic empirical analysis of the vertical linkages of foreign-owned firms in host economies. There is a research tradition on vertical linkages of foreign firms in the economic geography literature. O'Farrell and O'Loughlin (1981), for instance, statistically analyzed local procurement levels of foreign-owned affiliates in Ireland. In a more recent study, Turok (1993) investigated local sourcing by firms under foreign (including Japanese) ownership in the Scottish electronics industry ("Silicon Glen") in 1992 and concluded that the level of vertical linkage was low.[6] The only recent attempt to provide a more comprehensive explanation of local sourcing decisions in this tradition was Reid (1995), but this study was primarily concerned with the effect of just-in-time delivery systems on the spatial clustering of suppliers. Reid found that the use of just-in-time systems by 239 Japanese-owned manufacturing plants in the United States is positively associated with the proportion of material inputs procured at the county level (but not at the state or national levels).

Apart from the descriptive evidence presented in Kreinin (1992), Graham and Krugman (1990), and Froot (1991), which emphasized the reliance of Japanese overseas affiliates on component and material imports from Japan, a number of (case) studies have examined local procurement by Japanese firms. Hiramoto (1992) presented a case study of the subcontracting and sourcing relationships of Japanese television and VCR assemblers in Asia and Europe. He found that Japanese assemblers have often failed in their attempts to establish long-lasting subcontracting relationships with local parts suppliers similar to those they have with Japanese suppliers. Major obstacles were the lack of an orientation toward continuous improvement, the lack of emphasis on quality and reliability, the dominant position of the assembler-buyer, and the buyer's preference for the use of relatively ambiguous contracts. Belderbos (1997, chap. 8) examined aggregate data on procurement and value added of Japanese electronics subsidiaries in the European Union and the United States. While the local

6. Only 12 percent of components were supplied from Scotland and another 30 percent from the rest of the United Kingdom (Turok 1993, 406).

(European and North American) content of manufacturing operations was substantial (in the range of 40 to 60 percent), the role of locally owned firms in the supply chain was limited. Comparable findings were obtained by Capannelli (1993, 1997b) for Malaysia. These results are consistent with earlier work by Lim and Fong (1982) for Japanese investors in Singapore.

On the other hand, there is some evidence that reliance on in-house components and procurement from Japanese affiliates is declining. Baba and Hatashima (1995) and Chia (1995) argued that there has been a recent move from the use of firm-specific components developed internally or within the vertical *keiretsu* toward the open purchase of standard components. Greater competitive pressures have forced Japanese firms to redesign products in order to facilitate the procurement of cheaper mass-produced components in Asia. Baba and Hatashima (1995) described a number of cases in which Japanese electronics firms have extended local design activities in Southeast Asia.[7] Chia (1995) showed that an increasing number of Japanese firms have set up regional procurement offices in Singapore to facilitate cost-effective sourcing of components made in Asia.

Recent empirical work on Japanese FDI has explored the role of supplier and subcontractor linkages in the decision to invest abroad and the location of investments. Belderbos and Sleuwaegen (1996) found that vertical linkages between firms are an important factor in the decision to invest in Asia: subcontractor firms within vertical *keiretsu* are more likely to invest in Asia if the parent firm operates a large number of plants (a "regional core network") in the region. Using location data on Japanese manufacturing affiliates in the United States, Head, Ries, and Swenson (1995) found that Japanese plants were more likely to be set up in a state, the greater the number of existing Japanese plants in that state in the same industry. The existence of plants set up by parent firms or suppliers in the same vertical automobile *keiretsu* exerted an additional positive effect on location decisions by firms in the *keiretsu.* Horiuchi (1989) and Cusumano and Takeishi (1991) reported that Japanese automobile manufacturers actively help their *keiretsu* component suppliers to set up plants near their assembly operations abroad.

Empirical work on Japanese subcontracting and buyer-supplier relationships has been concerned primarily with establishing the role of risk sharing as well as the correlation between relationship-specific investments and the performance of suppliers and assemblers. These studies have focused on the automobile industry. Asanuma and Kikutani (1992) and Okamuro

7. Matsushita Electric and Seiko Epson are reported to have recently transferred part of their die-making activities to Southeast Asia in order to reduce costs and reduce the period from design to delivery of new models. Matsushita Electric makes dies for television parts and cabinets in Singapore and Malaysia, and Seiko Epson is producing dies for computer printers in Hong Kong. See "Manufacturing Technology Leaving Its Stamp on Asia," *Nikkei Weekly,* 23 June 1997.

(1995) provided evidence that the intensity of long-term supply relationships is positively correlated with the stability of performance. Dyer (1996) found evidence that automobile assemblers are more profitable, the greater the proximity (spatial clustering) of their suppliers. Proximity is associated with suppliers' dedicated investment in production facilities, greater sharing of know-how, and more intense communication. These are found to be correlated with faster design changes, improved quality, and increased return on investment. For the consumer electronics industry, Capannelli (1997a) found that technology transfer by Japanese assembly firms to their input suppliers is positively related to specific investments to enhance the former's technological capability and the latter's absorptive capacity and negatively related to the bargaining power of suppliers. The effectiveness of technology transfer was found to be greater in the case of lower end production inputs.

Studies of component procurement and supply chain management in the strategic management literature have also focused on the relation between sourcing strategies and firm performance. Kotabe and Omura (1989) examined sourcing strategies of a group of foreign (including Japanese) multinational firms in the United States and found that the extent of internal sourcing of major components is positively related to U.S. market performance of the product. Murray et al. (1995) surveyed 104 foreign-affiliated manufacturing subsidiaries in the United States in 1993 and found weak evidence that reliance on nonstandardized components and internal sourcing was related to better market performance as measured by sales growth. They also reported significant differences in procurement behavior between European- and Japanese-owned subsidiaries in the United States in 1991. Japanese subsidiaries sourced a significantly smaller share of the value of components in the United States and combined greater reliance on nonstandardized components with significantly higher levels of intrafirm sourcing.

A last research tradition has been concerned with formal analysis of the welfare and strategic effects of local content requirements (e.g., Belderbos and Sleuwaegen 1997; Jie-A-Joen, Belderbos, and Sleuwaegen 1998; Richardson 1993). The effect of local content requirements has been found to depend on, among other things, the market power of local parts suppliers, the cost competitiveness and level of vertical integration of local competitors in the assembly industry, and whether the requirements induce FDI in component production. Despite the wealth of theoretical studies, the only empirical study of the effect of content regulations is Hackett and Srinivasan (1998). Their finding that local content regulations exert a significantly negative effect on Japanese FDI would imply that, on balance, the negative effect on FDI in assembly industries is much stronger than any positive effect on FDI by assemblers and related suppliers in local component production to satisfy the requirements. However, they also

found a positive and significant effect of the stock of Japanese FDI on new investments. This is consistent with the finding of strong agglomeration economies by Head et al. (1995) and may in fact measure a partly offsetting positive effect on FDI by subcontractors in response to previous investments by assemblers facing local content regulations.

1.3 Data and Empirical Model

This section develops an empirical model explaining the extent of vertical linkages of Japanese manufacturing subsidiaries in Asia. The dependent variable is the local content ratio (LOCON), defined as sales of the subsidiary, minus components and materials imported from abroad, divided by subsidiary sales.[8] Since the dependent variable is restricted to the interval [0,1], two-limit Tobit analysis is used to relate the local content ratio to a set of explanatory variables.

We first introduce the data set and discuss the use of the dependent variable. This is followed by a discussion of the explanatory variables at the parent firm and subsidiary levels. We will start by estimating a set of empirical models including these variables while controlling for country characteristics through a set of country dummies. This helps us to focus on the estimates of variables at the level of the firm. Since our data set only includes nine Asian countries, the variation is not large enough to allow inclusion of a comprehensive set of country variables. Nevertheless, in a second set of extended models we do employ a set of country variables expected to have an impact on local content. Country variables are discussed in the last part of subsection 1.3.3.

1.3.1 Data

Subsidiary data are drawn from MITI's 1992 basic survey of Japanese multinational enterprises and account for operations in the fiscal year through March 1993. A representative number of 157 subsidiaries in the electronics industry had sufficient information on local content and a basic set of explanatory variables. Eighty-three of these were established in the four NIEs and 67 in the ASEAN-4 countries (Indonesia, Thailand, Philippines, and Malaysia), and 7 subsidiaries operated in China. Further details on the data selection as well as the definitions of the dependent and explanatory variables are provided in the appendix.

Table 1.2 shows the origins of procurements by Asian electronics subsidiaries of Japanese firms. Japan is the most important origin of procurements (46 percent), followed by the host country (39 percent) and other Asian countries (12 percent). Asian countries other than Japan are important sources of parts and components for subsidiaries in the ASEAN-4

8. When a subsidiary also imported finished goods, we deducted the value of such imports from both the total sales value and the total import value.

Table 1.2 **Distribution of Procurement by Asian Manufacturing Subsidiaries of Japanese Electronics Firms over Regions of Origin, 1992**

Country	Local (%)	Japan (%)	Asia (%)	Other (%)	Subsidiaries (number)
Hong Kong	48	34	18	0	8
South Korea	46	50	4	0	25
Singapore	40	43	15	2	27
Taiwan	50	43	6	1	38
NIEs	46	44	9	1	98
Indonesia	63	17	20	0	5
Malaysia	34	44	16	6	40
Philippines	16	42	42	0	4
Thailand	28	55	15	2	34
ASEAN-4	32	47	17	4	83
China	23	72	0	5	7
Asia-9	39	46	12	3	188

Source: Authors' calculations based on MITI (1994).

Note: From 188 subsidiaries with complete imformation (see appendix). Percentages are shares of total procurement.

Table 1.3 **Local Content Ratio of Asian Manufacturing Subsidiaries of Japanese Electronics Firms, 1992 (percent)**

Country	Local Procurement / Sales (A)	Value Added / Sales (B)	Local Content Ratio (A + B)
Hong Kong	33	36	69
South Korea	23	44	67
Singapore	30	39	69
Taiwan	29	44	73
NIEs	28	43	71
Indonesia	44	28	72
Malaysia	23	34	57
Philippines	10	44	54
Thailand	18	34	52
ASEAN-4	22	34	56
China	18	36	54
Asia-9	24	38	63

Source: Authors' calculations based on MITI (1994).

Note: From 188 subsidiaries with complete information (see appendix).

countries, Singapore, and Hong Kong, but less so for Taiwan, South Korea, and China.

Table 1.3 shows the average local content ratio by country. The local content ratio averaged 71 percent for the NIEs and 56 percent for the ASEAN-4 countries. Higher local content ratios in the NIEs are achieved

through both greater local sourcing (28 percent) and higher value added (43 percent).

1.3.2 Dependent Variable

Foreign-owned subsidiaries can achieve higher local content in a number of ways: (1) increasing the value added of the assembly activity, (2) increasing intrasubsidiary production of components, (3) increasing procurement of components and materials from Japanese suppliers in the same *keiretsu* that are producing in local plants, (4) increasing procurement from locally established independent Japanese firms, (5) increasing procurement from local subsidiaries of third country firms, and (6) increasing procurement from locally owned suppliers. The local content ratio of a subsidiary measures how much value its activity creates in the local economy, that is, to what extent the value chain is established locally. However, a potential measurement problem is associated with the local procurement share of the local content ratio. In particular, when local suppliers are foreign owned, these suppliers in turn will source part of their subcomponents and materials from abroad. The value added that is generated locally must be less than the price paid for the components. Hence, our local content measure (and the figures in table 1.3) overestimates the contribution to the local economy. There is evidence that this overstatement of actual local content is not negligible. Belderbos (1997, 326) reported that the local content ratio of Japanese electronics subsidiaries drops from 66 to 55 percent if the non-European content of components manufactured by Japanese suppliers in the European Union is deducted. Although this is an important qualification to our analysis, it is less likely to introduce a systematic bias into the empirical results concerning the determinants of local content. At the country level, the same factors that positively affect value added of final goods manufacturing will also have a positive impact on the value added of locally manufactured components. We did not find evidence that the local content of the electronic component subsidiaries in our sample is determined differently from the local content of final goods subsidiaries.[9] Hence, our measured local content ratio and actual local content will be strongly correlated.

A Japanese firm's decisions concerning the sourcing of components and materials for its manufacturing operations in Asia can be subdivided into two decision problems: (1) whether to procure the components in-house (or intra-*keiretsu*) and (2) whether to procure the components in Japan or overseas (in Asia). The "internalization" decision of problem 1 reflects the trade-off between the quality and reliability benefits of in-house produc-

9. In addition, our results appeared robust with respect to the choice of the dependent variable (including or excluding value added): we obtained very similar results with local procurement as the dependent variable. If the local procurement share of measured local content were systematically biased, we would expect differences in these results.

tion of components of proprietary design versus the cost reduction benefits of sourcing standard components. If a firm chooses external sourcing of components to maintain a competitive cost structure, it will be more likely to choose components produced in low-cost Asian locations (produced by locally owned firms or independent Japanese transplants). If a firm chooses proprietary component manufacturing, it is still possible that overseas manufacturing activities reach high local content levels. A condition is that the overseas manufacturing location allow cost-effective production of the components within the assembly plant or in a dedicated component manufacturing subsidiary established by the assembler or its related component suppliers. The local content level reached will therefore reflect both the importance of transactions costs associated with arm's-length trade and the attractiveness of Asian countries in component manufacturing.

1.3.3 Explanatory Variables

Parent Firm Level

We posit that the *R&D intensity* of the parent firm, R&DINT, has a negative effect on local content. R&D-intensive firms make greater use of proprietary designs and in-house know-how, and they possess more intangible assets related to capabilities in the manufacture of high-technology components. They are less likely to transfer the production of these components to external suppliers. Since production of in-house developed components is generally capital and technology intensive, it is less likely that Asian manufacturing locations provide substantial cost advantages for R&D-intensive firms. There is some evidence for this assertion: Fukao et al. (1994) found that R&D intensity has a significantly negative impact on the stock of FDI in Asia by Japanese electronics firms. We hypothesize that R&DINT is negatively correlated with the local content ratio. We also test whether the effect is stronger for the ASEAN-4 countries and China compared to the NIEs since the greater technological capabilities of the latter make them more attractive for R&D-intensive manufacturing operations.

Japanese firms differ in the intensity of long-term cooperative subcontracting and supplier-assembler relationships (e.g., Sako 1992; Dyer 1996). In particular, firms that are member of large vertical *keiretsu* with a substantial number of related component manufacturers will make intensive use of these relationships. Intra-*keiretsu* procurement is based on long-term relationships characterized by intensive interaction between supplier and assembler involving dedicated investments in equipment and human resources and requires the implementation of just-in-time delivery and total quality control systems. There is evidence that these relationships enhance performance and reduce risk (Dyer 1996; Asanuma and Kikutani

1992; Okamuro 1995). Since the assembler-supplier system is one of the bases for the competitiveness of Japanese firms, they have followed a strategy of emulating it abroad. In practice, however, it has proved difficult to involve locally owned suppliers in such relationships (Hiramoto 1992). Moreover, supplier-switching costs are higher for *keiretsu* firms given the sunk investments in existing relationships with Japanese suppliers (Hackett and Srinivasan 1998). Supplier networks have therefore often been replicated abroad through the establishment of overseas manufacturing plants by existing Japanese manufacturers of parts and components, in which the latter were often assisted by the "core" firm of the *keiretsu* (Belderbos and Sleuwaegen 1996).

The consequences of *keiretsu* membership for the local content of overseas operations are not unambiguous. On the one hand, the higher switching costs of *keiretsu* member firms may lead to a greater continuing reliance on inputs from long-standing suppliers located in Japan. On the other hand, if the supplier has followed the assembler abroad, *keiretsu* firms may be able to reach higher local content than independent firms. The possibility of replicating supplier networks abroad may be a particular advantage in locations where local or third country component manufacturers are lacking. We therefore examine whether the effect of *keiretsu* intensity is stronger in countries that have less developed indigenous electronic parts industries, such as the ASEAN-4 countries and China.

Since a substantial share of investment in Asia is done by the core firms of *keiretsu* or by member firms of *keiretsu,* membership in a vertical *keiretsu* itself is not a distinctive characteristic. Instead, we devised a measure of the intensity of supplier-assembler relationships. We used Toyo Keizai's publication *Nihon no Kigyou Guruupu* (Japanese Corporate Groups), to establish for each Japanese investor whether it belonged to a vertical *keiretsu.* Then we proxied the intensity of supplier-assembler relationships for *keiretsu* members by taking the ratio of the size (measured by paid-in capital) of all Japanese subsidiaries and related firms in manufacturing (*kogaisha* and *kankeigaisha*) to the size of the core firm of the *keiretsu* in Japan. We call this *variable keiretsu intensity,* KEIRINT. The values for KEIRINT corresponded well to our intuition concerning the strength of supplier networks, with, for example, the highest ratios for Matsushita and Fujitsu and the lowest for Sharp. Unfortunately, we were not able to identify *keiretsu* intensity for all Japanese investors, and the inclusion of KEIRINT reduces the number of valid observations by seventeen.

Subsidiary Level

At the subsidiary level, *experience* in manufacturing in a country is likely to be an important determinant of the extent of vertical linkages. Finding suitable local suppliers and establishing links with these firms is time consuming, in particular, if the suppliers have to adapt to the de-

mands of Japanese assemblers in terms of quality and delivery schedules. In other cases, redesign of the product is necessary to allow the use of locally made standardized components. O'Farrell and O'Loughlin (1981) found a positive effect of operating experience on the level of local procurement by foreign-owned subsidiaries in Ireland, but Reid (1995) could not establish a similar effect for Japanese firms in the United States. One reason for the latter result may be that no distinction was made between greenfield establishments and acquisitions. In cases where a local subsidiary was acquired by a Japanese investor, it is natural to assume that the subsidiary was relatively deeply embedded in the local economy at the time of the acquisition; the number of years of operation under Japanese ownership is not likely to have an important additional impact on local content. In fact, it is conceivable that under Japanese ownership, a restructuring of manufacturing activities takes place, which may involve a switch to the use of Japanese-made components. In our analysis of Japanese subsidiaries in Asia, the distinction between acquisitions and greenfield plants is of very limited importance because the role of acquisitions in Asia is marginal: only four subsidiaries in the sample were acquired. This small number does not allow us to test for a different effect of experience for acquired firms. We therefore use only one variable, EXPER, the number of months since operations started in the manufacturing subsidiary under Japanese control.[10]

As mentioned above, the *entry mode* is likely to have an impact on integration in the local economy. Acquired subsidiaries are likely to have higher local content given their local ownership and preacquisition operating experience. We also expect that joint ventures facilitate higher levels of local content than wholly owned subsidiaries, ceteris paribus. This is because the local joint venture partner or its related firms may have accumulated expertise either in electronic component manufacturing or in procuring components from local suppliers. Taking the wholly owned greenfield subsidiary as the base case, we include two dummy variables in the model, ACQUIS when the subsidiary was acquired and JV when the subsidiary is a joint venture with a local partner.

A feature of the operations of Japanese electronics firms in Asia is a certain dichotomy between subsidiaries producing for export markets and subsidiaries primarily selling on the local market. The *export versus local sales strategy* may have an impact on vertical linkages of the subsidiary. If the subsidiary focuses on the local market it is likely that (1) it produces relatively mature and low-priced products for this local market and not the most sophisticated products or models and (2) it has an incentive to

10. We tested a model that included both EXPER for greenfield and EXPER for acquired firms. As expected, the latter had a small and insignificant coefficient, while the coefficient of the former was only marginally different from the EXPER coefficient for all subsidiaries.

adapt the products to local tastes and circumstances. The more mature the products, the more likely it is that locally produced low-cost standard components can be used. Adapting products to the local market is likely to involve redesign, which allows the use of locally made components. Furthermore, subsidiaries selling price-sensitive products on the local market are more vulnerable to currency swings if they rely on procurement from Japan. In sum, we expect that subsidiaries with higher local sales ratios have higher local content. LOCSALES measures the percentage of subsidiary turnover destined for the local market. We expect this positive effect to be greatest for the ASEAN-4 countries and China, where demand is less sophisticated than in the NIEs.

Industry characteristics will have an effect on the extent of vertical linkages. High local content ratios may be more difficult to achieve in high-technology industries such as telecommunications than in the more mature consumer goods sectors. Subsidiaries manufacturing products that use components with a low value-to-weight ratio will be more inclined to use local components because transportation costs associated with imports are relatively high. We control for such possible systematic differences by including industry dummies. We regrouped the industry classification used in the MITI survey into four subclasses in the electronics industry: consumer goods, semiconductors and electronic parts, telecommunications and computer equipment, and other electronic and electrical equipment. We use consumer goods as the reference case and include three dummies: TELCOMP, PARTS, and OTHERIND.

Country Level

The first country characteristic affecting local integration is the availability of locally established component suppliers. We used data from Elsevier's *Yearbook of World Electronics Data* to calculate the *value of electronic parts and component production* in each country in 1992 (Elsevier 1995). As explanatory variable we took the natural logarithm of the production value, SUPPLIERS. The variable SUPPLIERS measures the availability of locally owned suppliers as well as Japanese-owned suppliers. It will also generally reflect the attractiveness of a country as a place to establish component manufacturing operations.

The extent to which *Japanese suppliers* play a role in the local component industry will also affect vertical linkages. By using long-standing suppliers from Japan established near the overseas manufacturing base, firms can avoid switching costs and emulate best practice in Japan. There may be important economies of agglomeration once a substantial number of Japanese suppliers have set up local manufacturing subsidiaries. Reduced input costs can result from increased specialization and training of local personnel. We used MITI survey data to establish the total turnover of Japanese electronic parts manufacturing subsidiaries in each country in

1992. We employ as an indicator of the presence of Japanese suppliers, JRATIO, the log of total turnover by Japanese subsidiaries divided by SUPPLIERS. We also hypothesize that firms with extensive supplier linkages within their *keiretsu* in Japan are likely to benefit most from the availability of Japanese suppliers. Hence we test for the cross-effect of JRATIO and KEIRINT.

The cost advantage of using a local network of suppliers also depends on the *quality of infrastructure*. Good infrastructure facilitates physical transport of components within the country and communication between assembler and suppliers. The perceived quality of infrastructure, as measured by a survey of U.S. multinational firms conducted by Business International Corporation, has been found to have a significantly positive impact on inward investment (Wheeler and Mody 1992; Hackett and Srinivasan 1998). We use the rating provided by Business International (1989) as an indicator of the quality of infrastructure in 1989: INFRA measures this quality on a scale of 0 to 10. We include INFRA as a moderating factor on the effect of SUPPLIERS. Hence we include SUPPLIERS * INFRA.

An important issue is to what extent *local content rules* directed at increasing the local content of (foreign-owned) manufacturing operations are successful in enhancing vertical linkages. We examined in some detail the available information at the country level on local content regulations and import restrictions on components and materials (Japan Machinery Center for Trade and Investment 1997; Commission of the European Communities 1998). We found that very few formal rules specifying local content requirements applied to the electronics industry. Most existing requirements apply to automobile and machinery manufacturing. The only country that regularly imposes local content and export performance requirements on foreign-owned firms is China; often these are part of trade-balancing requirements that link import restrictions to export performance. In some ASEAN-4 countries, preferential treatment given to foreign investment projects is contingent on local content (among other requirements). Malaysia, for instance, grants "pioneer status" (a right to tax exemptions) if the investment meets a number of conditions, among which are local content requirements. In Indonesia import tariff reductions can be made dependent on local content. Overall, we concluded that import requirements and local content rules in Asia, if applied, are mostly part of incentive schemes. Such schemes and the conditions vary with each investment project, and this introduces a degree of discretion into the application of local content rules. The schemes may link import restrictions or local content requirements to export requirements.

Based on these findings, we decided to use two alternative indicators of local content requirements: besides an indicator of local content requirements at the *country* level, we also use a measure at the level of the indi-

vidual *subsidiary*. At the country level, the presence and strictness of local content regulations and import restrictions is measured by the ratings given by U.S. multinational firms provided by Business International (1989). We averaged the ratings for the extent of component and material import restrictions and the use of local content requirements to construct the variable REGULATION. When local content requirements and import restrictions are made contingent on export requirements, subsidiaries with a local sales orientation will face stricter requirements than export-oriented firms. To control for this characteristic, we also include the cross-effect of LOCSALES and REGULATION. Both the cross-effect and REGULATION are expected to have a positive effect on the local content ratio.

The subsidiary-specific indicator of local content requirements is taken from the MITI survey. Subsidiaries are asked to indicate whether local content rules affect their manufacturing operations. If they indicate yes, the dummy variable for subsidiary-specific local content requirements, REGUSUB, takes the value one. Because REGUSUB varies by subsidiary, we also include the variable in the country dummy model. The dummy variable REGUSUB has the disadvantage that it does not indicate the strictness of the requirements. Given that local content rules tend to be stricter in the ASEAN-4 countries and China than in the NIEs, we attempted to remedy this to some extent by including REGUSUB separately for both groups of countries. We expect a stronger positive effect of REGUSUB for the ASEAN-4 countries and China. In addition, we include the cross-effect of REGUSUB and LOCSALES to test whether subsidiaries with a local sales orientation face stricter requirements.

1.4 Empirical Results

After presenting the results of the country dummy model, we analyze the results of the model with country variables. Finally, the results of a number of tests are discussed.

1.4.1 Country Dummy Model

Table 1.4 shows the results of five Tobit models explaining the local content ratios of Asian manufacturing subsidiaries of Japanese electronics firms. The first two equations do not include KEIRINT and are estimates based on 157 observations. Equation (1) is used as the basic model while equation (2) tests whether procurement behavior differs between subsidiaries located in the NIEs and those located in the ASEAN-4 countries and China. Equations (3), (4), and (5) include KEIRINT; its inclusion reduces the number of observations to 133.

In accordance with our expectations, the parent firm's R&D intensity negatively affects local content. R&D-intensive firms make greater use of

Table 1.4 **Determinants of Local Content Ratios of Asian Subsidiaries: Tobit Estimates with Country Dummies**

Variable	(1)	(2)	(3)	(4)	(5)
R&DINT	−1.28		−1.23	−1.32	−1.25
	(−2.41)**		(−2.21)**	(−2.40)**	(−2.24)**
R&DINT*NIES		−1.23			
		(−1.58)			
R&DINT*(1 − NIES)		−1.10			
		(−1.54)			
KEIRINT			0.17	0.19	
			(3.21)***	(3.47)***	
KEIRINT*NIES					0.20
					(2.21)**
KEIRINT*(1 − NIES)					0.16
					(2.49)**
EXPER	0.0006	0.0005	0.0006	0.0007	0.0006
	(2.68)***	(2.58)**	(3.03)***	(3.32)***	(3.04)***
ACQUIS	0.29	0.24	0.24	0.20	0.24
	(1.81)*	(1.50)	(1.55)	(1.36)	(1.56)
JV	0.05	0.04	0.05	0.05	0.04
	(1.28)	(1.14)	(1.14)	(1.20)	(1.09)
LOCSALES	0.12				
	(2.25)**				
LOCSALES*NIES		0.01	−0.01	−0.04	−0.01
		(0.18)	(−0.16)	(−0.48)	(−0.13)
LOCSALES*(1 − NIES)		0.23	0.17	0.10	0.18
		(3.06)***	(2.20)**	(1.23)	(2.22)**
REGUSUB	0.06				
	(1.37)				
REGUSUB*NIEs		0.00	−0.05	−0.14	−0.05
		(0.01)	(−0.63)	(−1.59)	(−0.60)
REGUSUB*(1 − NIES)		0.10	0.15	0.08	0.15
		(1.74)*	(2.69)***	(1.31)	(2.61)***
REGUSUB*LOCSALES				0.34	
				(2.16)**	
TELCOMP	−0.06	−0.05	−0.09	−0.07	−0.09
	(−0.71)	(−0.67)	(−1.12)	(−0.88)	(−1.16)
PARTS	−0.05	−0.03	−0.02	−0.02	−0.02
	(−1.33)	(−0.72)	(−0.38)	(−0.44)	(−0.43)
OTHERIND	−0.06	−0.06	−0.04	−0.05	−0.04
	(−1.00)	(−1.00)	(−0.57)	(−0.62)	(−0.59)
Indonesia	0.24	0.14	0.13	0.15	0.14
	(1.78)*	(0.97)	(0.89)	(1.01)	(0.93)
South Korea	0.12	0.11	0.14	0.13	0.14
	(1.13)	(1.04)	(1.23)	(1.16)	(1.22)
Malaysia	0.11	0.00	0.00	0.01	0.01
	(1.02)	(0.01)	(−0.01)	(0.09)	(0.05)
Philippines	0.08	−0.05	−0.03	−0.01	−0.03
	(0.55)	(−0.31)	(−0.21)	(−0.07)	(−0.16)

(*continued*)

Table 1.4 (continued)

Variable	(1)	(2)	(3)	(4)	(5)
Singapore	0.15	0.14	0.16	0.17	0.16
	(1.43)	(1.36)	(1.48)	(1.59)	(1.43)
Thailand	0.06	−0.06	−0.08	−0.06	−0.07
	(0.55)	(−0.45)	(−0.58)	(−0.47)	(−0.50)
Taiwan	0.19	0.17	0.20	0.20	0.20
	(1.88)*	(1.71)*	(1.83)*	(1.85)*	(1.82)*
China	0.13	0.01	0.04	0.03	0.05
	(0.97)	0.07	(0.25)	(0.21)	(0.30)
Constant	0.44	0.50	0.43	0.43	0.43
	(4.17)***	(4.65)***	(3.65)***	(3.73)***	(3.65)***
N [censored]	157 [6]	157 [6]	140 [4]	140 [4]	140 [4]
Log likelihood	19.04	21.49	25.84	28.15	25.91
χ^2	49.52	54.41	58.19	62.80	58.32

Note: Numbers in parentheses are *t*-values.

*Significant at the 1 percent level.

**Significant at the 5 percent level.

***Significant at the 10 percent level.

nonstandardized and technology-intensive components, often developed and produced by the firm in Japan. There is no evidence, on the other hand, that this effect is significantly stronger in the ASEAN-4 countries and China. The estimated coefficients for R&DINT do not differ markedly in equation (2), while the standard error of the separate estimates is substantially higher.

The results show a robust positive and significant effect of operating experience on the local content ratio. Operating experience in the host country increases the vertical linkages of subsidiaries in the local economy, because the switch to local suppliers and the process of adaptation to the new environment require time. However, the estimated coefficient of EXPER suggests that this effect in itself is limited: one additional year (twelve months) of local operating experience increases the local content ratio by 0.6 percentage points. The results can only be taken as partial confirmation of the role of Japanese firms' relatively late internationalization in procurement behavior.

Our expectation that the entry mode of the subsidiary has an impact on the input-sourcing strategy is partly confirmed. Both ACQUIS and JV consistently have positive signs, but their significance is low. ACQUIS is significant (at the 10 percent level) in equation (1).

The hypothesis that local content increases if sales are destined for the local market is confirmed by the positive and significant coefficient of LOCSALES in equation (1). The results of equations (2), (3), and (5) show that this effect is largely driven by the procurement behavior of subsidiar-

ies in the ASEAN-4 countries and China: LOCSALES is significant for subsidiaries in these countries but insignificant for subsidiaries located in the NIEs. This suggests that for countries with relatively unsophisticated markets, focusing on local markets helps subsidiaries to achieve lower dependence on imports of technology-intensive parts and components.

REGUSUB, the variable indicating local content requirements at the subsidiary level, has a positive sign but is insignificant in equation (1). However, if the effect is split between the NIEs and the ASEAN-4 countries and China, it appears that these requirements have an insignificant effect on the local content ratio of subsidiaries located in the former countries but a positive and significant impact on that of subsidiaries in the latter. This indicates that relatively strict local content requirements have changed procurement behavior in the ASEAN-4 countries and China but such restrictions play no role in influencing sourcing decisions of subsidiaries in the NIEs. In equation (4), it is also tested whether local content regulations have a greater impact on subsidiaries selling on local markets. The cross-effect of LOCSALES and REGUSUB is positive and significant, suggesting that local-market-oriented subsidiaries indeed face stricter requirements. Inclusion of the cross-effect increases the standard errors of the coefficients of LOCSALES and REGUSUB, which become insignificant.

The effects of the inclusion of the *keiretsu* intensity variable, KEIRINT, in equation (3) confirm that *keiretsu* linkages have a major impact on vertical integration and local procurement. KEIRINT has a positive sign and is highly significant. Moreover, inclusion of KEIRINT clearly improves the fit of the model: the χ^2 increases by a substantial margin. Separating the effect of KEIRINT for subsidiaries in the NIEs and subsidiaries in the ASEAN-4 countries and China in equation (5) shows a slightly higher coefficient for the NIEs. Hence, we do not find evidence that *keiretsu* firms are able to reach higher local content ratios in countries with less developed local supply infrastructures. Perhaps investments in local manufacturing plants by *keiretsu* suppliers are also less viable in these countries than in the NIEs.

After controlling for subsidiary and parent firm characteristics, there is not much additional variation in local content ratios across countries. Only the dummy for Taiwan is consistently significant (at the 10 percent level), indicating that Taiwanese subsidiaries reach higher ratios than subsidiaries in Hong Kong, ceteris paribus. The coefficient of the Indonesia dummy is positive and significant at the 10 percent level in equation (1), but this appears to be related to the local sales orientation of Indonesian subsidiaries and stricter local content requirements. The Indonesia dummy becomes insignificant if the models include separate (and higher) estimates for local sales orientation and local content rules in the ASEAN-4 countries and China.

Nor does the industry of the subsidiary exert a strong independent influence on the local content ratio. The coefficients for TELCOMP, PARTS, and OTHERIND are negatively signed, indicating that subsidiaries producing consumer goods tend to have higher local content, but the coefficients are not significant.

We conclude that the results generally confirm our hypotheses concerning the effects of parent firm and subsidiary characteristics on local content. Almost all coefficients have the predicted signs and reach conventional significance levels in most equations; for subsidiary-specific local content regulations and local sales orientation this only applies to the ASEAN-4 countries and China. The only unexpected result is the lack of geographic differentiation in the effects of R&D intensity and *keiretsu* intensity.

1.4.2 Country Variable Model

Table 1.5 shows the estimated coefficients of equations (6) through (10), which include host country variables. A general observation is that the estimated effects for most parent and subsidiary variables do not differ markedly from the estimates of the country dummy model. R&DINT and EXPER remain significant, ACQUIS is significant at the 10 percent level in all equations, and REGUSUB (eqs. [7], [9], and [10]) and LOCSALES (eqs. [9] and [10]) remain positive and significant for the ASEAN-4 countries and China.

The results for the host country variables are generally less unambiguous. In equation (6), the size of the host country's electronic parts industry, SUPPLIERS, has the expected positive sign but is far from significant. SUPPLIERS does affect local procurement conditional on good quality of host country infrastructure: SUPPLIERS * INFRA becomes significant in equation (7).

In equation (8), the country-specific indicator of local content regulations and import restrictions, REGULATION, is substituted for REGUSUB. In addition, the cross-effect of REGULATION and LOCSALES is included. REGULATION has the expected positive sign but is insignificant, while its cross-effect with LOCSALES is insignificant with the wrong (negative) sign.[11] Taken together with the results for REGUSUB, this suggests that local content regulations vary considerably between foreign subsidiaries in a country and have a greater impact on the procurement behavior of specific subsidiaries (presumably those that apply for some form of favorable investment status) rather than affecting local content of all investors.

In equation (9), the indicator for the presence of Japanese suppliers,

11. Nor does REGULATION reach significance if the cross-effect with LOCSALES is excluded.

Table 1.5 **Determinants of Local Content Ratios of Asian Subsidiaries: Tobit Estimates with Country Variables**

Variable	(6)	(7)	(8)	(9)	(10)
R&DINT	−1.57	−1.66	−1.77	−1.40	−1.49
	(−2.89)***	(−2.84)***	(−3.06)***	(−2.40)**	(−2.56)**
KEIRINT	0.19	0.22	0.20	0.14	
	(3.33)***	(3.84)***	(3.54)***	(2.29)**	
EXPER	0.0009	0.0008	0.0008	0.008	0.0008
	(4.44)***	(4.04)***	(3.79)***	(4.07)***	(4.23)***
ACQUIS	0.29	0.26	0.31	0.24	0.24
	(1.93)*	(1.73)*	(1.91)*	(1.65)	(1.66)*
JV	0.03	0.03	0.03	0.01	0.01
	(0.86)	(0.89)	(0.65)	(0.32)	(0.23)
LOCSALES*NIES	0.07	0.01	0.08	0.01	0.01
	(0.98)	(0.15)	(0.63)	(0.14)	(0.19)
LOCSALES*(1 − NIES)	0.10	0.09	0.20	0.18	0.20
	(1.28)	(1.10)	(1.01)	(1.97)*	(2.14)**
REGUSUB*NIEs	0.00	−0.02		−0.04	−0.03
	(−0.06)	(−0.32)		(−0.54)	(−0.39)
REGUSUB*(1 − NIES)	0.09	0.12		0.13	0.12
	(1.64)	(2.02)**		(2.30)**	(2.10)**
REGULATION			0.02		
			(0.91)		
REGULATION*LOCSALES			−0.03		
			(−0.68)		
SUPPLIERS	0.04				
	(1.33)				
SUPPLIERS*INFRA		0.0033	0.0030	0.0049	0.0037
		(2.29)**	(1.92)*	(3.01)***	(2.08)**
KEIRINT*SUPPLIERS*INFRA					0.004
					(1.58)
JRATIO				0.12	0.15
				(0.51)	(0.65)
KEIRINT*JRATIO					−0.14
					(−0.68)
TELCOMP	−0.08	−0.10	−0.08	−0.08	−0.09
	(−1.07)	(−1.33)	(−1.04)	(−1.01)	(−1.14)
PARTS	−0.03	−0.04	−0.03	−0.02	−0.02
	(−0.74)	(−0.91)	(−0.78)	(−0.54)	(−0.61)
OTHERIND	0.03	0.03	0.02	0.03	0.04
	(0.36)	(0.37)	(0.26)	(0.28)	(0.41)
Constant	0.19	0.29	0.27	0.09	0.14
	(0.83)	(2.73)***	(1.65)	(0.37)	(0.60)
N [censored]	140 [4]	133 [4]	133 [4]	128 [2]	128 [2]
Log likelihood	18.90	19.79	18.14	26.31	27.24
χ^2	44.30	46.59	43.28	47.44	49.31

Note: Numbers in parentheses are *t*-values.

*Significant at the 1 percent level.

**Significant at the 5 percent level.

***Significant at the 10 percent level.

JRATIO, is introduced. It has the expected positive sign but is not significant. Nor does the inclusion of cross-effects of KEIRINT with SUPPLIERS and JRATIO in equation (10) give significant effects.[12] In light of the strong positive effect of the KEIRINT variable, these results are puzzling. Given the higher switching costs for firms with intensive intra-*keiretsu* supplier relationships, we expected the positive effect of KEIRINT to work through the replication of *keiretsu* supplier networks abroad. We can think of a number of reasons why the results do not bring this out. First, the variable JRATIO may not be an accurate proxy for the strength of the local Japanese supply base. JRATIO is derived from MITI survey data with a limited response rate, and response rates may differ by country. Furthermore, JRATIO measures sales of responding component subsidiaries and hence includes exports, while export-oriented subsidiaries may not have been set up to supply local manufacturers. We are not able at this point to remedy these potential problems. Second, we may not be able to estimate country variable effects precisely enough because the number of countries (seven) in our country variable model is small. Third, in theory we should include an indicator for the local presence of suppliers *within the same keiretsu* instead of a proxy for the presence of Japanese suppliers overall. These issues need further attention in future research.

1.4.3 Further Tests

We performed a number of other tests, the results of which are not shown. These do merit some discussion. We also hypothesized that the characteristics of the local market may have an impact on the local content of manufacturing operations. The more sophisticated the demand for electronic goods, the more firms will be inclined to adapt and redesign products for the local market, which may also involve a switch to higher value-added components produced locally. We used as a measure of demand sophistication, MARKET, the value of electronics sales in the country in 1992 (taken from Elsevier 1995) per capita. Market sophistication may moderate the effect of LOCSALES: the more sophisticated market demand, the more the market resembles the major export markets (the European Union, the United States, and Japan) and the smaller the effect of differences in local versus export sales strategy. The cross-effect of LOCSALES and MARKET had the expected negative sign but was not significant.

Another test involved adding a dummy variable that takes the value one if the investing firm is a core firm in the vertical *keiretsu*. The results did not support the hypothesis that core firms behave differently from member firms. Another consideration was that in the country dummy model, the strict regulations in China linking export and import requirements could

12. Including KEIRINT itself in eq. (10) does not change these results.

bias the effect of LOCSALES: the regulations are likely to increase the effect of LOCSALES on the local content ratio, compared with other Asian countries. We included a cross-effect of the China dummy with LOCSALES. The coefficient was positive, as expected, but not significant.

We tested whether we could find evidence that transfer-pricing issues are affecting reported local content ratios. Affiliates located in host countries with higher tax rates may have an incentive to engage in transfer pricing and report a higher value of imports from the parent firm (and hence a lower local content ratio). We calculated host countries' effective tax rates by taking the pretax current profit minus after-tax current profit divided by pretax current profit for all Japanese subsidiaries reporting in the 1992 MITI survey.[13] We included this effective tax rate as an explanatory variable in an attempt to control for the effects of transfer pricing. The variable had a counterintuitive positive sign but was not significant, while the other coefficients remained unchanged.

A last test involved substituting the local procurement ratio (local procurement divided by total procurement) for the local content ratio as the dependent variable in the model. The estimated effects were very similar to those in the local content ratio models. The one important difference was that the country-specific measure of local content rules, REGULATION, did reach conventional significance levels in the model of equation (8). We took this result as further confirmation that local content rules in Asia have an impact on vertical linkages.

1.5 Conclusions

We examined the determinants of the vertical linkages, that is, the local content (intrasubsidiary value added and procurement of inputs from locally established suppliers), of 157 Asian subsidiaries of Japanese multinational firms in the electronics industry in 1992. Consistent with our theoretical considerations, we found that a number of characteristics, both at the parent firm level and at the subsidiary level, affect subsidiaries' local content ratios. Operating experience has a positive effect on the local content ratio. As subsidiaries gain operating experience in the local economy, they are able to deepen their vertical linkages. This result is consistent with the notion that the alleged lack of vertical linkages of Japanese multinational firms is the result of a "vintage effect": the relatively late internationalization of Japanese firms. However, the magnitude of the estimated experience effect is too small to take these results as more than a partial confirmation of the vintage effect explanation. The results indicate that

13. This gave us the following rates: Hong Kong, 0.138; Korea, 0.348; Singapore, 0.192; Taiwan, 0.207; Indonesia, 0.286; Malaysia, 0.112; Thailand, 0.369; Philippines, 0.217; and China, 0.065.

acquired subsidiaries are more integrated into the local economy and have higher local content ratios than greenfield subsidiaries. Subsidiaries of R&D-intensive parents rely more strongly on imports of (nonstandardized) components designed by the parent and have lower local content ratios. Subsidiaries located in the ASEAN-4 countries and China that sell a high percentage of manufactured output on the host market reach higher local content levels than export-oriented subsidiaries. A local market orientation is likely to be associated with the use of mature and standardized low-cost components procured from locally established suppliers, whereas an orientation toward sophisticated export markets is associated with technology-intensive components that are not typically available locally.

Membership of the parent firm in a vertical *keiretsu* with intensive supplier-assembler relationships has a robust positive impact on local content. We ascribed this to the ability of *keiretsu* members to stimulate the creation of a network of *keiretsu* component and parts manufacturers in host economies, which helps them to achieve higher local content levels. Apparently, this effect offsets a possible negative effect of *keiretsu* relationships on local content that may be due to the higher costs involved when switching to overseas suppliers outside the *keiretsu*. However, we could not establish with the data available that *keiretsu* firms reach higher local content in countries with a greater presence of Japanese suppliers.

Host country local content regulations have a positive and significant effect if measured at the subsidiary level but not if a more general measure is used at the country level. This finding is consistent with the observation that although there are few formal local content rules in Asian countries, preferential investment status programs give governments the discretionary power to demand changes in procurement behavior on a case by case basis. It should be noted, though, that the finding that local content requirements have been capable of changing procurement behavior does not tell us whether the benefits of these policies have outweighed their costs. Achievement of local content targets comes at the price of tax relief or investment subsidies, and perhaps more important, there is evidence that local content requirements reduce the total volume of foreign investment (Hackett and Srinivasan 1998).

In general, our attempt to establish the effects of host country characteristics on local content was less successful, which may be due to the limited number of countries represented in our sample. We did find that the size of the host country electronic parts and component manufacturing sector combined with the availability of good local infrastructure raises the local content of Japanese subsidiaries.

This study is a first attempt to shed some light on the determinants of vertical linkages by Japanese firms. In order to allow a better assessment of vertical linkages and potential spillovers to the local economy as well

as the role of *keiretsu* supplier linkages, it may be necessary in future research to distinguish between local procurement from Japanese subsidiaries and local procurement from locally owned suppliers.[14] In addition, the effect of overseas supplier networks of vertical *keiretsu* should be analyzed directly by measuring the size of these networks for each *keiretsu* in each country. We are planning to examine these networks by combining the available information on *keiretsu* membership with databases on overseas subsidiaries. We expect that this approach will provide us with more robust evidence concerning the interaction of *keiretsu* linkages, local supply infrastructure, and local content. We are also planning to remedy the limited variation in host country characteristics by extending the study to more countries and, possibly, by adding data on local content and host country variables in 1995. An extension to 1995 is of interest because evidence exists that local procurement in Asia increased between 1992 and 1995 (MITI 1998a).

Another avenue for further research is to change the focus from the host country level to the regional level. In order to gain insight into the role of "regional core networks" in East Asia and their importance in Asian trade and industrial development, a perspective is needed that takes into account procurements from other Asian countries (excluding Japan). As can be seen from table 1.2, procurements from other Asian countries are not unimportant.

Japanese subsidiaries appear to have been quick to adjust to changing economic conditions after the Asian economic crisis in the summer of 1997. According to a recent MITI survey, Japan's manufacturing subsidiaries in the ASEAN-4 countries reduced their investment in tangible fixed assets by 21 percent and increased their exports to Japan by 11 percent from the last quarter of 1996 to the last quarter of 1997 (yen-based figures; MITI 1998b). Such changes are bound to have a substantial impact on procurement behavior. There are some indications that the increased cost of imported components due to the depreciation of Asian currencies has spurred firms to increase local procurement.[15] More insight concerning the procurement strategies of Japanese firms may be obtained by investigating changes in vertical linkages throughout the 1990s. We hope to be able to contribute to research in this area in the future.

14. It may be possible to study such local linkages in the future because MITI is planning to introduce such a distinction in the 1999 survey.

15. E.g., Hitachi Consumer Products in Thailand reportedly plans to raise the local content of its washing machine manufacturing operations from 43 percent (in early 1998) to 85 percent within a year. See "Local Procurement Up in Southeast Asia," *Nikkei Weekly*, 27 July 1998.

Appendix

Data Sources, Selection, and Description of Variables

Data Selection

Our data on local procurement and intrasubsidiary value added of overseas manufacturing subsidiaries of Japanese electronics firms are taken from MITI's fifth *Basic Survey on Foreign Direct Investment* (MITI 1994) and concern fiscal year 1992 (the year ending 31 March 1993). This MITI survey includes a total of 314 subsidiaries in East Asia. For a relatively large number of subsidiaries, the information on local procurement and procurement by region of origin was incomplete, and a first screening reduced the number of observations to 203. We further eliminated subsidiaries with fewer than ten employees and a few cases in which the data were unreliable (e.g., the value of total procurement exceeded that of total sales). This diminished the number of observations by 15, and we ended up with reliable information for a sample of 188 firms.

We matched these data with information on parent firms using fiscal year 1992 financial data from published financial reports (MOF 1993) for firms listed on the Tokyo Stock Exchange and Toyo Keizai's *Nihon no Kigyou Guruupu* (for *keiretsu* membership). We could not establish the parent firms of all Asian subsidiaries, and R&D and *keiretsu* information on parents was not available for all subsidiaries. This reduced the number of observations to 157 in the basic country dummy model and further, to 140, in models that included the *keiretsu* variable. The data on host country characteristics from Business International do not include information on China, which further reduced the sample to 133 in the country variable model, and the presence of Japanese suppliers could not be established for 5 more observations, reducing the number of observations to 128.

Variable Definitions

Table 1A.1 provides the definitions of the variables and the data sources.

Table 1A.1 **Variable Definitions and Data Sources**

Variable	Definition	Source
LOCON	Local content ratio: (total sales − total imports) / (total sales − imports of finished goods)	1
R&DINT	Parent firm R&D ratio: parent firm R&D expenditure / total sales	1, 5
KEIRINT	Intensity of supplier-assembler relationships within the vertical *keiretsu* in Japan; paid-in capital of the core *keiretsu* firm's manufacturing-related companies in Japan / paid-in capital of the core *keiretsu* firm. Core firms have at least 250 billion yen in sales.	2
Entry mode		1
Omitted dummy	Greenfield and 100% Japanese equity share (reference case)	
ACQUIS	Acquisition (100% Japanese equity share) of existing firm	
JV	Joint venture	
Industry dummies		1
Omitted dummy	Consumer goods	
TELCOMP	Telecommunications and computers	
PARTS	Electronic parts	
OTHERIND	Other electronic devices	
EXPER	Operating experience: number of months of production since start of operations until March 1993	1
REGUSUB	Subsidiary-specific local content requirements: dummy variable that takes value 1 if subsidiary reports that it faced such requirements	1
LOCSALES	Local sales ratio: sales in host country / total sales	1
SUPPLIERS	Size of local supply industry of electronic parts and components: natural log of host country's production of electronic parts	3
JRATIO	Presence of Japanese-owned suppliers in the local supply industry: natural log of total sales by Japanese subsidiaries manufacturing electronic parts / natural log of total production of host country electronic parts industry	1, 3
INFRA	Quality of infrastructure: indicated on a 0–10 range	4
REGULATION	Strictness of local content requirements and restrictions on component and material imports: indicated on a 0–10 range, where 0 means no regulation, 10 strict regulation	4

Sources: (1) MITI (1994). (2) Toyo Keizai Shinpousha, *Nihon no Kigyou Guruupu* (Japanese corporate groups; Tokyo, 1990). (3) Elsevier (1995). (4) Business International (1989). (5) MOF (1993).

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Comment Toshihiko Hayashi

FDI is expected to be an important vehicle by which technology and know-how are transmitted from a home country to a host country. The transmission mechanism is commonly called spillover, perhaps borrowing from the similar concept well established in the local public finance literature. Belderbos, Capannelli, and Fukao (BCF) are interested in how the extent to which such spillover takes place varies among individual subsidiaries and what factors determine the scope of spillovers. BCF are also concerned with how Japanese FDI fares in Asia in this regard because it is often observed that Japanese subsidiaries in Asia are less likely to generate spillovers to local economies than are subsidiaries from other home countries.

Two contrasting hypotheses have been advanced to account for the alleged lack of enthusiasm for linkages in Japanese subsidiaries: the idiosyncrasy hypothesis and the vintage hypothesis. The idiosyncrasy hypothesis says that idiosyncratic behavior on the part of Japanese multinational corporations—reflecting *keiretsu*-oriented or inward-looking attitudes—leads to less interaction with local industrial communities in the host country, and thus less spillover. The vintage hypothesis says, to the contrary, that the idiosyncrasies are only temporary. The basic reason for less involvement by Japanese subsidiaries is simply that they are relatively new to the host country and hence less experienced. As vintage develops Japanese subsidiaries will gain experience in dealing with the local business community and workforce, deepening vertical linkages and increasing spillovers.

In my view, BCF's study reported here is no doubt an important contribution to this debate, although other facets of their findings merit no less recognition. Making use of the data set *Basic Survey on Foreign Direct Investment,* published by MITI in 1994, BCF try to decipher the relation between the local content ratio of Japanese electronics manufacturing subsidiaries and the characteristics of the parent company as well as the subsidiaries themselves. Through their methodologically sound and laborious work, several interesting findings emerge.

BCF Findings

BCF define local content to include "both the value added of manufacturing (in-house production of components) and the value of components

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and materials sourced from local (Japanese and third party owned, as well as locally owned) suppliers." They take this measure of local content and divide it by total sales of the subsidiary to get the local content ratio. By means of a Tobit model with the local content ratio as dependent variable and R&D intensity, intensity of supplier-assembler relationships (*keiretsu*), vintage, and other factors as explanatory variables, BCF obtain some very interesting results. Three of the most interesting findings are as follows:

1. Their prior conjecture that the parent firm's R&D intensity negatively affects the local content ratio is empirically verified. Their results give support to the view that "R&D-intensive firms make greater use of nonstandardized and technology-intensive components, often developed and produced by the firm in Japan."
2. *Keiretsu* intensity has a positive sign and is highly significant in their estimates, suggesting that "*keiretsu* linkages have a major impact on vertical integration and local procurement." BCF ascribe this finding to the "ability of *keiretsu* members to stimulate the creation of a network of *keiretsu* component and parts manufacturers in host economies, which helps them to achieve higher local content levels."
3. Operating experience has a positive effect on the local content ratio. From this BCF confirm, albeit cautiously, that the vintage effect is the cause of the alleged lack of vertical linkage of Japanese multinational firms.

Suggested Research Agenda

Though BCF's findings are extremely interesting by themselves, I would learn more if they followed up their analyses along the lines suggested below.

In the course of their analyses BCF carefully distinguish the factors that affect the parent firm side and those that affect the subsidiary side. However, their final estimation is based on a kind of reduced-form model. It would help me understand the nature of the problem better if they presented a structural form model and obtained estimates for structural coefficients.

If BCF had shifted from econometrics to case studies to substantiate their analyses, they would have encountered a richer reality. For example, they make use of the ratings given by U.S. multinational firms provided by Business International to proxy an explanatory variable, REGULATION. Though it may tell us something about the country-wise degree of freedom to invest, the index seems to provide only tangential information if any to the parent firm contemplating FDI. It seems to be often the case that for Japanese firms searching for investment opportunities, the choice is between Dalian and Shanghai rather than between China and India. And if the chosen location is Dalian, should it be downtown Dalian or the Economic and Technological Development Zone in the suburbs?

Policy Implication

This leads me to the question BCF pose at the outset. They seem to be concerned with the spillover effects that FDI is expected to bring to the host country. However, their study concentrates on the degree of local content of foreign subsidiaries, based on the hypothesis that higher local content will be correlated with greater spillover effects.

It goes without saying that the degree of vertical linkage is an important piece of information. However, from a policy perspective, it would be just as important to know whether spillovers are taking place in the market. The question is whether spillovers are a case of pecuniary externalities or a case of technical externalities.

If vertical linkages create increased demand for local products and labor, which induces or encourages productivity-enhancing measures in indigenous industry, the host country government would have to be concerned with the amount of higher linkage FDI and little else.

However, if spillovers are more technical in nature, such as foreign subsidiaries acting as role models, demonstration effects, or increased opportunities for local spinoffs, the presence and the magnitude of FDI itself would be important. In that case it may be necessary for the host country government to encourage or give additional incentives to foreign firms with greater or lesser degrees of linkage to invest in the host country. Also, the role of Japanese electronics manufacturing subsidiaries in Asia would have to be evaluated in this context as well.

Comment Lee Branstetter

I found this to be an extremely interesting, original, and ambitious paper. Belderbos, Capannelli, and Fukao, individually and together, have been among the most important and prolific contributors to the burgeoning literature on the economic analysis of Japanese FDI at the micro level. This paper is an important addition to that record of research, and I believe that the research agenda that grows out of this paper will yield many interesting results. I should also note that I am quite envious of the wealth of data to which these authors have been allowed access.

The authors begin by noting that economists have little systematic evidence on the determinants of local sourcing activity by multinational firms. The authors utilize unusually rich data collected by the Japanese General Management and Coordination Agency that is rarely provided to outside researchers. This data set includes information at the subsidiary

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level on local sourcing and other variables, information on parent firms, and information on *keiretsu* linkages among parent firms and their affiliates. The authors then analyze the determinants of local sourcing at the micro level, using Tobit regression techniques. They find some results consistent with their initial predictions. I found the empirical work in the paper to have been well executed, and I do not question the results. Therefore, I will actually concentrate most of my initial remarks not on the body of the paper but on the motivation outlined in the first few pages.

One important element of that motivation can be summarized as follows. A primary benefit of FDI is technology spillover or technology transfer from the multinational firm to host country enterprises. However, the amount of technology spillover that actually accrues to the host country may depend in part on the "embeddedness" of Japanese subsidiaries in Asia. Therefore, in order to get a sense of the long-term benefits of Japanese FDI for the host countries, one needs to look at this embeddedness, as measured by the local sourcing activity of Japanese affiliates at the subsidiary level. These views are not unique to these authors. In fact, similar views color much of the current debate among policymakers concerning the costs and benefits of FDI in developing countries. The authors also contend that even if the link between embeddedness and technology transfer is not so strong or direct, the economics of local procurement are an interesting and important topic.

I think that technology spillovers and technology transfer are fascinating and important phenomena. My own contribution to this volume, chapter 4, examines the role Japanese FDI may have played in fostering R&D spillovers between Japan and the United States. However, "traditional" international economic analysis emphasizes other benefits of FDI, which have little to do, at least directly, with technology or embeddedness. Viewed through that analytical lens, the chief benefit of FDI is the same as the chief benefit of trade: namely, the ability to obtain goods (or factor services) at lower opportunity cost than that available under autarky.[1] The additional benefit from FDI over trade is that a capital-scarce country can obtain the factor services of capital directly (and more cheaply) even when the indirect trade of factor services through trade in goods may be limited or may fail to achieve factor price equalization.[2] With a free trade and investment regime, the resource cost of a given basket of consumption goods is likely to decline substantially, and the saved resources can be reallocated to other sectors in which their marginal product is higher.

1. Helpman and Krugman (1985) presented this sort of model in a useful form.

2. To be more precise, one can construct an equilibrium in which trade in goods alone fails to bring about factor price equalization. However, allowing for FDI pushes the global economy toward factor price equalization, allowing the capital-scarce country access to the factor services of capital at the new world price, which would be lower than the price available under autarky *or* free trade without FDI. If there is some natural or artificial barrier to trade in goods, then the role of FDI in the model could become even more pivotal.

These are, if you will, the direct benefits of FDI. These benefits are likely to be substantial. Furthermore, these benefits do not depend on embeddedness, as the authors have acknowledged. In fact, embeddedness could impede this kind of benefit. Let us consider the following example. Imagine that a Japanese auto producer decides to establish a manufacturing subsidiary within a certain country. Let us further imagine that this producer is "forced" to source parts and services from local firms, due to restrictive local content requirements. Now, these restrictions are designed to raise the embeddedness of the Japanese firm. However, these restrictions, by forcing the Japanese firm to rely on high-cost, inefficient domestic producers, could actually raise the price and lower the quantity (and quality) of the final good sold by the Japanese firm in the domestic market. Attempts to increase embeddedness could actually reduce the welfare of the host country. This speaks to the "less benign view" of Japanese FDI mentioned by the authors. I am concerned that Japanese firms in Asia may be unfairly criticized for an insufficient level of embeddedness, and the response to this criticism could very well be something that winds up making the host country worse off rather than better off.[3]

Even if we were to focus solely on the benefits brought by FDI through improved levels of productivity in the host country industry, these can arise through multiple channels, as the authors have acknowledged. One potential channel is, of course, technology transfer to local firms in the host country through the sorts of supply chain relationships stressed in this paper. However, it is also true that simply through their presence in the host country market, Japanese affiliates can bring about improved productivity in the host country at the industry and firm level by raising the level of competitive pressure on domestic incumbents. The least efficient local firms are forced out of the market, and the more efficient local firms are forced to become yet more efficient in order to withstand the competitive pressure of the foreign affiliates. This competition improves resource allocation within the host country industry and raises the level of productivity, even if supply relationships with domestic firms are completely absent.[4]

Having pointed out that important benefits from FDI will accrue to the host country even in the absence of local sourcing, we can also question the extent to which foreign affiliates can be expected to function as channels of technology spillover or technology transfer. This is something the authors acknowledge, but it is also a point worth reemphasizing. Using microlevel data and careful econometric analysis, Haddad and Harrison

3. I do not mean to imply here that the linkages between multinationals and domestic firms are unimportant. For a theoretical treatment that formalizes the concept of "linkages" and highlights their potential importance, see Rodríguez-Clare (1996).

4. This point has been raised by a number of other researchers, including Richard Caves (1974).

(1993) and Aitken and Harrison (1999) found *no* evidence that the presence of foreign affiliates accelerated the productivity growth of domestic firms in Morocco and Venezuela. In fact, the latter paper found a negative effect of the presence of foreign affiliates on domestic firm productivity in Venezuela. This seems to at least call into question the view that technology transfer or spillover is an important or inevitable consequence of multinational activity in the host country industry.

In a similar fashion, we might also question whether technology spillovers are proportional to the density of commercial transactions, as the authors suggest. To illustrate this point, let me use a trivial example. I purchase much more from my physician, my landlord, and my mechanic than I do from other economists. Yet I receive relatively little in the way of "knowledge spillovers" or technology transfer from these transactions. On the other hand, I purchase very little from my fellow economists, yet I learn a great deal from reading their papers and interacting with them at conferences. Now let me note a more substantive example, which the authors also mention. Chung, Mitchell, and Yeung (1996) investigated the impact of Japanese FDI in the U.S. auto component industry using plant-level data. They found that the increased Japanese FDI in this industry after 1985 was associated with increased productivity growth. However, the productivity of U.S. component plants supplying Japanese assembly plants grew *more slowly* than that of firms with no ties to the Japanese plants. Here embeddedness actually apparently retarded the technological development of plants with closer supply relationships. Chung et al. concluded that the positive impact on productivity identified in the data was due to competitive pressure from Japanese entrants rather than technology transfer mediated through supply relationships.

Now let us turn briefly to the definition of the dependent variable. The numerator of the authors' measure of local sourcing, LOCON, is simply the value of subsidiary sales minus the value of imported parts and components. This measure does not distinguish between the subsidiaries' own production and the sourcing of parts to local (i.e., host country owned) firms, as the authors freely acknowledge. My own concern is that this measure could differ between countries for reasons that have little or nothing to do with "sourcing strategy." For instance, let us say that Japanese affiliates in one host country experience a surge in overall domestic demand that drives up demand for the output of the affiliates in that country. This increase in demand could be met partly by an increase in price (and profits). This leads to a larger measured level of local sourcing in this country even though the local sourcing strategy has not changed. In contrast, let us suppose that the currency of a second host country depreciates with respect to the Japanese yen. This means that the value of imported components relative to the local currency value of sales will be higher, and the measured level of local sourcing correspondingly lower, than was the

case before the currency fluctuation. However, the sourcing strategy has not changed.[5] In more general terms, the authors' inference is limited by sample size and by the use of a single cross section.

However, it is clear that this data source and the authors' basic approach could yield substantial insights with data from more than one year. This would allow for the use of panel data techniques. The authors could focus on differences in behavior of a given affiliate over time, allowing for a more precise identification of the kind of relations the authors are seeking to examine. The authors also suggest that their data could provide some insight into the development of the East Asian financial and economic crisis, and I heartily agree. It is probably obvious to every participant in this conference that the speed with which that crisis is resolved and its ultimate human and financial cost will depend in a vital way on the response of the Japanese firms operating in these countries. The authors' data and approach are tailor-made for examining the evolution of this response across industries and countries. Such an examination could provide crucial information for policymakers and academics alike, and I hope that the authors are able to proceed in this direction as soon as possible.

Again, I feel that this is an interesting and important paper. I look forward to future work by the authors along these lines.

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5. I should note that these criticisms are not so important in the present paper. The problems I raise in this paragraph are presumably taken care of in those regressions in which the authors use country-specific fixed effects, since they only have a single cross section. In the context of a panel data set, these concerns could be dealt with by including data on host country wages, demand shocks, and exchange rate fluctuations.