Foreign Investment and International Plant Configuration: Whither the Product Cycle?*

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ABSTRACT

We analyze the determinants of the decision to invest abroad in particular configurations of overseas plants for 120 Japanese firms active in 36 well-defined electronic product markets. We find support for a structured internationalization decision model in which the decision to produce abroad and the choice for a specific international plant configuration appear nested strategic options. Drivers at the industry and firm level push firms to consider overseas investment, and regional characteristics pull firms towards particular plant configurations. The product cycle still appears as an important force pushing firms to set up Asia-focused or global plant configurations. In contrast, plant configurations focused on the US and the EU are a result of restrictive trade policies and offensive market access considerations vital to non-dominant but technology intensive firms in competitive global industries.

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1. INTRODUCTION

Since the mid-1980s it has been argued that the increasingly global character of competition in industries is pushing multinational firms to configure and coordinate manufacturing activities on a global basis. Leading scholars such as Porter (1986), Ohmae (1985), and Bartlett and Ghoshal (1987) saw an emerging trend towards networks of decentralized but interdependent plants. Decentralization was seen as a necessity because of strong swings in exchange rates, rising protectionism and a growing need to respond quickly to changing and differentiated consumer demands. Global coordination allows firms to benefit from major scale and scope economies associated with shortened product life cycles and increasing development costs. A presence in major markets allows firms to reduce the lag between the introduction of new and improved products between the home and foreign markets, necessary to increase revenues within a shorter time frame.

A number of these concepts have been analyzed more formally in recent work. Kogut and Kulatilaka (1994) show that real option theory can put a value on the operational flexibility gained through operating a global manufacturing network with establishments in different currency areas. Kalish, Mahajan and Muller (1995) develop a diffusion model of international product introduction decisions to analyze under which circumstances a 'sprinkler' strategy, which involves the simultaneous introduction of the product in various markets at the same time, is preferred over a 'waterfall' strategy of lagged introduction in distant markets. They find that a 'sprinkler' strategy is more likely to be preferred in case of short product life cycles, large and growing foreign markets, and strong foreign competition.

These theories and concepts contrast markedly with the traditional product cycle concept of internationalization of production developed by Vernon (1979). Product cycle theory predicts that new products are first introduced and produced in the home market in a 'waterfall' fashion. Foreign investment in overseas production follows with a lag, when process and product technologies have been established and matured and when reduced margins due to increased competition pushes firms to search for low-cost locations. It has been argued that the developments in the global industry environment from the second half of the 1980s have made the product cycle irrelevant (e.g. MacCormack et al 1997; Bell 1995, McDougal, Shane and Oviatt, 1994). However, to date this critique has not been accompanied by systematic

empirical tests whether the product cycle has indeed lost its power in explaining foreign investment decisions.[1] This is surprising because the international plant configuration chosen by a firm is a key factor in its internationalization strategy with important repercussions for performance (Porter, 1986; Morrison and Roth ;1992,Yip, 1995).

In this paper we attempt to fill this gap through a systematic analysis of the role of the product cycle in the determination of global manufacturing investment. We adopt a theoretical framework in which the product life cycle is embedded in a more general conceptual model that encompasses other relevant theoretical approaches to foreign direct investment, including internalization theory, resource based theory and the theory of oligopolistic reaction. Empirically, we analyze the decisions to invest abroad and the choice for global or regionally focused international plant configurations by 120 Japanese firms active in 36 narrowly defined product markets. We constructed a disaggregated database with detailed data on plant locations, market shares, product maturity, and regional market size, among others. This disaggregated level of analysis ensures that we model investment and plant configuration decisions where they are taken: at the business unit level. It enables us to test simultaneously for the effect of product maturity, firm-level competitiveness and product-level competition, and region- and product-specific characteristics such as protectionism and market size. The focus on Japanese industry is of interest since Japanese firms' export strategies in the 1970s and early 1980s made them a specific target of protectionist policies in the US and Europe. This coupled with their 'focus' strategies on serving various developed markets with relatively undifferentiated but high quality products made them early adopters of global manufacturing strategies (Ohmae, 1985; Bartlett and Ghoshal, 2000). At the same time, however, it has been argued that patterns of Japanese foreign direct investment patterns closely follow product cycle theory (Ozawa, 1991; Thomsen, 1993).

Our disaggregated analysis extends earlier work on (Japanese) foreign investments that has either focused on the firm or the industry level (e.g. Belderbos and Sleuwaegen, 1996; Kogut and Chang, 1991; Drake and Caves, 1991,), or has limited analysis to investments in a single region or country (e.g. Hennart and Park, 1994; Kogut and Chang, 1996; Chang, 1995; Pugel,

[1] The evidence to date has consisted of cases studies or descriptive tests of consistency with trade and foreign investment data (e.g. Dubois et al 1993; Ozawa, 1991).

Kragas and Kimura, 1996). It shares features of previous studies of plant location decisions (e.g. Mayer and Muchielli, 1999; Head, Ries and Swenson, 1995; Devereux and Griffith, 1998) but broadens the scope of analysis from location decisions for plants within a given region to decisions on global plant configurations.

The remainder of this paper is organized as follows. The next section describes the theoretical framework of the model of foreign investment and international plant configuration decisions. Section 3 develops hypotheses concerning the major push and pull factor driving these decisions. Section 4 describes the empirical methodology and the dataset. Empirical results are presented in Section 5 and Section 6 discusses the findings and offers concluding remarks.

2. FOREIGN INVESTMENT AND INTERNATIONAL PLANT CONFIGURATION: A STRUCTURAL DECISION MODEL

The theoretical framework we propose embeds the working of the product life cycle in a more general conceptual model that draws on other theoretical approaches; including internalization theory (Caves, 1996; Buckley and Casson, 1976; Hennart 1982), resource based theory (e.g. Collis, 1991), oligopolistic reaction theory (Knickerbocker, 1973) and the stage theory of internationalization (Johanson and Vahlne, 1977, 1990). Essentially, the proposed model considers the decision to internationalize and choose for a particular spatial configuration of production as the result of a decision making process responding to various internal and external push and pull factors (Root, 1987; Anderson, 1994; Yip, 1995; Bartlett and Ghoshal, 2000). Drivers related to firm resources and competitiveness, domestic rivalry, and the product cycle push firms to expand abroad, while a set of locational factors pull firms to invest in specific foreign markets.

The resource-based theory of the multinational firm emphasizes the application of underutilized productive resources to new businesses opportunities abroad. Intangible resources, such as technology and marketing skills, which can be exploited without substantial extra costs in new markets, encourage firms to diversify into new businesses abroad (Caves, 1971; Wolf, 1977; Chang, 1995; Delios and Beamish, 1999) while successful deployment of resources abroad is based on a strong international competitive position for the

products concerned (Chang, 1995). Internalization theory sees the foreign investment decision as the result of high transaction cost associated with the sale or rent of technological know how (Hennart, 1992), while in the evolutionary view of the multinational firm it is the relative efficiency of the firm in transferring and exploiting proprietary know how in diverse markets that explains successful multinational investment (Kogut and Zander, 1993). The theory of oligopolistic rivalry in foreign investment developed and tested by Knickerbocker (1973) argues that firms may also be pushed to engage in foreign investment earlier depending on the oligopolistic structure of the home market. Firms in loose-knit oligopolies follow their rivals in making matching reinvestments overseas to prevent them from building up competitive advantages from their foreign presence (e.g. Yu and Ito 1988).

The product cycle has linked the internationalization process to the innovation and successful introduction of new products. Initial production takes place near the point of innovation because of communication costs within the innovating enterprise and uncertainty about the production process in the early stage (Vernon, 1966; 1974). Following diffusion and standardization of the product in the domestic market, firms are driven to exploit foreign markets. This is done at first by means of exporting, followed by the establishment of plants in growing foreign markets, and finally the relocation of production of the mature product in low-cost countries. The transfer of technological and organizational knowledge is facilitated by a reduced tacitness and complexity as the technology matures, reducing the cost of the transfer (Teece, 1977; Martin and Salomon, 2000; Kogut and Zander 1993). The stage theory of internationalization suggests a similar sequential pattern in the process of internationalization. It emphasizes the role of knowledge about foreign markets in determining the direction of internationalization and the commitments firms make in foreign markets (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977, 1990; Fina and Rugman, 1996). Knowledge of foreign markets obtained through exporting facilitates subsequent production abroad, while experience with the process of transferring manufacturing activities abroad reduces the risk and costs of subsequent foreign investments. The role of exporting and overseas manufacturing experience in facilitating foreign investments has been supported by a number of empirical studies (Davidson, 1980; Chang, 1995; Belderbos 1997a; Martin and Salomon, 2000).

The foregoing arguments imply that the decision to invest abroad depend on competitive resources of the firm and its international experience and respond to the particular industry

environment such as the degree of rivalry and the stage of the product cycle. These are firm- and industry-specific factors pushing firms to consider foreign investment. Given the forces pushing firms to decide to establish foreign manufacturing operations, the firm has to decide on a specific plant configuration. This decision is affected by a number of external pull factors favoring specific plant configurations. The main factors distinguished in the literature on (the location of) foreign direct investment are advantages of lower labor cost, the advantages of locating close to a large market, and the need to overcome the various kinds of trade barriers. The importance of being located close to demand is demonstrated by Krugman (1991). Empirically evidence of the role of local demand and lower labor cost is found in empirical studies of the location decisions by Japanese firms (Head, Ries and Swenson, 1995; Mayer and Muchielli, 1999; Belderbos and Carree, 2000), among others. The pull effect of tariff and non-tariff barriers, such as voluntary export restraints and antidumping duties on inward investment in particular regions has been theoretically analyzed in Smith (1987) and Motta (1992) and empirically demonstrated in Belderbos (1997a) and Pain and Barrell (1999). Besides these locational pull factors, the choice for particular plant configurations is also affected by firm- and industry factors such as heterogeneities in resources, experience, competitive position and product maturity (Collis, 1991; Yip 1995; Dubois et al., 1993). For instance, the firm's possession of market-specific knowledge of a certain region or country favors plant location there (Johanson and Vahlne, 1977, 1990). Firm-specific resources based on technological knowledge are less of a prerequisite to compete in developing countries than in developed markets (Fukao et al., 1994; Belderbos and Sleuwaegen, 1996). Conversely, product maturity and standardization of technologies is more important for the cost-effective transfer of production to developing countries (Vernon, 1974)

Given the complexity of the internationalization and plant configuration decision as described above, a test of the role of the product cycle model requires the formulation of hypotheses that can be falsified (Anderson, 1994). In our research design we implement this by introducing a direct measure of the product cycle effect in terms of the maturity of products, and by developing hypotheses within the framework of a structured decision model. We operationalize the product cycle effect as product maturity while controlling for the degree of international market competition and the size of overseas markets. This way we can test whether the standardization and maturity of technology associated with the stage of the product cycle has an independent impact on foreign investment, apart from growth in competition and foreign markets, which are also central theses in resource based and foreign

direct investment theories. The effect of product maturity is one element in a proposed structured decision model. The analytical framework set out above suggests that in such a model, we have to consider the different working of push factors on the decision to invest abroad as well as the location- (configuration-) specific effects of pull factors. This suggests a distinction between the decision to invest abroad and the plant configuration decision while taking into account that these decisions tend to be taken simultaneously rather than consecutively. The approach taken is to model the decision to invest abroad and the international plant configuration decision appear as a nested set of strategic options available to the firm. In deciding whether to invest in international manufacturing operations, firms take into account the various plant configuration options if the international operations are chosen and the relative profitability of these. The corresponding empirical model is the nested logit model, in which the option value of different plant configuration features as an independent explanatory variable in the internationalization decision. The nested strategic option model is depicted in Figure 1.[2] Firm- and industry specific push variables determine the internationalization decision. Locational pull variables determine the plant configuration decision, but these choices are also affected by a differential of firm- and industry characteristics. The attractiveness of the different plant configurations in turn enters the internationalization decision as an option value and has an independent positive impact on the decision to invest abroad.

INSERT FIGURE 1

We consider three possible international plant configurations for each product:

- Asia-bound configuration (I): Foreign manufacturing investment in Asia only;
- West-bound configuration (II): Foreign manufacturing investment in the US and the EU but not in Asia;
- Global configuration (III): foreign manufacturing investment in all regions.

[2] A similar specification has been used in a plant location model for Japanese firms in the European Union distinguishing countries and regions (Mayer and Ries, 1998) and to analyze the export vs. foreign investment decision and the investment location decisions of US firms (Devereux and Griffith, 1999). The model has the

Manufacturing investments in the US and EU are grouped together because previous research has shown that the determinants of investment are not substantially different between these two regions (Belderbos, 1997a). In contrast, major differences in the relationship between technological and marketing capabilities and investment decisions have been found at the firm level between Asia on the one hand, and Western markets on the other (Belderbos and Sleuwaegen, 1996).[3]

Table 1 shows the distribution of foreign investment and plant configuration decisions across products for our sample of 36 products. The number of Japanese manufacturers per products varies between 6 and 27 and the total number of firm-product combinations is 533. In about half of these cases firms are engaged in foreign investment. Among the different plant configurations, the global configuration is relatively most common (96 cases), but the other two configurations are also well represented (93 cases for the Asia-bound configuration and 84 cases for the West-bound configuration). The table shows systematic differences across products (e.g. with a global configuration dominant in the VTR, CTV, and fax industries) but at the same time instances of substantial variation across firms within an industry (e.g. in the CD player and dot matrix printer industries). Below we develop and test hypotheses concerning the determinants of these differences across products and firms.

INSERT TABLE 1

3. HYPOTHESES

In the empirical model we distinguish between hypotheses concerning firm and industry push factors driving the foreign investment decision (section 3.1) and hypotheses concerning specific pull factors specific to particular plant configurations (section 3.2). Firm and industry characteristics determine the foreign investment decision and may also exert a differential impact on the probability that a specific plant configuration is chosen. Section 3.3. discusses

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advantage that it can be falsified, i.c. it can be tested whether the distinction between internationalization and plant configuration in a valid one. See section 4.

the use of control variables.

3.1 Firm and Industry Push Factors

The Product Cycle

Vernon's product cycle theory [Vernon (1979)] suggests that production technologies are more easily transferred abroad and adapted to local conditions, and foreign locations are more likely to have cost advantages, if technologies and products are mature and relatively standardized. For new products, manufacturing will be more centralized because the fast rate of change in product and process technology requires close coordination with R&D operations and an experienced manufacturing work force. Both are most likely to be available in the home country where the firm is headquartered and where strategic decisions are taken.

Hypothesis 1: Foreign investment is more likely for products that have reached a more advanced stage of their product life cycle.

The product life cycle is also expected to play a role in the choice of international plant configuration. Investments in less developed countries are likely in the more mature stages of the product cycle, while investments in developed markets are predicted to occur in intermediate stages. In the most mature stages of the product cycle, products are more likely to have been diffused and accepted in less developed countries, and the maturity of the technology makes it more readily transferable in a cost effective way to countries with a less developed technological infrastructure and a less skilled workforce (Dicken, 1998). As a product matures, it is therefore less likely that a West-bound configuration is chosen and more likely that firms choose a configuration including production in Asia (a global configuration). In the most mature stages, concentration of production in low-cost location in Asia becomes more likely.

Hypothesis 1: Product maturity has a negative impact on the choice for a West-bound

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[3] The focus on the three main international configurations allows us to keep the number of estimated coefficients manageable. Separating the two developed markets of the EU and the US would introduce 6 more alternative configurations, and increase the number of coefficients (see Table 4) by 102.

configuration, and to a lesser extent a global configuration, as opposed to an Asia-bound configuration.

Firm competitiveness at the product level and positioning in the home market

The theory of the multinational firm suggests that only firms with a competitive advantage based on proprietary assets such as technological strength, brand names, or manufacturing expertise will be able to invest abroad and compete successfully (e.g. Caves, 1996; Dunning, 1993). In order to reduce market transaction costs, the coordination of activities related to the exploitation or generation of the proprietary assets are internalized within the firm through foreign direct investments. The firm's competitiveness in a specific product market appears closely related to its domestic market share (Mitchell, Myles Shaver and Yeung, 1992). Caves (1996: p.58) suggests that the propensity to invest abroad rises monotonously with domestic market share. With a higher market share, further domestic sales increases are more likely to force a competitive response by rival firms, reducing the perceived price elasticity in the domestic market. This reduces the marginal return on domestic expansion relative to the marginal return on expansion to serve overseas markets. Chang (1995) finds that Japanese firms are more likely to engage in foreign investment for product lines in which they possess the strongest competitive advantage and faces the lowest risk of overseas business failure. These investments also have an option value as they can later serve as a platform to expand investment into the firms' less competitive product lines.

Hypothesis 2: The higher a firm's share in the product market in Japan, the more likely that the firm will manufacture the product abroad.

On the other hand, previous studies on foreign investment and export decisions have suggested that domestic market leaders are less likely to expand abroad compared with 'follower' firms with intermediate market shares (e.g. Mascarenhas, 1986; Ito and Pucik, 1993; Hennart and Park, 1994). Given a dominant presence of the market leader(s), follower firms face the strongest constraints on domestic expansion and can only reach a larger scale of operations in case they look for expansion abroad in markets with similar demand characteristics. The empirical evidence has suggested that intermediate positions in the domestic market are associated most strongly with foreign investment in other developed

markets. In the context of plant configuration decisions, we argue that this pattern of non-dominant firm expansion abroad holds, but is most prevalent in case of expansion in Europe or the United States (a West-bound configuration). Given the more limited resources and scale of non-dominant firms, they are likely to choose a focused geographic expansion strategy. Investments in developed market with similar demand characteristics is likely to provide the largest marginal benefit and may in addition allow acquisition and development of additional resources (e.g. through acquisitions). Dominant firms on the other hand, have the resources and competitiveness to expand in all regions and to benefit from the scale economies of a global plant configuration. The least competitive firms with the smallest market shares in the domestic market may lack the resources to invest in developed markets and opt for a purely cost-based internationalization strategy focused on Asia.

Hypothesis 2a: Domestic market share has a positive effect on the choice for a global plant configuration as opposed to an Asia-bound configuration. Non-dominant firms are most likely to choose a West-bound configuration.

Oligopolistic Rivalry in the domestic market

The relationship between foreign investment and domestic industry wide-competition has been the subject of research ever since the seminal work of Knickerbocker (1973). Knickerbocker launched the hypothesis that in loose-knit oligopolies firms recognize interdependencies with their rivals and will follow them as soon as they expand abroad in order to avoid a weakening competitive position in foreign as well as domestic markets. On the other hand, in tight oligopolies characterized by a very high concentration firms are more likely to invest abroad in a coordinated way that helps to sustain the collusive equilibrium from which they benefit. The hypothesis that in loose oligopolies, rivalry between the firms increases the occurrence and speed of foreign expansion has been supported by a number of empirical studies (Knickerbocker, 1973; Flowers, 1976; Caves, Porter and Spence, 1980; Yu and Ito, 1988, Hennart and Park, 1994, Chang, 1995; Kinoshita and Mody, 1997).

Hypothesis 3. Firms in loose-knit oligopolistic product markets are more likely to invest abroad.

Competition in foreign markets

Market share in Japan is a good indicator of a Japanese firm's competitiveness vis-à-vis other Japanese firms, but is not necessarily a good indicator of competitiveness vis-à-vis foreign firms, given the differences in the competitiveness of the Japanese industry as a whole vis-à-vis foreign industries across products. The global competitiveness of Japanese industry can be measured by the world market share of Japanese firms. The internalization theory of the multinational firm suggests that foreign direct investment is more prevalent by industries possessing greater global competitiveness. Firms in leading industries are more likely to be able to overcome the disadvantage of doing business abroad in an unfamiliar environment. The greater the industry's world market share, the greater its overseas market penetration and the more likely that scale economies warrant overseas production.

Hypothesis 4: The greater the global competitiveness of Japanese industry, the more likely that Japanese firms operating in this industry invest abroad.

Following the argument concerning firm-level competitiveness, competitiveness at the industry level associated with greater market penetration at the world level is also likely to enable investments in global plant configurations, rather than Asia-bound configurations. On the other hand global competitiveness of the industry is not necessarily a positive force for West-bound configurations. Caves (1996) and Kalish et al (1995) and Motta (1992) have shown that firms are more likely to engage in defensive investments abroad in order to maintain market share in case of a credible threat of entry by foreign firms in overseas markets. Foreign investment may serve as a strategic commitment to increase market presence and dislodge efforts by foreign competitors to penetrate the market. It may also facilitate adaptation of products to local consumer demand, increase brand recognition and goodwill among foreign consumers, and facilitate quick matching of actions of local competitors. These considerations play the largest potential role in the US and the EU where rival firms pose the most important credible threats and where the largest developed markets are at stake. Hence investments in the EU and the US may be more likely in case of strong local competition if compared to a situation of Japanese dominance of the world industry.

Hypothesis 4a A global plant configuration is more likely the stronger the position of Japanese industry in the world market. A West-bound plant configuration is most likely in case of competitive threats from US and EU firms and hence an intermediate position of

Japanese industry in the world market.

Core products and strategic importance of the product line

Different products manufactured by a firm may vary strongly in their strategic importance to the firm and their ability to affect overall performance and growth. Based on resource based theory and transaction cost theory it has been argued and empirically shown how firms optimize the exploitation of their proprietary assets in the extension of their product and geographical scope (e.g. Wolf, 1975; Delios and Beamish, 1999; Geringer, Tallman and Olson, 2000). However, as to the timing of investments, Chang (1995) argued that firms are likely to invest abroad in their core business first and use this investment platform as an option to invest further in less central products after gaining tacit knowledge on how to operate successfully in the overseas location. Hence, if we observe the presence of foreign manufacturing investment at any point in time, this suggests that the occurrence of foreign investment is larger under core products than under non-core products.

Hypothesis 5. Firms are more likely to engage in manufacturing investment for their core products.

In case a product constitutes a multinational firm's core business line, the firms is more likely to aspire to achieve a global presence and choose for a global plant configuration. Key resources and capabilities with potential scale economies are most likely to underlie the core businesses and allow a configuration with multiple foreign plants. The strategic importance of the product forces the firm to seek profit opportunities in multiple markets and the option value of core product investments in production platforms abroad can be best utilized in a global configuration (Kogut, 1985).

Hypothesis 5a: A choice for a global plant configuration is more likely for core products.

Internationalization Experience

Central to the resource argument to invest abroad is the managerial expertise and the acquisition and exploitation of knowledge to operate in foreign countries. Casson (1994) examines internationalization as a corporate learning process. In his model the cost of

acquisition of information about a market is the main set-up cost of entry. Once these are incurred in an initial investment project in distribution activities, set-up cost for manufacturing investments decline. Investment in overseas distribution, after-sales service, and marketing increases sales growth potential, provides feedback on local market and investment conditions, and generally serves as a platform facilitating expansion into manufacturing. Japanese firms have been particularly active in establishing overseas distribution networks that have facilitated export growth (Yamawaki, 1991) and subsequent manufacturing investments. Empirical studies on foreign investment have found that previous experience in foreign markets positively affects the decision to invest in manufacturing (Hennart and Park, 1994; Yu, 1991; Belderbos, 1997a; Chang, 1995; Kogut and Chang, 1996).

Hypothesis 6: Foreign investment is more likely the more experience the firm has accumulated in operating abroad through earlier investments in foreign distribution activities.

Technology Intensity

Besides a firm's competitiveness and market position in given product lines, the overall possession of intangible technological assets may have an additional affect on foreign investment. This is because high market shares may be based on the repeated introduction of innovative products, but also on brand image in the domestic market and investments in domestic distribution networks. Since technological advantages generally are more susceptible to transfer abroad than the marketing advantages (e.g. Hennart and Park, 1994; Kimura, 1989), innovative firms may be more likely to invest abroad.

Hypothesis 7: Technology intensive firms are more likely to invest abroad.

Technological intensity may also affect the international plant configuration choice. It has been argued that Japanese firms may locate production in advanced countries to benefit from technological spillovers (Kogut and Chang, 1991). The spillover argument is more important for firms with a strong absorptive capacity, which is reflected in their technological intensity (Veugelers, 1997; Cohen and Levinthal, 1990). Scope for such spillovers is by far the largest in developed markets such as the EU and the US. In addition, considering that technology

intensive firms may use relatively more highly skilled labor, they may have a greater preference for manufacturing in developed markets. Fukao et al. (1994) find that R&D intensive Japanese firms operate relatively smaller scale manufacturing activities in Asia and large scale activities in the US and Europe.

Hypothesis 7a: Technology intensive firms are more likely to choose a West-bound configuration.

3.2 Configuration-Specific Pull Factors

So far we have introduced firm and industry characteristics that are decisive in the decision to invest abroad and that may have a differential impact across plant configurations. Another set of factors affecting the choice of plant configuration are location- or configuration- specific. These are pull factors influencing the profitability of particular configuration and hence the likelihood that it is chosen.

Trade Protection: Tariffs

The tariff jumping argument for foreign investment holds that investment in a host country becomes relatively more attractive the higher the import duties levied by the host country. Duties raise the cost of serving the host country market through exports from the home country or from export platform countries (e.g. Smith, 1987). Tariffs have been found to significantly affect inward investments (e.g. Belderbos, 1997a; Campa et al., 1998).

Hypothesis 8: The higher the tariff level in a region for a specific product, the more likely that a plant configuration is chosen which includes investment in that region.

Trade Protection: Antidumping and voluntary export restraints

Besides conventional import duties, Japanese firms' exports to the EU and the US have been affected by voluntary export restraints and antidumping actions, with the electronics industry as one of the major targets. In particular antidumping actions remain a popular mode of trade policy to protect domestic industries, after GATT and WTO agreements have restricted or abolished he use of import duties and export volume restraints (Belderbos, 1997b). Both

voluntary export restraints and antidumping actions have been found to impact on Japanese investments in the US and the EU (e.g. Belderbos, 1997a; Kogut and Chang, 1996; 1991; Drake and Caves, 1992).

Hypothesis 9: If in a region antidumping actions or VERs have targeted Japanese firms, this increases the likelihood that a plant configuration is chosen which includes investment in the region.

Market Size

Market size is an important pull factor for the location of foreign investment (e.g. Head Ries and Swenson, 1995; Wheeler and Moody, 1992). The larger the market, the more attractive local production becomes and the more likely it is that sales levels warrant the fixed costs of setting up local production facilities (Buckley and Casson, 1981; Smith 1987). Likewise, the larger the market the greater the benefits of adaptation of products to local market conditions facilitated by local assembly.

Hypothesis 10: the size of the market for the product has a positive effect on the choice for a plant configuration that includes local production in that market.

Local experience

Internationalization experience may be region-specific and therewith influence the choice of plant configuration. The more experience a firm has accumulated in a region the lower the perceived risks and informational costs of entering the region through direct investment in manufacturing. Differences in regional experience can orient the firm towards a configuration building on the strongest regional experience and help firms to further invest in the region.

Hypothesis 11: A choice for a specific plant configuration is more likely, the more experience a firm has accumulated in the regions covered by the plant configuration through earlier investments in foreign distribution units.

3.3 Control Variables

In addition to the characteristics of firms, industries and locations for which we have hypothesized effects on foreign investment and the choice of plant configuration, we include control variables for which we do not have a strong prior concerning their effects on foreign investment and plant configuration: firm size and horizontal and vertical keiretsu membership.

Firm size is often used as an indicator of economies of scale, which favors centralization of production in the home country. On the other hand, firm size may also reflect the ability of firm to overcome financial barriers to invest in foreign countries, especially when these investments involve substantial risk. Larger firms may be able to overcome barriers to enter risky markets where they are at a disadvantage with respect to institutional and organizational structures (Caves, 1996: p.59). There may also be differences in the importance of firm size depending on the location of foreign investment (Belderbos and Sleuwaegen, 1996).

We also control for possible effects of membership of Japanese business groups (*keiretsu*) on investment decisions. Member firms of horizontal keiretsu may benefit from information exchange on foreign investment risks and local operations within the group, for instance information gathered by the general trading firm, and may be more able to finance risky foreign investment projects (Belderbos and Sleuwaegen, 1996; Chang, 1995). In vertical business groups, the presence of manufacturing networks abroad established by 'core' firm has been found to positively affect foreign investment decisions by related suppliers within the group, which may benefit from assistance, experience, and an exclusive overseas market provided by the 'core' firm (Belderbos and Sleuwaegen, 1996). Similarly, vertical keiretsu firms have also been found to cluster their manufacturing investments in the US and the EU (Head Ries and Swenson, 1994; Mayer and Head, 1999). The agglomeration benefits constituted by agglomerations of keiretsu investments, including positive external effects on worker training, specialized supplier availability, Japan-specific institutional infrastructure, and the availability of information on investment risk, is likely to have a positive impact on foreign investment by member firms (Chang, 1995). However, we do not expect these supplier-assembler relationships to play an important role in our analysis. Since we focus attention on consumer (final) goods industries, our sample mainly includes assembling firms and no vertical keiretsu firms focusing on component production.

4. EMPIRICAL METHODOLOGY AND DATA

Following the arguments presented in the previous sections, the strategic choices concerning the decision to invest abroad and the particular plant configurations are considered as nested options in a structured decision model. The corresponding empirical model, which allows for a nested structure and differential impacts of firm and industry specific push factors as well as configuration(location)-specific pull factors, is the nested multinomial logit model. We write the probability that firm i in industry j chooses a particular configuration s as the product of the probability that the firm chooses to invest abroad ($f = 1$) and the probability that it chooses a particular international plant configuration, conditional on a positive foreign investment decision. Formally:

$$P^{s}_{ij} = P^{f}_{ij} P^{s}_{ij|f=1} \tag{1}$$

The foreign investment choice P^{f}_{ij} depends on the different levels of expected profitability associated with the two options, which in turn depend on firm and industry characteristics X_{ij} and Y_j . If the firm decides to invest ($f = 1$) the firm has the option to choose between the three international plant configurations. We write the profitability associated with the plant configurations *s* as:

$$\prod^{s}_{ij|f=1} = a^{s} + b^{s} \ln X_{ijs} + g^{s} \ln Y_j + d \ln Z_{js} + e_{ijs} \tag{2}$$

Where a^{s} alpha is a configuration specific constant and e^{s}_{ij} is an error term representing non-systematic idiosyncratic factors. X_{ijs} are explanatory that may vary over firms and industries with coefficients b^{s}, Y_j are variables that vary over industry with coefficients g^{s} and Z_{js} are the configuration-specific (pull) variables with coefficients δ. If e^{s}_{ij} has a Type I extreme value distribution, the conditional probability that configuration s will generate the highest profits, and hence the conditional probability that the firm will choose configuration *s*, is described as a hybrid conditional logit model:

$$P^{s}_{ijf=1} = \frac{\exp\left[a^{s} + b^{s} X_{ijs} + g^{s} Y_{j} + dZ_{js}\right]}{\sum_{q=1}^{3} \exp\left[a^{s} + b^{s} X_{ijs} + g^{s} Y_{j} + dZ_{js}\right]} \qquad (3)$$

Equation (3) is a hybrid or 'McFadden' logit model combining a conditional logit specification (configuration-specific regressors with generic coefficients) with a multinomial logit specification (firm and industry-specific characteristics with configuration-specific coefficients).[4] To identify the model, the coefficients a, b and g have to be normalized to zero for one configuration. In the empirical analysis we will take the Asia-bound configuration as the reference choice. The generic coefficients d belonging to configuration (choice) characteristics do not vary by configuration and are estimated model-wide.

Turning back to the decision to invest abroad in the nested model, the probability of choosing foreign investment or not depends on the potential profitability contributions associated with the three options available for international plant configurations. The sum of profit contributions of the conditional configuration choices is called the Inclusive Value (IV) and is defined as:

$$IV_{ij} = \ln\left(\sum_{s=1}^{3} a^{s} + b^{s} X_{ijs} + g^{s} Y_{j} + dZ_{js}\right) \qquad (4)$$

The probability of choosing to invest abroad in the first stage then becomes:

$$P^{f}_{ij} = \frac{1}{1 + \exp[a^{f} + b^{f} X_{ij} + g^{f} Y_{j} + sIV_{ij}]} \qquad (5)$$

Where s is the estimated impact of the profit contributions on the propensity to choose to produce abroad. We followed the two-step procedure proposed by Greene (1997, p.923), by estimating first equation (3). From this estimation we calculated the inclusive values and included these in the estimation of equation (5). The estimation of s allows for a statistical test of the fit of the nested logit model in comparison with a standard multinomial logit model with domestic production and the three international plant configuration as same-level choices. In case s is equal to one, the unconditional probability to choose a specific

[4] e.g. Cramer, 1991; Greene, 1997; McFadden, 1984.

configuration ($P_{ij}^{f}\, P_{ijf=1}^{s}$) can be rewritten as a one-stage multinomial model with four choices (including a domestic configuration). This would make the multinomial model superior over a nested logit model (e.g. Greene 1997; Mayer and Muchielli 1999; Devereux and Griffith 1999). In addition, if s is zero, then the profit contributions of the plant configuration decisions do not affect the foreign investment decision and the nested model neither is appropriate (McFadden 1984). Hence a test for the appropriateness and statistical validity of the nested decision structure is that s is both significantly different from one and zero.

The Dataset

We constructed a micro-level database Japanese firms' plant establishments in the United States, the European Union, and East Asia for 36 products in the electronics and precision machinery industries. The 36 electronics products (see Table 1) are all final goods in order to focus on products with comparable characteristics in terms of marketing channels and manufacturing organization. The products are defined at the four or five digit level, reflecting differences in product maturity between market segments (e.g. laptop vs. desktop computers, and LCD televisions vs. conventional televisions) and often detailed application of antidumping measures (e.g. dot matrix printers vs. laser printers). For each product, Japanese manufacturers were identified based on Japanese electronics industry data.[5] After excluding foreign-owned firms this resulted in a comprehensive list of Japanese producers for each product. In total, the dataset includes 120 individual firms, of which 28 are privately held. The 120 firms on average manufactured between 4 and 5 products, resulting in a total number of firm-product combinations of 533. Fifteen observations had to be omitted because no data were available for the explanatory variables; this reduced the dataset to 518 observations. The dependent variable was created by determining whether the firms had set up manufacturing plants for each product (counting plants in operation in 1992) in the EU or US, and / or in Asia, using a variety of firm-level data sources. In 266 out of 519 cases foreign investment occurred. In the plant configuration choice analysis this gave us 266 decisions each on a set of 3 choice possibilities, hence 798 observations in McFadden's conditional logit model.

[5] Mainly Denshi Keizai Kenkyuujo (1993) and Yano (1989-1995). An appendix with a detailed description of data sources and data construction can be obtained from the authors upon request.

Explanatory Variables

We describe the definition of the explanatory variables employed to test our hypothesis. For convenience the hypothesized signs of the coefficients to be estimated are listed in Table 2 in addition to the means and standard deviations of the variables. In Table 2 and in the presentation of the results we normalized the coefficients for the Asia-bound configuration to zero. The signs in Table 2 therefore indicate the expected direction of the explanatory variables on the conditional probability that the West-bound and global configurations are chosen and not the Asia-bound configuration.

INSERT TABLE 2

The product cycle is measured as the number of years since the recorded start of production in Japan for each product. Since the effect of the product cycle on plant configuration may be non-linear (the effect of an additional year of maturity is likely to be stronger for intermediate levels than for the highest levels), we include the natural logarithm of this variable to test hypotheses 1 and 1a. Market share data (hypotheses 2 and 2a) were collected for the years 1990-1991 primarily from Yano (1990-1992). Since this source generally does not list the precise market shares for smaller players in the Japanese market, market shares could not be determined in percentages terms for a number of firms. We classified firms into four groups: those with market share smaller than 5 percent, with market shares between 5 and 10 percent, with market shares between 10 and 20 percent, and greater than 20 percent, respectively. The latter group we consider dominant firms; firms with market shares within the 10-20 percent range are competitive but non-dominant firms. Based on the market share data of individual firms we calculated the Herfindahl index in Japan for each product. We followed Shepherd (1997) in defining a loose oligopoly as an industry with a Herfindahl index greater than 1000 and smaller than 1800.[6] Loose oligopoly is a dummy variable which takes the value 1 for such industries and tests Hypothesis 3. We collected data on Japanese industry's share of the

[6] The Herfindahl-Hirschman index is defined as $\sum_{i=1}^{N} (share_i)^2$. We calculated the index by assuming that the market share that was not assigned to the larger players (on average around 5 percent) was evenly distributed over the smallest firms (for which no precise market share data was available).

world market in 1990-1992 (Hypotheses 4 and 4a) from various sources.[7] Based on the information available, Japanese industry's world market share could be classified as low (< 25 percent), intermediate (25-75 percent) or dominant (> 75 percent). Japanese industry's world market share reflects low competitiveness in most white goods sectors and computers while Japanese industry dominates world markets for several consumer electronics products (e.g. CD players, VCRs, facsimile machines, cameras). In order to test Hypotheses 5 and 5a, we defined a core product as a product that is part of a firm's line of business that represents at least 10 percent of total turnover. Internationalization experience is defined as the number of months since the establishment by the firm of its first sales subsidiary in the US, EU or East Asia. Since the effect of an additional months or year of experience will be greater for firms that only recently invested in distribution compared to firms that have been active for, say, 20 years, we chose a logarithmic specification.[8] Technology intensity (Hypothesis 7 and 7a) is measured as the number of patents in the five year period 1989-1993 granted to the firm or its subsidiaries by the US patent office, per 1 billion Yen of turnover.[9]

We calculated the tariffs that can be avoided by choosing a specific plant configuration as weighted averages of the tariff levels for each country or region (Hypothesis 8). As weights we used the relative size of the country markets for each product. Asian tariffs are weighted averages of pre-Uruguay Round tariffs published by the GATT in Taiwan, Malaysia, Thailand, South Korean, Hong Kong, and Singapore, the six largest electronics markets in Asia in the early 1990s. West-bound configuration tariffs are weighted averages of EU and US pre-Uruguay Round tariffs, and global configuration tariffs are weighted averages of tariffs in the other two configurations. US and EU tariffs vary between 2 and 10 percent while average tariffs in East Asia often reach higher than 30 percent for color televisions, VCRs, and white goods. To control for this high variability in the explanatory variable and since we expect a larger marginal impact of tariff increases moderate tariff levels, we take the natural logarithm of the average tariff for the configurations. A second configuration-specific trade policy variable concerns antidumping actions and voluntary export restraints targeting

[7] The main method was to add data on overseas production by Japanese firms to figures on domestic Japanese production and to divide this sum by the figure for world market volume.

[8] Since the number of months of overseas experience firms can be zero (for firms lacking a sales subsidiary abroad) we added 1 month to all observations before taking the natural logarithm.

Japanese exporters (Hypothesis 9). In particular in the second half of the 1980s, a range of Japanese export products, among which mobile phones, PBX systems, CD players, computer diskettes, dot matrix printers, copiers, and typewriters, have been affected by the imposition of antidumping duties by the US or EU administrations.[10] In addition, for a few products, Japanese exports to the US or the EU have been affected by quantitative restrictions or punitary tariffs.[11] Our antidumping & VER measure of trade protection takes the value 1 if antidumping or other trade restrictions have been applied to the specific Japanese export product, and the value 2 if both the US and EU have imposed such measures. This reflects that the incentives for 'antidumping jumping' investment are stronger if both these major markets are difficult to access through exports from Japan. Market size is a configuration-specific variable measuring the size of region's market covered by the configuration as a percentage of the 'Triad' markets (Western Europe, the US, and Japan/East Asia). It is an indicator of the relative importance of foreign markets in comparison with the Japanese market (Hypothesis 11). To capture regional experience effects, we include a variable measuring the number of months (in logs) since a firm's first establishment of a distribution subsidiary in the regions covered by the plant configuration (Hypothesis 11). In case of a global configuration, we took the average experience of the East Asia and the US/EU regions.

The control variable firm size is measured as the natural logarithm of the firm's turnover. Vertical keiretsu is a dummy variable taking the value one if the firm is listed as a member of one of the larger vertical manufacturing groups in Japan. Horizontal keiretsu is a similar dummy variable measuring horizontal keiretsu membership.[12]

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[9] See Belderbos (2000) for details on Japanese electronics firms' patenting intensity and a description of the data.

[10] See Belderbos (1997b). Asian countries, such as Taiwan and South Korea, only recently have incorporated antidumping articles in their trade legislation.

[11] VERs have been affecting Japanese CTV exports to both the US and the EU, the EU operated a VER for Japanese VCRs in the 1980s and national quota applied to import of stereo sets until 1992. The US imposed a punitive tariff on Japanese PCs imports during 1987-1991 in accordance with its Super 301 bilateral trade policy legislation.

[12] For vertical keiretsu we used the list provided in Dodwell Marketing Consultants' *Corporate Groupings in Japan*. For horizontal keiretsu we used the same source as well as a more elaborate Japanese language source, *Keiretsu no Kenkyuu* by Keizai Chousa Kyoukai (the membership definitions of Dodwell and Keizai Chousa

5. RESULTS

The estimation results are presented in Table 3 (the decision to invest abroad) and Table 4 (the plant configuration decision conditional on a positive investment decision). We first discuss the results of the first stage decision on investment abroad.

INSERT TABLE 3

The estimated coefficients presented in Table 3 represent the marginal impact on the odds ratio of the probability of producing abroad relative to the probability of domestic production only. The model generally performs well with all but one of the explanatory variables for which hypotheses were developed significant at the one or five percent levels. In 74 percent of the cases the investment or domestic production choices are rightly predicted. The estimated coefficient for the Inclusive Value is 0.23 and lies within the hypothesized interval <0,1>. The coefficient is significantly different from zero at the 10 percent level if we adopt a conservative two-sided test, and significantly greater than zero at the 5 percent level under a one-sided test. This confirms the role of the second stage expected profitability associated with the different plant configurations in deciding to invest abroad or not. Furthermore, the coefficient of the Inclusive Value is significantly different from one (at the one percent level), confirming that the nested logit model cannot be reduced to a multinomial logit model. These results confirm the appropriateness of the hypothesized decision process of foreign investment and plant configuration choice.

The empirical results support the product cycle hypothesis 1. Product maturity has a strong and positive effect on the decision to invest abroad. The results also show that the higher the domestic market share, the greater the probability that the firm invest abroad, consistent with Hypothesis 2. The increasing value of the coefficients of market share up to the dominant market share level suggests that overall, non-dominant firms are not more likely to invest

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Kyoukai differ for a number of firms). We obtained comparable results and report results obtained with the Keizai Chousa Kyoukai definition.

abroad compared with dominant firms. Firms in moderately concentrated industries show a higher probability of investing abroad, as indicated by the positive and significant effect of While Japanese industry's world market share has a positive and significant effect on investment abroad in support of hypothesis 4, the probability of investment is not increasing with world market share: there is not substantial difference between the coefficients of intermediate to high market shares and dominant shares. Core products of the firm are more likely to be produced abroad than other products, confirming Hypothesis 5. The extent of accumulated experience in doing business abroad has a significant and positive impact on the foreign investment decision, in support of Hypothesis 6. The only hypothesis receiving no empirical support is Hypothesis 7: the coefficient of technology intensity has a counter-intuitive negative but is not significantly different from zero. This appears at odds with a large body of existing literature on foreign investment, which has found significant effects of the possession of intangible assets (Caves 1996). This appears to be due to the inclusion of market share data at the product level, which can be seen as the expression of the intangible assets in terms of product-level competitiveness. The effect of market share has also in other work appeared to be a superior predictor of foreign investment (Caves 1996, p.59). Among the control variables, no coefficient reaches statistical significance.

INSERT TABLE 4

Estimates of the first two sets of coefficients in Table 4 are the marginal impact on the odds ratio of a Japanese firm choosing a West-bound or global plant configuration and not an Asia-bound configuration (the reference choice), conditional on a decision to invest abroad. The third set of coefficient represent the marginal impact on the odds ratio of choosing a West-bound configuration and not a global configuration. The latter coefficients are equal to the difference between the first and second sets of coefficients and are included in the Table to enable direct inspection of the significant differences between global and West-bound configurations. The configuration-specific variables are variables of type Z_{js} for which only one generic coefficient is estimated. For each configuration a constant term is estimated, which captures fixed effects associated with that configuration such as geographic location, the degree of cultural and economic integration with Japan, and macro economic factors such

as labor and capital costs.[13]

The empirical model rightly predicts the chosen plant configuration in 78 percent of cases and the pseudo R^2 reaches 0.317, which is relatively high for conditional logit models. The empirical results support the product cycle hypothesis 1a. Product maturity has a strongly significant negative effect on the probability that a West-bound configuration is chosen compared with an Asia-bound configuration. The probability of a global configuration is also negatively affected but in this case the coefficient is smaller and not significant. The difference between the coefficients for West-bound and global plant configurations is large and itself significant as is demonstrated by the last columns with results for the case where a global configuration is taken as reference state. Hence, for novel products a West-bound configuration is most likely to be chosen, for products in intermediate stages of the life cycle a global configuration, while the most mature products are most likely to be produced in Asia only. Hypothesis 2a is also largely accepted. Market shares greater than 5 percent, and in particular market shares greater than 10 percent, have a significantly positive impact on the probability of choosing a global configuration and not an Asia-bound configuration. In contrast, the probability of choosing a West-bound configuration instead of an Asia-bound configuration is only significantly higher for non-dominant firms (with market shares in the 10-20 percent range). Dominant firms (market shares greater than 20 percent) are much less likely to choose a West-bound plant configuration compared with a global configuration. Hypothesis 3a finds partial support in the results. The higher Japanese industry's world competitiveness expressed by its market share, the more likely that firms in the industry choose a global plant configuration. This effect is particularly strong in case of a dominant position of Japanese industry, where the differences between a global configuration and both Asia- and West-bound configurations are significant. In non-dominant but competitive Japanese industries (market shares in the 25-75 percent range) West-bound and global configurations are equally likely as hypothesized, but the effect on the probability of a West-bound configuration compared with an Asia-bound configuration just fails conventional significance tests. The results confirm Hypothesis 5a: if the product belongs to a core business of the firm, it is significantly more likely to choose a global configuration as

[13] Note that since we use a dummy structure, the estimated constant term represents the fixed effect for firms manufacturing a non-core product with a market share small than 5 percent in industries with low Japanese world market shares not characterized by a loosely oligopolistic structure.

opposed to both an Asia- and West-bound configuration. Technology intensity has the hypothesized positive effect on the probability that a West-bound configuration is chosen (Hypothesis 7a). This effect is significant in comparison with the choice for a global configuration, partially confirming our hypothesis. The significant effect of the loose oligopoly dummy variable on the probability of choosing a global configuration compared to both Asia-bound and West-bound configurations suggests that the follow the leader behavior in foreign investment in moderately concentrated industries is played out on a global scale rather than at a regional level.

With the exception of the regional experience variable (Hypothesis 11), all configuration-specific regional pull variables have the expected effect on the relative profitability of choosing one configuration versus another. The average level of import tariffs in the region covered by the plant configuration has a positive effect but fails to reach significance (Hypothesis 8). The existence of VERs and the imposition of antidumping measures has a strongly significant effect on the choice of plant configuration, confirming Hypothesis 9. The positive and significant effect of regional market size confirms Hypothesis 10.

Among the control variables, firm size has a positive and significant effect on the probability of choosing a West-bound or global plant configuration, in line with earlier empirical studies **(**Belderbos and Sleuwaegen, 1996; Caves, 1993; Horiuchi, 1989). Membership of horizontal or vertical keiretsu has no significant effect either on the investment decision or the plant configuration decision. The finding on horizontal keiretsu contrasts with Chang (1995) but is more in line with Belderbos and Sleuwaegen (1996) and Hunley (1998) who found mixed effects of keiretsu membership. Hunley (1998) suggests that the cartel like properties of horizontal keiretsu shield firms from competition and so provides fewer incentives for innovation and competitive achievement on world markets. The absence of an effect of vertical keiretsu membership is consistent with the view that the effects of vertical keiretsu on foreign investment decisions works primarily through supplier-assembler linkages (Belderbos and Sleuwaegen, 1996; Head Ries and Swenson, 1995). Since our sample only includes final (consumer) goods industries, these linkages play a lesser role in our empirical model.

6. DISCUSSION AND CONCLUSION

Overall, the empirical results lend strong support to the notion of a structured push-pull decision model of internationalization of production in which different strategic plant configurations function as nested options in the decision go invest abroad. Firm resources and competitiveness, domestic and overseas competition, and changing technological conditions related to the product life cycle push firms to invest abroad. These factors have a differential impact on the subsequent choice of international plant configuration, while this choice is also affected in a major way by regional pull factors such as restrictive trade policies and market growth. The empirical results on international plant configuration choice in particular showed strong differences between the two configurations that include manufacturing plants in the Western markets of the EU and the US: a global vs. a West-bound plant configuration. This suggests that previous research limiting analysis to the determinants of (Japanese) investment in a particular region or country may obscure a number of important aspects of internationalization strategies. The fact that a firm invests in the US or the EU in itself does not reveal information on the firms' internationalization strategy and plant configuration choice, which in turn is associated with a substantial variability in firm-level competitiveness and technological intensity as well as different conditions in the Japanese and global industry.

A central question analyzed in this study was the extent to which the product cycle is a key factor in explaining the internationalization of the firm. Our findings suggest that the product life cycle has not lost its significance in explaining international production in the 1980s and early 1990s. Both the decision to invest abroad and the choice of particular plant configurations are significantly affected by the stage of the product life cycle. The results are consistent with a pattern of investments in the EU and the US in the early stages, extending to a global plant configuration in intermediate stages, and a concentration of manufacturing activity in Asia in the final stages of the product cycle. At the same time, the strong negative effect of product maturity on the choice of a West-bound plant configuration comprising manufacturing activity in the EU and US only, suggests that product maturity is not a major force here. Other explanations, such as the need to jump trade barriers and the search for overseas (R&D) resources in the face of strong overseas competition, play more important roles.

Our use of micro-data at the level of the product and the firm also allowed a contribution to a better understanding of the different motives for investing abroad and the validity of various internationalization theories in relation to the plant configuration chosen by the firm. Four

motives can be distinguished: defensive trade barrier circumvention (tariff jumping investment), offensive market access and technology acquisition, market diversification, and cost reduction (e.g. Dunning 1993). The latter two motives are consistent with the product life cycle model, where diversification moves firms to a global plant configuration and cost reduction pushes firms to concentrate production in Asia in the later stages of the product cycle. The former two motives, on the other hand, deviate from it. The strong effect of trade policy measures on the choice of plant configuration shows that firms can be pulled towards foreign production in a West-bound configuration quite apart from product maturity considerations, in line with the predictions of Ohmae (1985). This confirms previous empirical findings of substantial effects of antidumping measures on (Japanese) investments in the US and the EU (Belderbos, 1997a; Barrell and Pain, 1999). Offensive market access and technology acquisition likewise has an impact mainly on investments in the developed markets of the EU and the US only. A West-bound plant configuration is likely to be chosen by non-dominant, but technologically intensive, Japanese firms for products characterized by relatively strong world-wide competition. These investments are likely to be made in order to get access to foreign technology and in order to learn from overseas market experience and may also include acquisitions of foreign firms. This finding is consistent with the important role of technology sourcing and acquisitions in the expansion of Japanese firms' R&D operations in the US and the EU (e.g. Belderbos, 2000).

Limitations and further research

In concluding we should also point out some important limitations of our study and suggest possible routes for further research. The main limitation of our research we consider the cross section nature of the micro level data. Although the inclusion of a variety of products at different phases of the product life cycle allowed us to assess the impact of product maturity on international production, the cross section nature of the data is not well suited to uncover paths of dynamic internationalization processes. While our results on West-bound plant configurations are consistent with the notions of growing convergence of developed markets and industries across countries (Dicken, 1998) and short product cycles, we are unable to test whether the product cycles have shortened over time. There are two contrasting hypotheses concerning dynamic internationalization processes. Dougall, Shane and Oviatt (1994) and Bell (1995) argue that many international new ventures at the product level are radically and

quickly implemented on a global scale. For such ventures international competencies are of great importance and there is less path dependence on domestic competencies and growth, avoiding all kinds of inertia in globalizing the product line. This globalization models where firms meter several foreign markets in a simultaneous fashion, contrasts with a gradual incremental approach to internationalization described in the Scandinavian literature (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977). Testing these alternative hypotheses would necessitate the use of longitudinal data, preferably extending or repeating the dataset up to the late 1990s. Given the formidable task of gathering the micro-level data, we consider this a major challenge for future research.

A second limitation is that we did not examine the relationship between different plant configuration and performance and profitability. Beamish and Delios (1999) found that geographic scope of operations has a separate positive feedback on performance of Japanese firms, which they attribute to increased scale economies and cost reduction, or technology spillovers and global learning. Geringer, Tallman and Olsen (2000) found more mixed effects of international diversification on Japanese firm performance. Our model suggest that the profitability of different degrees of geographic scope in international production depends on the push and pull factors affecting the firm in the industry. Depending on firm resources, competition, and product cycle effects a more limited scope of overseas production may generate more profits than a wider scope. This more detailed prediction concerning the international operations of firms at the product level suggests that future research on (geographic) diversification and performance should focus on the business unit level, rather than aggregate to the firm level.

More detailed insight into the rationale of international plant configurations could be obtained if we had more precise information on the geographic mandate of the manufacturing operations abroad. In particular in Asia, a distinction can be made between plants exporting to EU and US markets, and local or Asian market oriented plants. Such a distinction would allow us to trace further to what extent firms have rationalized their global operations along their internationalization path (Douglas and Wind, 1993; Sleuwaegen, 1993) or have circumvented European and US trade barriers by setting up operations in other Asian countries. In further research we aim to setup global profiles of firms and determine the scope of their operations, which would enable us to further decompose international manufacturing strategies.

A final and obvious limitation is the restriction of our data to the (broadly defined) electronics sector and to Japanese firms, for which the internationalization process is of a much more recent origin than for Western firms. Comparative analysis using data on other industries and US or European firms may trace out interesting similarities and dissimilarities.

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FIGURE 1: Internationalization and Plant Configuration in a Structural Model of Nested Decisions

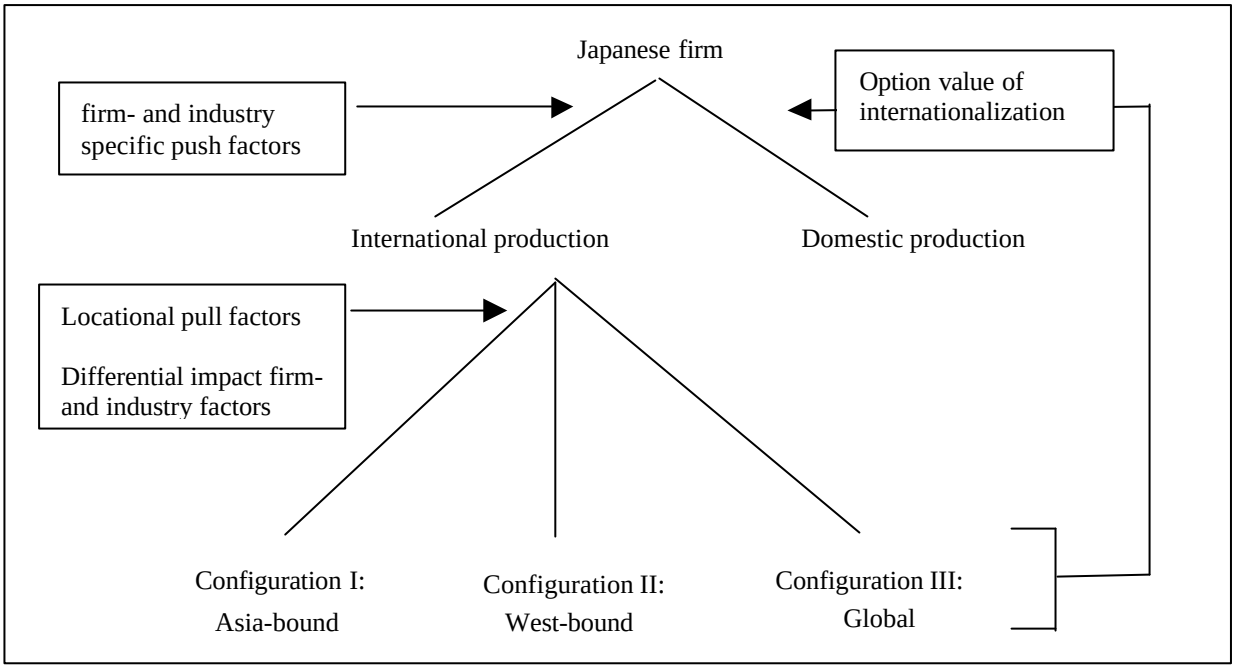

Table 1: Foreign Investment and Plant configuration Choices by Product

		Foreign Plant Configurations:			
	Domestic Production	**Asia-bound**	**West-bound**	**Global**	**Total**
Airconditioners	2	5	0	5	**12**
Audiotapes	5	0	2	2	**9**
Calculators	3	6	0	0	**9**
Camcorders	9	0	0	1	**10**
Cameras	2	8	0	0	**10**
Car audio	7	4	2	7	**20**
CDPs	10	5	4	7	**26**
Cellular Mobile Phones	13	0	3	5	**21**
Copiers	9	2	5	2	**18**
CRT TVs	2	5	0	9	**16**
Desktop PCs	15	3	1	1	**20**
Dot matrix printers	6	2	7	6	**21**
Facsimiles	15	1	4	7	**27**
FDD	7	7	0	4	**18**
HDD	15	0	3	2	**20**
headphone stereo	3	6	0	0	**9**
Inkjet printers	5	0	0	1	**6**
Laser printers	21	0	4	0	**25**
Laser Disk Players	14	0	0	0	**14**
LCD TVs	11	2	0	0	**13**
Microdisks	9	0	8	0	**17**
MWOs	4	0	4	2	**10**
Pagers	11	0	0	3	**14**
PBX	11	1	6	2	**20**
Portable PCs	10	0	4	3	**17**
Projection TVs	1	0	7	0	**8**
radiocassetteplayers	6	10	0	1	**17**
Refrigerators	3	6	0	1	**10**
Stereosets	2	11	3	7	**23**
Typewriters	6	0	5	1	**12**
Vacuum cleaners	5	1	1	1	**8**
Videotapes	4	0	3	2	**9**
VTRs	6	0	2	12	**20**
Washing machines	3	5	0	0	**8**
Watches	1	3	0	2	**6**
Workstations	4	0	6	0	**10**
Total	**260**	**93**	**84**	**96**	**533**

Table 2: Explanatory Variables: Hypotheses, Means and Standard Deviations

Variable	Hypothesis	Expected Sign: Investment Decision	Configuration Decision US	Configuration Decision EU	Configuration Decision Global	Mean	Std. Dev.
Firm and Industry characteristics*							
Product life cycle (ln years)	H1, H1a	+	--		-	2.567	0.636
firm market share 5-10% (dummy)	H2, H2a	+	+		+	0.108	0.311
firm market share 10-20% (dmmy)	H2, H2a	+	+		+	0.162	0.369
firm market share 20-60% (dummy)	H2, H2a	+	-		+	0.087	0.282
Loose oligopoly (dummy)	H3	+				0.545	0.498
Japan world market share > 25%, < 75% (dummy)	H4, H4a	+	+		+	0.615	0.487
Japan world market share > 75% (dummy)	H4, H4a	+	-		+	0.254	0.454
Core product (dummy)	H5, H5a	+	0		+	0.775	0.418
Internationalization Experience (ln months)	H6	+				5.401	1.462
Technology intensity (US patents per 1 bln Yen sales)	H7, H7a	+	+		0	1.027	1.275
Inclusive Value (IV)		0<IV<1				3.841	1.205
Configuration specific variables**							
Tariffs (ln %)	H8			+		2.430	0.651
Antidumping & VERs (dummy)	H9			+		0.476	0.675
Market size (% of 'Triad' market)	H10			+		0.555	0.311
Regional Experience (ln months)	H11			+		5.425	1.111
Control Variables*							
Vertical keiretsu (dummy)						0.592	0.492
Horizontal keiretsu (dummy)						0.326	0.469
Firm size (ln sales)						12.931	1.726

Notes: Hypothesized signs for the configuration decision are relative to the choice for an Asia-bound configuration (the reference state). Means and standard deviations for 518 choosers (observations) for firm and industry characteristics and control variables, and for 266 choosers x 3 choices (798 observations) for configuration specific variables.

Table 3. Logit Model of the Decision to Establish a Plant Abroad

	coefficient	t-ratio (asymptotic)	
Firm and Industry characteristics			
intercept	-6.13	-4.64	***
Product life cycle	0.86	4.30	***
firm market share 5-10%	1.20	3.31	***
firm market share 10-20%	1.84	4.81	***
firm market share 20-60%	2.59	4.95	***
Loose oligopoly	0.56	2.29	**
Japan world market share > 25%, < 75%	1.02	2.70	***
Japan world market share > 75%	0.94	2.33	**
Core product	0.78	2.97	***
Internationalization Experience	0.29	2.83	***
Technology intensity	-0.10	-1.11	
Inclusive value	0.23	1.78	*
Control Variables			
Vertical keiretsu	0.17	0.61	
Horizontal keiretsu	-0.28	-1.20	
Firm size	-0.06	-0.60	
Number of observations		519	
Pseudo R^2		0.26	
Loglikelihood		-266.3	***
% correctly predicted		74	

Note: Z-value is asymptotic normally distributed *=significantly different from zero at the 10 percent level, ** = 5 percent level, *** = 1 percent level. A choice is correctly predicted if the predicted probability is greater than 0.5.

Table 4. Conditional Logit Model of the Choice Between International Plant Configurations

reference state:	**West-bound** *Asia-bound*		**Global** *Asia-bound*		**West-bound** *Global*	
	coefficient	t-ratio (asymptotic)	coefficient	t-ratio (asymptotic)	coefficient	t-ratio (asymptotic)
Firm and Industry characteristics:						
intercept	-4.30	-1.48	-11.03	-3.63 ***	6.72	2.62 ***
Product life cycle	-1.39	-3.23 ***	-0.47	-1.17	-0.92	-2.55 **
firm market share 5-10%	0.71	1.10	0.93	1.60	-0.23	-0.40
firm market share 10-20%	1.55	2.59 ***	2.23	4.00 ***	-0.68	-1.42
firm market share 20-60%	-0.20	-0.29	2.14	3.60 ***	-2.34	-3.77 ***
Japan world market share > 25%, < 75%	1.03	1.42	1.64	2.54 **	-0.61	-0.79
Japan world market share > 75%	-0.42	-0.53	2.01	2.63 ***	-2.43	-2.83 ***
Core product	0.28	0.52	1.69	2.72 ***	-1.41	-2.16 **
Technology intensity	0.21	1.19	-0.30	-1.53	0.51	2.58 ***
Configuration-specific variables:						
Tariffs	0.76	1.50	0.76	1.50	0.76	1.50
Antidumping & VERs	1.39	4.79 ***	1.39	4.79 ***	1.39	4.79 ***
Market size	4.58	3.51 ***	4.58	3.51 ***	4.58	3.51 ***
Regional Experience	-0.13	-0.93	-0.13	-0.93	-0.13	-0.93
Control variables:						
Loose oligopoly	0.34	0.74	1.12	2.43 **	-0.77	-1.79 *
Vertical keiretsu	-0.12	1.19	0.16	0.31	-0.27	-0.53
Horizontal keiretsu	0.06	0.13	0.25	0.60	-0.19	-0.47
Firm size	0.30	1.69 *	0.34	2.06 **	-0.04	-0.26
Number of choosers (choices)			266 (3)			
Pseudo R^2			0.317			
Loglikelihood			-199.6 ***			
% correctly predicted			78			

Note: *=significantly different from zero at the 10 percent level, ** = 5 percent level, *** = 1 percent level. For configuration-specific variables of the form Z_{js}, one generic coefficient d is estimated. A choice is correctly predicted if the predicted probability is greater than 0.333.