



On the Channels of Foreign Direct Investment to Exchange Rate Pass-Through Strategies: An Analysis from Spatial Panel Data

Piriya Pholphirul

The Graduate School of Development Economics

National Institute of Development Administration (NIDA)

Serithai Road, Klong-Chan, Bangkok, Thailand, 10240

Tel: 66-2-727-3636 E-mail: piriya.p@nida.ac.th

Abstract

Exchange Rate Pass-Through and Pricing-to-Market behavior is an important consideration in International Economics and Industrial Organization Theory. The goal of this paper is to provide both theoretically and empirically justified definition of Foreign Direct Investment (FDI) effect on extent of exchange rate pass-through. In the theoretical part, the Cournot fashion of international duopoly market is constructed to explain reaction functions between a local firm in a host country and a foreign multinational. Preliminary results of theoretical framework indicate that FDI will have an affect on the lowering degree of exchange rate pass-through and generates higher degree of Pricing-to-Market behavior. We estimate the model of exporters with multi-destination by observing samples of five U.S. exporting industries based on 4-digit SIC index. We approach the ideas of spatial econometrics with belief that disturbance terms are possible to spatially correlate across countries, based on geographic proximity measurement. The estimated results show that all types of foreign direct investments have an affect on the lowering degree of pass-through while *Joint Venture* generates the most significant prediction and *Division* generates the least. The effect of having the first foreign operation in local markets is not significant to the degree of pass-through.

Keywords: Exchange Rate Pass-Through, Multinational Corporation, Spatial Correlation

1. Introduction

Following the collapse of the Bretton Woods exchange rate system in the 1973, there has been a considerable increase in empirical researches on the relationship between exchange rates and goods prices. Two of the most striking studies are “Exchange Rate Pass-Through” which refers to the response of import prices to exchange rates and “Pricing-to-Market” which refers to price discrimination across export markets induced by the exchange rate volatility. Initially, the model of balance of payments assumed a one-for-one response of import/export prices to exchange rate as “full” or “complete” exchange rate pass-through. However, several studies suggest that exchange rate pass-through is less than complete where the prices of foreign products sold in the domestic market change by a lower percent than do exchange rates¹. As a result, customers in that country do not interpret exchange rates change as relative price changes. Many studies of exchange rate pass-through are to explain the market competition status of traded goods. The rise of imperfect competition and strategic trade theory led researchers to estimate exchange rate pass-through at the industry level. Incomplete pass-through explains when markups of price over marginal cost change with exchange rate changes and performs as nonzero markups. Because the nonzero markup is a deviation against the perfect competition condition, incomplete exchange rate pass-through validates the shift towards models of imperfect competition. Firms in imperfect competitive market initially have market power and can markup their prices over the marginal cost in order to earn nonzero economic profit².

Even though exchange rate pass-through behavior exists when a firm engages in export/import activities and can control their traded good prices in the international market, international trade is however not the only method to capture international markets. Exporting firms can behave in other ways by investing abroad through *Foreign Direct Investment* (FDI). Foreign direct investment involves the activities that multinational corporations have such as operations abroad in terms, for example, of mergers, acquisitions, or establishing new foreign branches or affiliations. In regards to the U.S. data from the Bureau of Economic Analysis (BEA) in 1998, 68% of U.S. international trades are made within and by the multinational firms and their affiliates, which provides the evidence that foreign direct investment and degree of multinationals should have an effect on export firms’ pricing strategies. These motivations build up the ideas to extend more on the scope of allowing capital to become mobile across countries in real sector and how that would affect on firms’ Pricing-to-Market behavior and degree of exchange rate pass-through.

Market demand and cost of production are treated as exogenous parameters that influence not only pricing behavior, but also some changes in market structure such as the entry decision to foreign markets or acquisition of foreign

subsidiaries. In search of a larger market of multinational firms, a manufacturer begins to access to foreign markets with difference reasons such as lower cost of production, different consumer preference in goods, different in rate of return on investment or higher transaction cost on export. Eventually, the exporting firm establishes distribution and production networks by setting up a brand new firm or by acquisition of local firms. Foreign Direct Investment then tends to be an important topic in explaining the multinational firms' strategies. Moreover, a firm that invests abroad gains market and input advantage from investment abroad. The role of new-entry firm whether in term of mergers, acquisition, or integration of firms should affect changes in the market such as prices, market demand, strategies of local firms, etc. International mergers and acquisitions seem to be an old story in the field of finance where multinational conglomerate merger/acquisition happens when multinational firms make many direct investments by purchasing the stock of foreign firms in related or other industries. This then makes the analytical setting international from the financial viewpoint of a financial theory.

Based on previous literatures, it is evident that no research has been done to explain the direct aspects of foreign direct investment and extent of pass-through. Nevertheless, there are likely to be some previous researches explaining the similarity and applicability of works that can be the guilds of explaining this relationship between international investment and degree of pass-through of exchange rates on prices. Gron and Swenson (1996) show that the incomplete exchange rate pass-through exists when firms are able to shift their production across countries or alter their location of acquiring input. Multinational firms can acquire input either from host countries or from domestic countries, which enhances ability of multinational firms to produce in multiple locations and gives more flexibility to adjust to changes in input price, resulting in a smaller pass-through of exchange rates on prices. This can imply the effect of foreign direct investment for local production on pass-through elasticity. Rangan and Lawrence (1993) use the export price index issued from the Bureau of Labor Statistics (BLS) showing that the real U.S. export prices do not change much if there is high share and high level of intra-firm export between parent companies and their foreign affiliations. Another recent research paper from Yoshida (2001) simply estimates that firms set their own *distribution agent* affect on reducing pass-through effect of yen on Japanese export prices. The results from these three articles seem to support my future research that outward foreign direct investment and capital outflow are likely to decrease the degree of exchange rate pass-through, which increases the degree of markup in local-currency pricing strategies that multinational firms should have. However, two papers from Desiraju and Shrikhande (1996) and Yoshida (1999) may contradict this result. Desiraju and Shrikhande (1996) study the effects of the international distribution channel (e.g., a dealer, an import jobber, or a retailer) in the foreign market on exchange rate pass-through. The magnitude of the pass-through depends on the presence of an incentive problem in the distribution channel. When there is no incentive problem, pass-through is complete; however, when there is an incentive problem, pass-through depends on various characteristics of intermediary and the market setting. Yoshida (1999) extends works of Desiraju and Shrikhande by examining an explicit incorporation of local distributors in an analysis of pricing behavior of exporting firms. He shows that the degree of exchange rate pass-through becomes more complete if there is vertical integration between parent export firm and local distributor firms in the local market. Section II contains the empirical studies of estimating degree of exchange rate pass-through (with foreign direct investment being independent) by considering the spatial correlation effect in Panel Data study. Section III interprets the estimated results and intuitive explanation. Section IV discusses the policy debates based on results found from in this paper.

II. The Empirical Specification

The incentive of this framework refers to a simple model of price discrimination by an exporter selling to several export destinations (Knetter; 1989, 1992). This generates the price-cost markup function, which caused change from three components: (i) changes in marginal cost in production of goods, (ii) changes in the markup of price over marginal cost (price elasticity), and (iii) changes in exchange rates.

$$P_{it} = e_{it} MC_t \left(\frac{\varepsilon_{it}}{\varepsilon_{it} - 1} \right)$$

The Panel Data estimation of price-cost markup is formalized as follows:

$$p_{it} = \beta_1 e_{it} + \beta_2 e_{it} FDI_{it} + \gamma_1 (gdp_i) + \gamma_2 (PPI) + \gamma_3 (p_{i,t-1}) + \gamma_4 D_YEAR + \alpha_i + \varepsilon_{it}$$

Where, α_i is a country effect, and ε_{it} is a regression disturbance with $IID \sim N(0, \sigma_\varepsilon^2)$. The null hypothesis requires that price charged equals the marginal cost, and export prices are equal across destination nations. Therefore, in the null hypothesis, prices should vary in the correlated data such as country effect, exchange rate, or foreign direct investment variables and other control variables. Constant elasticity implies that exporters will change their prices to each destination country with a fixed markup over marginal cost. Marginal cost is common across destination regardless of consideration in other delivery charge or freight and transportation cost, but varies over time. Therefore, the time dummy D_TIME variable reflects the time effect to capture changes of marginal cost over timing³. The individual effect or country effect (α_i) measures the specific markups to the various destination markets. Within the alternative

hypothesis, the estimated coefficient (α , β_1 , and β_2) may not be zero which implies degree of exchange rate pass-through with different circumstance of direct investment. The statistical interpretation of β 's is straightforward. A value of zero implies that the markup to a particular destination is unresponsive to fluctuations in the value of the exporters' currency against the buyer's. Changes in currency values will fully pass-through to buyers in terms of local currency pricing. Thus, completed exchange rate pass-through happens when $\beta = 0$. Negative value of β implies that, for example $\beta_1 = -0.8$, in response to a 10-percent appreciation (depreciation) of his currency, the exporter would reduce (increase) his markup by 8 percent and pass-through the remaining 2 percent price reduction (increase) to the buyer. Thus, $(1+\beta_1)$ measures for degree of exchange rate pass-through. Positive value of β estimation correspond to the case in which destination-specific changes in markups amplify the effect of destination-specific exchange rate changes on the price in units of the buyer's currency. This is called "perverse exchange rate pass-through", which commonly happens if the change of export country's currency is in the opposite direction and is relatively small compared to that change of the import countries' currencies. The result is that pass-through can be greater than one if the exchange rate of the exporting country moves in the same direction of exchange rates in importing countries, so that the normal exchange rate pass-through is magnified by the rival's currencies. Therefore, including the *FDI* variables, the estimated coefficients to degree of exchange rate pass-through will be $1+\beta_1+\beta_2$.

The estimated coefficients of control variables and the year dummy D_YEAR , γ_s , measure effects to export unit prices that would occur from other shocks. Three control variables are included to account for both individual shock and time shock. The estimated coefficient on the log of real GDP (*gdp*) to unit value of export pricing can be either positive or negative depending on the degree of income elasticity in the local market. If income elasticity is high, consumers in domestic market tend to consume more than an additional increase in their income level. Hence, foreign multinationals tend to increase price to capture higher profit. With lower income elasticity, consumers in domestic countries partially adjust their consumption within full amount change of their income. In this case, firms tend to lower prices to protect against their profit loss that may occur. The estimation of second control variable, Producer Price Index (PPI), should be positive in that the firm increases price as they observe the incremental shock of production cost or market price. With the incremental shock of production cost, firms transfer burden to their customers by reflecting the increase of price. The last control variable, lagged period of export price ($p_{i,t-1}$), allows for the possibility of a partial adjustment of export prices to exchange rates. As from the earlier discussion, the short-run relationship of exchange rate pass-through, without direct investment variables, is given by the estimated coefficient $1+\beta_1$. The long run pass-through is then given

by $1 + \frac{\beta_1}{1-\gamma_3}$ and long-run pass-through with effects from foreign direct investment should be $1 + \frac{\beta_1 + \beta_2}{1-\gamma_3}$

The price data used in this study are the export unit value from 1989-2000 calculated by the "DATAWEB" provided by the U.S. International Trade Commission (<http://www.usitc.gov>) on the quantities and values based on four-digit 1987 Standard Industry Classification (SIC) export of manufacturing products. The unit values (in term of US\$) are obtained by dividing the value of Free-Alongside Ship (*FAS*) export by the quantity of export from the U.S. to each destination country. Even though the Bureau of Labor Statistics (BLS) in the Department of Commerce publishes disaggregated export price indices, the reported price data are not classified or broken down by destination or source but rather are average figures for all destination market or source countries of exporting⁴. The GDP variables are collected from the World Development Report issued by World Bank and the *PPI* variables are collected from the Bureau of Labor Statistics (<http://www.bls.gov>) segregated by industry samples. In regards to the Year Dummy variable, the twelve year-dummy variables (D_YEAR) are generated equal to one in which that year is present and equal to zero otherwise. Therefore, variables $D1989$, $D1990$, $D1991$, ..., $D2000$ represent time-effect but $D1989$ is excluded from the estimation to avoid "Dummy Variable Trap". Lastly, the annual exchange rate variables (e) are the nominal exchange rates adjusted by the *Consumer Price Indices (CPI)* of destination countries to control for the movement of cost. The annual average exchange rate and consumer price data are obtained from the International Financial Statistics (IFS) provided by the International Monetary Fund.

This foreign direct investment data is a common variable denoted as *FDI* measuring the number of U.S. foreign affiliates, subsidiaries, or other foreign operations of U.S. multinational firms located in multi-destination countries. Multinational firms, which also play a role as exporters establish their own subsidiary and/or affiliation, joint venture with other firms, or establish their internal branches or division abroad. The effect that exchange rate pass-through should matter whether exporters establish their subsidiary, affiliation, or division, should also be considered⁵. *FDI* variables are classified into four channels based on the "Directory of Corporate Affiliations". Directory of Corporate Affiliates issued from "Who Owns Whom" lists a number of U.S. and foreign firms that have operation both in domestic and international countries as the following terms:

- *Subsidiary*: A chartered business operating abroad and owned by the U.S. parent company at 50% or more
- *Affiliation*: A chartered business operating abroad and owned by the U.S. parent company at less than 50%

- *Joint Venture*: A business operating abroad in which the U.S. parent firm shares responsibility and ownership with one or more companies
- *Division/ Branch*: An internal unit of a U.S. parent company operating abroad, and is not incorporated

We generate dummy variables *SUBSIDIARY1*, *AFFILIATE1*, *J_VENTURE1*, and *DIVISION1* as equal to one if international operations exist during the sample period 1989-2000. However, these variables might be overstated if the first operations are established at the end of the sample period. Therefore, we add four more dummy variables, *SUBSIDIARY2*, *AFFILIATE2*, *J_VENTURE2*, and *DIVISION2*, taking a value of one for years in which the first operation is present. Nevertheless, these dummy variables do not cover and assess the number of subsidiaries/affiliates. The estimated coefficients may understate the effect of foreign operation of parent firms for a country with more than one subsidiary/affiliate. This case should happen if there is a large geographic area in destination countries, such as China, India, etc., where one subsidiary cannot cover the entire market. Finally, *SUBSIDIARY3*, *AFFILIATE3*, *J_VENTURE3*, and *DIVISION3* account for the number of subsidiaries, affiliates, joint ventures, and divisions accordingly in each destination country.

We extend works of Knetter (1989, 1992) in which the estimation of a panel data model might cause problems where disturbances will be autocorrelated across the cross-sectional units. Because cross-sectional unit in this paper are worldwide countries, the issue of spatial econometrics is adapted here in the context of exchange rate pass-through and pricing-to-market. We call the disturbances as *spatial correlated*, based on some geographic or economic proximity measure. In order to account this spatial effect to international pricing strategies, we would like to answer the question that whether or not there is a pure “border” effect in international price discrimination. In the other words, is price discrimination across markets greater than discrimination within them after controlling for the border or distance effect?⁶ In practice of regional science, there are attempts to address issues of this problem. This can be, for example, that a shock in one country (ε_{it}) will be associated with shock of other countries (ε_{jt}) in a certain period. This spatial shock causes inconsistent and bias estimators by using standard estimation of fixed effect panel data. To capture this problem, we, firstly, should test whether there is any spatial correlation existing in the data by using the standard testing of spatial econometric theory. Secondly, if data are found to have spatial correlation problems, we can transform and re-estimate models by using different methodologies. Due to small series of time ($T = 12$), we adopt works based on Druska and Horrace (2004). See details in Appendix section.

III. Results

The following five sample industries based on 4-digit SIC which contains the largest share of U.S. export volume during 1989-2000 are observed:

- Electronic Computer (SIC-3571)
- Telephone and Telegraph Apparatus (SIC-3661)
- Semiconductors and Related Devices (SIC-3674)
- Motor Vehicle Part and Accessories (SIC-3711)
- Aircraft (SIC-3721)

Moran's I Statistics and *spatial autocorrelation coefficients* λ_i shows that spatial autocorrelation in error component exists in three out of five sample industries (Electronic Computer (SIC-3571), Telephone and Telegraph Apparatus (SIC-3661), and Motor Vehicle Parts and Accessories (SIC-3711), which we adapt from works of Druska and Horrace (2004) (See Appendix). In addition, we apply the common fixed-effect panel data based on Knetter (1989, 1992) for the remaining two industries: Semiconductor and Related Devices (SIC-3674) and Aircraft (SIC-3721), which are not spatially correlated. Table 1 to Table 5 presents estimated results

The first column (I) for each table shows the degree of exchange rate pass-through without including Foreign Direct Investment variables. The pass-through coefficient is one plus the value of β coefficient when sign of β can be interpreted as discussed earlier. For example, the estimated coefficients of Column (I) are $\beta = -0.008$ for the Electronic Computer industry, $\beta = -0.006$ for Semiconductors and Related Devices, $\beta = -0.014$ for Motor Vehicle Parts and Accessories, and $\beta = -0.083$ for the Aircraft industry. It is straightforward to interpret that, by 10% appreciation of the US dollar or 10% depreciation of local currency, export prices in US dollar decreases by 0.08%, 0.04%, 0.14% and 0.83% respectively, while the import prices in unit of local currency increases by 9.92%, 9.96%, 9.86%, and 9.17% respectively. Therefore, exchange rate pass-through for these four industries (Electronic Computer, Semiconductors and Related Devices, Motor Vehicle Parts and Accessories, and Aircraft) are “incomplete” for the U.S. multinational firms. The traded local-currency pricing of export good in local market only changes partially with full amount of exchange rates change. However, the estimated coefficients do not seem to supply large amounts of partial pass-through. In addition, the results show that degree of exchange rate pass-through is insignificant for the Telephone and Telegraph Apparatus.

The breakdown of U.S. outward direct investment: *Subsidiaries, Affiliations, Joint Venture, and Division*, to degree exchange rate pass-through are shown in column (II) to column (VIII). Column (II) to column (V) illustrates the regressions for each variable series of *SUBSIDIARY, AFFILIATION, J_VENTURE, AND DIVISION*, respectively. Column (VI) shows the effect of having foreign operation (*SUBSIDIARY1, AFFILIATION1, J_VENTURE1, and DIVISION1*) in the sample year, 1989-2000, while column (VII) provides the explanation of having first foreign operation (or the first year of establishing foreign operation), which are *SUBSIDIARY2, AFFILIATION2, J_VENTURE2, and DIVISION2*. The last column (VIII) illustrates a number of foreign operations to degree of pass-through (*SUBSIDIARY3, AFFILIATION3, J_VENTURE3, and DIVISION3*). The estimated coefficients of time-dummy variable (D1990, D1991, ..., D2000) are not presented in the tables.

Considering foreign direct investment in term of “Subsidiary” (*SUBSIDIARY1*), we find that having subsidiary in the sample reduces degree of exchange rate pass-through in the Electronic Computer industry and the Aircraft industry. Another form of “subsidiary” (*SUBSIDIARY2*), which represents the first year effect of having U.S. subsidiaries established in the local market also shows the result of reducing degree of pass-through in only one out of five sample industries: Semiconductor and Related Devices. Having an additional number of subsidiaries (*SUBSIDIARY3*) slightly increases the degree of pass-through in the Aircraft industry but reduces the degree in the Semiconductor and Related Device industry. Therefore, establishing a number of subsidiaries in the local market is somehow ambiguous to explain whether it should increase or decrease its markup level. Foreign direct investment in terms of Affiliation and Joint Venture are found to have an effect on the degree of exchange rate pass-through by, firstly, having the U.S. Affiliation aboard (*AFFILIATION1*) reduce the degree of exchange rate pass-through in the Electronic Computer and Telephone and Telegraph industry. A number of U.S. foreign affiliations also support this effect by lowering its degree in the Telephone industry as well. Foreign direct investment in terms of international Joint Venture (*J_VENTURE1*) shows the strongest effect on reducing degree of pass-through in all five-sample industries, while a number of joint venture projects also have significant effects on lowering the pass-through in the Electronic Computer, Telephone and Telegraph Apparatus, and Aircraft industries.

The results of estimation shows that U.S. foreign direct investment outflows in terms of U.S. foreign subsidiaries, U.S. foreign affiliations, and, especially U.S. Joint Venture with other firms in the local market having effects on reducing degree of exchange rate pass-through. Multinational firms that invest abroad can also enhance their market power so that they have abilities to have some markups or maintain the traded goods prices in the local market. In addition, some companies with global operations can shift supply locations from one country to another to overcome effects of exchange rate fluctuation. That is, increasing the number of supplier locations internationally makes the firm less vulnerable to currency changes in the export market because they can readily relocate their sourcing to a currency that is more favorable. Obviously, factors of production other than cost may permit U.S. firms exporting to the foreign markets to reduce the impact of exchange rate fluctuations, thereby reducing the extent of exchange rate pass-through (Clark, Kotabe, & Rajaratnam, 1999). Direct investment in terms of *Division* contributes the least effect in explaining the degree of exchange rate pass-through. Having U.S. foreign division in the sample year (*DIVISION1*) increases the degree of pass-through in the Aircraft industry but a number of foreign divisions show evidence in the decrease of the pass-through degree in the Semiconductors and Related Devices and the Aircraft industry. Therefore, division is the only type of foreign direct investment that generates both plus and minus sign estimation.

We can explain intuitively that division is the internal unit of firm, and is not incorporated. Therefore, it does not have any roles on production of goods, but it rather performs in terms of services such as sales office, lab institutes, research and development, and the repair and maintenance section. Since the multinational level of firms is determined by the extent of foreign production, foreign division/branch such as distribution office, research and development, etc does not exist in production of host country but in service-enhancement, which somewhat may have an affect on the increment of marginal cost. However, increase of cost from establishing international branch/division is not included into the production cost but into other kinds of cost, such as cost for research and development or other kinds of service transaction in a firm’s accounting statement. The increment of this kind of non-production cost should have an affect on reducing the price-cost margin, which explains the increase in the degree of exchange rate pass-through or lower degree of pricing-to-market. Secondly, international transaction between headquarter of multinational firms and their internal unit of branch/division is usually done by a single unit currency. Since the international branch/division is not incorporated, its earnings or expenditures have to be transferred back and forth to the headquarter. Using one unit currency (usually in the source-country’s currency) reduces the loss that may happen from exchange rate volatility or transaction cost of currency exchange. It is likely that there are fewer exchanges of currencies for international transaction between multinational and its foreign affiliates, and the direct investment in term of international branch and division does not have much affect to the degree of exchange rate pass-through. Thirdly, even if there is currency exchange between the headquarter and its international branch offices, the headquarter will not reduce the price-cost margin if it sells goods through its foreign branches/division. Since the foreign branch is not incorporated and is still in the same unit of multinational firms, increase in the transfer of pricing among internal sectors does not generate extra

profit for the whole organization. The headquarter then does not increase the price-cost margin that it changes charging to its foreign division. We can assume that branch/division performs as the sales office or distributor in this case so the headquarter may give decision power to the foreign branch itself to charge prices in domestic markets and transfer that abnormal earning back to the headquarter. Beyond research studies, people may believe that having branch/division abroad may increase performance which then leads to capture brand-loyalty and reliability from customers. These effect cause change in the demand condition that multinational firms should face in their foreign markets. This demand condition may enhance the monopolistic competition of multinational firms to be able to increase their price-cost margin, which leads to a lower degree of pass-through. However, there have been no researches done that try to explain these arguments.

Besides specifying types of foreign direct investment, the estimated results also show that foreign operations established in the first year, denoted as *SUBSIDIARY2*, *AFFILIATION2*, *J_VENTURE2*, AND *DIVISION2*, are not significant to the degree of pass-through. We can intuitively explain it as a due to lag of demand and supply adjustment. First period of establishing foreign direct investment does not immediately have an affect on demand condition in local markets but takes a longer period for the demand adjustment. This kind of adjustment may also include the switching behavior on domestic consumers. Lag of supply is from the duration period that multinational firms spend on setting machines or penetrating international markets. Pholpirul (2006) explain the reasons why channels foreign direct investment reduces degree of exchange rate pass-through that can be analyzed as follows:

1) Performance Orientation.

Direct investment can enhance firm's market performance. That performance can be increased because of specific knowledge or managerial skills that usually come with direct investment. A performance orientation relates to how the firm defines and measures market success. Firms sometimes aim to having different performance goals. In the marketing literature, discussion of performance orientation usually deals with market based rather than finance-based measures. Such differences in performance orientation will affect the extent of exchange rate pass-through. As direct investment enhances a firms' performance and earns market share in the host market, firms pricing to maximize export market share will seek to lower export market prices and hesitate to raise them, even when exchange rates are volatile. Therefore, when the exporting countries currency appreciates, market share-oriented multinational corporations tend to pass-through less of the cost increase in the export market. However, firms pricing to maximize a financial performance measure would more likely focus on expanding margins whenever possible. Then the degree of pass-through of financial-targeting firms will be more than that of the market-share targeting firms.

2) Sourcing and Location Strategy.

Direct investment abroad also reduces cost from the sourcing strategy. For example, during the mid-1980s when the U.S. dollar depreciated sharply, U.S. firms found it increasingly difficult to use foreign supplies because they have to pay higher in U.S. dollar term. However, firms that engage in direct investment or international production usually can switch suppliers from different places. Moreover, multinational firms that invest abroad, often sign contracts with suppliers on a long-term basis with fixed input prices. Therefore, costs of production of firms would not be tremendously affected from exchange rates volatility. Firms with global operations can shift supply locations from one country to another to overcome the effects of adverse exchange rate fluctuations. That is, firms can readily relocate their sourcing locations of more favorable currency if the number of international supplier location increases. This is then obvious that direct foreign investment by production in different countries reduces degree of exchange rate pass-through. In conclusion, firms using international suppliers on a long-term contract tend to pass-through less of the exchange rate fluctuation than those relying on short purchases of supplies. Moreover, firms with many alternative sources of supplies tend to pass-through less of the exchange rate fluctuations than those with few suppliers

3) Distribution System.

Multinational enterprises that focus on foreign direct investment can establish their own distributors rather than hire local distributors. Three factors to consider in the roles of distribution systems are *Intensity of distribution*, *Channel length*, and *Integration of distribution*. Distribution intensity is important for example; a firm is unable to the respond to the increase in demand if a firm has low distribution intensity or maybe only a single importer/distributor responsible for setting contracts with retailers. This situation is called "bottleneck effect". If exchange rate change is temporary, using alternative direct investment to expand distribution will not likely be feasible, because of the time limit. However, for more permanent exchange rate changes, direct investment by foreign corporation to expand distribution intensity may reduce bottleneck effect, which leads to the fall in price proportionately, leading to increased market share. Therefore, in a currency appreciation of the exporting country, the degree of exchange rate pass-through is positively related to the firm's intensity of distribution in the export market. This result is similar to the result from Yoshida (2001).

For the channel length and integration of distribution, the relationship between channel length and exchange rate pass-through also implies the positive relationship in that increase in channel length implies an increase in degree of

pass-through. One explanation, for example, is that the channel distribution is vertical. Sellers and buyers and independent actors will act to optimize their own position. That is, they will pass-through and/or absorb changes as it suits them. However, channel integration can be measured in terms of the degree to which firms own their channel intermediary. Foreign direct investment then obviously increases degree of channel integration. Degree of exchange rate pass-through reduces in high degree of channel integration because firms do not have to optimize their own position. Therefore, the degree of pass-through will be positively related to channels length but negatively related to degree of channel integration. (Clark, Korabe, & Rajaratnam, 1999). Therefore, the effect of direct investment on exchange rate pass-through through the investment on distribution channel is still unclear depending on degree of channel intensity, channel length, and/or channel integration.

4) Brand Loyalty.

Brand loyalty is a big issue in explaining the link between direct investment and degree of pass-through. Brand loyalty not only represents the firm's reputation but also reflects the customer's memory-based knowledge of the brand. Direct investment is not the only source to build brand equity or brand royalty, but it is also depends on marketing strategies such as advertisements, promotions, or worldwide recognition. Strong brand royalty implies high customer awareness, and generally assumes strong promotional support. Therefore, brand loyalty provides benefits on competitive advantage and ability of increase markup of price over production cost. It also decreases the propensity that consumers will switch brands, thereby decreasing price elasticity. Thus, it is clear that brand equity is a significant factor in the exchange rate pass-through phenomena. Therefore, foreign direct investment that can enhance its brand loyalty in domestic markets will reduce the degree of exchange rate pass-through.

IV. Policy Debates

Understanding the determinants of foreign direct investment and pricing behavior is an important contribution to the policy debates. The policy liberalization alters many parameters of international location of multinational corporations. The liberalization of direct investment regimes strengthens international production by allowing firms greater freedom in making international location decisions and in choosing the mode to serve each market. All enterprises in the market have to raise technical efficiency and have to be more responsive to market forces to stay in business, not only in tradable activities but also in services and infrastructure. The multinational corporations have to restructure their activities and deploy their assets to compete with local firms. However, the objectives of multinational corporations differ from those of host governments: governments seek to spur national development, while multinational firms seek to enhance their own competitiveness in an international context, increase market share and market power, and maximize their long-run profit. In the other context, rapid innovation and deployment of technology, in line of logistic and market demands, are more important and are a dominant factor in enhancing market power over other existing local firms.

Moreover, the results show that in both the theoretical and empirical part, foreign direct investment is affected by the lowering degree of exchange rate pass-through where lower degree of pass-through means increasing market power of the multinational firms. Therefore, the policies debates that government in the host countries should be concerned are the debates over "competitiveness". The competitiveness debate has two perspectives, which are strongly interrelated. First, there is concern over the "competitiveness of multinational enterprises" on an international basis and second, there is concern over the "competitiveness of market and location". Competitiveness of multinational enterprises considers whether firms maintain price over changes of other factors such as exchange rate, production cost, shock in market demand, etc. Since a firm has the ability to charge differently and maintain higher price over its cost for each country is considered as its own market power. Pricing-to-Market ability, competitiveness of location and market is concerned when multinationals gain market power over price once they invest in the local market⁷. Market power generates market inefficiency and market distortion in which customers and producers in the local market would suffer. Thus, policymakers in host countries should study more in these possible aspects. Nevertheless, most developing countries still support foreign direct investment inflow by giving particular tax and other fiscal incentives to attract multinational enterprises. More broadly, and perhaps with greater economic implications, attracting foreign capital through low wage and flexible working condition has also become part of many countries' economic policy, and is articulated as a concern over competitiveness explained above. In regards to the "competitiveness", the effects of direct investment and degree of exchange rate pass-through found in empirical results show that direct foreign investment could either reduce or somewhat amplify degree of exchange rate pass-through. These results can be analyzed as that the foreign direct investment may improve market efficiency or distort market efficiency by increasing anti-competitive effects. With higher degree of exchange rate pass-through in the effect of investment inflows, the multinational corporations may improve market and industrial efficiency and resource allocation in their host countries by entering into industries where high entry barriers reduce the degree of domestic competition. The entry of multinational firms into these monopolistic industries is likely to raise the level of competition and force existing local firms to become more efficient. However, foreign entry may cause a fall in the number of firms in the industries if the least efficient

local companies are forced out of business. This result can be against our fear that foreign multinational corporations may out compete and generate monopoly power over local firms that are even worse than the existence of domestic oligopolies in host countries. This competitive promotion effect may also be against if there is risk in that those foreign multinational firms with market power may also repatriate profits and avoid taxation through transfer pricing. The generality of competition motivates an examination of study in foreign direct investment and industry structure in host countries. One problem to consider is whether multinational corporation entry explains industry structure or whether industry structure determines if multinational firms will enter or not. In regards to the studies of developing countries, most authors have not been able to or have not even tried to determine whether the high degrees of concentration in the industries where foreign affiliates are present have been caused by multinational corporations or whether multinational corporations have just been attracted to these industries by profit earning opportunities (Blomström & Kokko, 1996)

Therefore, in this case where foreign direct investment increases market competitiveness, it can be discussed that competition improves market efficiency and welfare, but there are cases where it might not necessarily be that way. First, economies of scale are important determinants of industrial productivity, as foreign entry increases concentration in relatively small national industries. Resource allocation and efficiency may well improve from the increase in average firm size. Whether this effect is stronger than that of the reduced competition depends on market characteristics and trade policy. For example, a fall in the number of firms from fifty to forty should not necessarily reduce the competitive environment, but a reduction from three to two producers certainly would. Similarly, increased concentration is likely to have more harmful effects in protected industries or infant industries than the import-competing or export-oriented industries. The government policies on foreign direct investment need to counter two sets of market failures. The first arises from information or coordination failures in the investment process. This failure can lead a country to attract insufficient investment or wrong quality of investment. The second is when private interests of investors diverge from the economic interests of host countries. This causes foreign direct investment to have negative effects on development or may lead to static benefits that are not sustainable over time. This also considers infant industries in which the development of local enterprises can be jeopardized when inward direct investment crowds out those enterprises. The last should be concerned with weak bargaining and regulatory capabilities on the part of host country governments, which can result in an unequal distribution of benefits or abuse of market power by multinational firms (Oman, 2000). One of the best policy debates among policymakers in host countries is to promote “linkages” between foreign affiliations of multinational corporations and domestic firms, where the linkages can be classified into *Backward Linkages*, *Forward Linkages*, and *Horizontal Linkages*.⁸

Extent of exchange rate pass-through is also important for monetary policymakers to launch the monetary policy. It is obvious to say that the optimal monetary policy depends in a fundamental way on the type of price stickiness. Within the partial exchange rate pass-through status where prices are stickier and not responsive to exchange rates, monetary policymakers cannot rely on the exchange rate to provide the necessary adjustment to real shocks. To the extent that consumers do not interpret exchange rate changes as relative price changes in the short run, monetary policy can only achieve an inferior outcome in which it is unable to control the relative demand for domestic and foreign goods. The benefits of floating exchange rates are then diminished in the absence of strong expenditure-switching effects. A number of papers have analyzed monetary policy behavior in the presence of imperfect exchange rate pass-through. For example, Devereux and Engel (2000) examine that the implications of local currency pricing in the case of optimal monetary policy in response to real shocks is fully consistent with fixed exchange rates. Devereux, Engel, and Tille (1999) and Tille (2000) provide the studies to support these monetary policy debates within lower exchange rate pass-through and inward foreign direct investment. If foreign subsidiaries or affiliates’ shares are held by domestic firms or local people in higher proportion, those domestic shareholders can buy from foreign producers, which are multinational firms in this case, at prices set in the producer’s currencies, and sell to domestic consumers at prices set in the consumers’ currencies. Therefore, the role of subsidiaries as intermediaries is important to distinguish exchange rate pass-through to import prices from the pass-through to consumer prices. Higher share of domestic control in foreign, which is the U.S. in this case, subsidies/affiliates over imports, vary among countries and industries of imported goods. Implementing this central role of intermediaries to reduce problem of exchange rate pass-through to monetary policy should be subjected on ownership of domestic firms or local governments in foreign subsidiaries. Those intermediary agents would absorb some of the exchange rate fluctuations in their profit margins, as indicated by the larger degree of exchange rate pass-through to import prices than to consumer prices.

Exchange rate pass-through not only reflects the debates in policy development in competitiveness and in monetary policy, but is also important in international trade policy. One of the main questions to answer is whether devaluation of domestic currency would improve domestic country’s balance of trade and its welfare implication. Within the international trade literature, the arguments about whether devaluation will improve the trade balance can be heard to follow. It is argued that the flow of goods respond only with time lags to changes in the exchange rate. Firstly, the analysis of “J-Curve” is used to describe the movement over time of the trade balance within currency devaluation. It explains that, after the currency devaluates, trade balance may deteriorate at first and improvement may come later.

Secondly, to achieve the success of currency devaluation, the “Marshall-Lerner Condition” must hold. The analysis of Marshall-Lerner Condition indicates that the devaluation will improve the trade balance and provide a stable foreign exchange market if the elasticity of demand for domestic imports plus the elasticity of demand for domestic export exceeds one. Therefore, the limited degree of exchange rate pass-through in import goods, which means smaller elasticity of demand for domestic imports within exchange rate volatility, may explain why the Marshall-Lerner Condition may not hold in reality.

Our result also supports this argument in that foreign direct investment inflows market tend to substitute import demand in domestic market, which cause lower responsiveness of import demand. Lower degree of pass-through from the presence of foreign direct investment is likely to increase the possibility of not being able to hold the Marshall-Lerner Condition. This condition also explained in Tille (1999, 2000) in that a country can benefit from the depreciation of domestic currency, called *Beggar-thy-neighbor*, or is adversely affected, by what is known as *Beggar-thyself*, depends on the degree of substitutability between goods produced domestically or internationally. If the cross-country substitutability is high, domestic customers still pay higher price for import within currency devaluation, which causes the inability of the trade balance to improve. Our result causes trade policymakers to worry as to how to implement international trade policy. One of the solutions is to have the intermediaries owned by domestic people to allow consumer prices to be independent from imported prices. With this result, the degree of cross-country substitutability would decrease and it would encourage domestic customers to purchase more domestic products and less imported goods.

Appendix

This section considers estimation of a panel data model with disturbance that is autocorrelated, based on some geographic measure. However, estimation of spatial panel data should be considered whether time dimension is small or large. If the time dimension is large, the panel data can be considered to estimate a seemingly unrelated regression model, or an error component model to permit for cross sectional correlation, and estimate the cross sectional correlations via the time dimension of the panel. This means that, if time dimension is large, feasible and efficient estimation is preceded. Unfortunately, the usual panel data case, as well as those in this paper, is when the cross sectional dimension is large and the time dimension is small (fixed), so this small dimension of time variables violates the consistent estimation of the cross sectional correlations. Specifically, we apply the Druska and Hoxby (2004) estimation procedure to the usual panel data case and introduce a generalization of their estimator based on certain restrictions on the spatial dependence over time. It is also important to stress that the panel data presented is for the case where T is small and fixed, consequently the current discussion also hinges on the ex ante specification of a spatial weight matrix. If the time dimensions are allowed to grow, the specification of the weight matrix becomes unnecessary. In our concern to show the spatial panel data of small T , as in this paper, 12 years during 1989-2000 and more than one hundred (of U.S.) worldwide exporting countries shows that consistent estimation of cross sectional correlations in the error process may not be justified.

Consider the fixed effect model,

$$y_{it} = \alpha_i + \beta'X_{it} + \varepsilon_{it}, i=1, \dots, N; t=1, \dots, T, \quad (A1)$$

where β is $(k \times 1)$ and X_{it} is $(1 \times k)$. T is assumed to be fixed, so we cannot rely on T -asymptotic, then collecting i the model becomes

$$y_t = \alpha + \beta'X_t + \varepsilon_t, t=1, \dots, T, \quad (A2)$$

where $\alpha' = [\alpha_1, \dots, \alpha_N]$ and X_t is $[N \times k]$. Suppose that the error term is spatially lagged so that

$$\varepsilon_t = \lambda_t W_t \varepsilon_t + u_t, t=1, \dots, T,$$

$$\varepsilon_t = (I_N - \lambda_t W_t)^{-1} u_t \quad (A3)$$

where element u_t is independently and identically distributed with zero-mean and finite variance σ^2_t . λ is the scalar, spatial autoregressive parameter, where $|\lambda| < 1$. W_t is a $(N \times N)$ spatial weighting matrix, which captures the spatial autocorrelations across cross sectional units. All diagonal elements of W_t are zero and the matrix. $(I_N - \lambda_t W_t)$ is non-singular ($|\lambda| < 1$). The elements of W_t are w_{ijt} chosen based on some geographic or economic measures such as contiguity, distance, or trade between regions.

The estimation of λ_t and σ^2_t allows feasible and efficient estimation of initial equation y_{it} above. It also notes that if $\lambda_t = \lambda$ and $\sigma^2_t = \sigma^2$, and T is large and $T \rightarrow \infty$ then $E(u_t u_t')$ is constant. However, here assuming that T is fixed, the estimation $E(u_t u_t')$ is then not reasonable consistent. Now, assume that λ_t and σ^2_t are known, collecting t ,

$$y = \iota_T \otimes \alpha + x\beta + \varepsilon, \quad \varepsilon = (\lambda^* \otimes I_N)W^* \varepsilon + u \quad (A4)$$

where ι_T is a T dimension column vector of ones, x is $(NT \times k)$ and

$$W^* = \begin{bmatrix} W_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & W_T \end{bmatrix}, \quad \lambda^* = \begin{bmatrix} \lambda_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \lambda_T \end{bmatrix}$$

Then, we can notice that $E(uu') = \begin{bmatrix} \sigma_1^2 I_N & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \sigma_T^2 I_N \end{bmatrix}$. In this case, we can justify that the disturbance u is spatially

heteroskedastic. Now, define $\Phi_t = (I_N - \lambda_t W_t)/\sigma$ and pre-multiply the model in equation y_t to get,

$$y_t^* = \alpha_t^* + X_t^* \beta + u_t^*, \quad (A5)$$

where,

$$y_t^* = \Phi_t y_t, X_t^* = \Phi_t X_t, \alpha_t^* = \Phi_t \alpha, \text{ and } u_t^* = \Phi_t u_t$$

Collecting t , we can generate the transformed equation as follows:

$$y^* = \alpha^* + X^* \beta + u^*, \quad (A6)$$

where $\alpha^* = [\alpha_1^*, \dots, \alpha_T^*]'$, and NT is the dimensional column vector. This above equation y^* now proceeds a "well-behaved" disturbance, that is $E(u^*) = 0$ and $E(u^* u^{*'}) = I_{NT}$. The identification of estimates of the parameters in equation y^* hinges on estimation of the unknown parameters W_t and λ_t which will be ultimately undertaken in the sequel.

Because the "contiguity matrix" $[W]_{N \times N}$ of N countries is selected by creating the w_{ij} , where $w_{ij} = c_{ij} / \sum_{i=1}^N c_{ij}$ and c_{ij} is

equal to one if countries i and country j share a boundary, we can imply that the weight matrix is fixed over time and would match to Fully Restricted Specification procedure based on Druska and Horrace (2001).⁹ As this case we can see that $W_1 = \dots = W_T = W$, $\lambda_1 = \dots = \lambda_T = \lambda$, and $\sigma_1^2 = \dots = \sigma_T^2 = \sigma^2$, implying that $\Phi_1 = \dots = \Phi_T = \Phi$.

Then, $\alpha_t^* = \Phi \alpha^*$ in equation (A5) and $\alpha^* = I_T \otimes \Phi \alpha$ in equation (A6). In this case, the error term ε of equation (A4) is no longer heteroskedastic, but it has variance matrix $E(\varepsilon \varepsilon') = \sigma^2 I_{TN}$, so Φ need not be a function of σ for efficiency. Therefore, the fixed effect estimation of equation (C6) under this full restriction will then be efficient for α^* and β if λ and σ^2 are known.

If we figure out that $W_1 = \dots = W_T = W$, $\lambda_1 = \dots = \lambda_T = \lambda$, and $\sigma_1^2 = \dots = \sigma_T^2 = \sigma^2$, another challenging step is to find $\hat{\Phi}_t = (I_N - \hat{\lambda}_t W_t)$, where we can substitute $\hat{\Phi}_t$ for Φ_t and estimate equation (A6). The average estimates of λ are $\hat{\lambda} = T^{-1} \sum_T \hat{\lambda}_t$. We call these estimations the *fully restricted average* estimates. The estimates will

be consistent as $N \rightarrow \infty$. These are implied two-stage estimates, where the first-stage unrestricted estimates are calculated ($\hat{\lambda}_t$) which can be used to estimate

$$\hat{\Phi} = (I_N - \hat{\lambda}_t W_t)$$

which can be substituted as Φ and can be used to estimate the second-stage fixed effect of equation (C6)¹⁰

The spatial autocorrelation has been tested in the standard model of panel data that we estimated as the column (I) of the five industries. Then, we use the residuals from these standard fixed effect estimation to determine, which industries spatial correlation exists, by employing the most widely used test for spatial dependence, called the *Moran's I Statistic*. The test using λ coefficients and *Moran's I statistics* generates the same result of testing the spatial autocorrelation in error components. The results show that spatial autocorrelation in the error term existing in three out of five sample industries, which are the Electronic Computer (SIC-3571), the Telephone and Telegraph Apparatus (SIC-3661), and Motor Vehicle Parts and Accessories (SIC-3711), measure foreign direct investment variables in non-monetary units. In the other remaining two industries. Semiconductors and Related Devices (SIC-3674) and Aircraft (SIC-3721), the spatial correlation problems seems not to exist. The positive sign of λ_t and φ_t means that the spatial error component is "positively" correlated and the negative sign means that it is "negatively" spatial correlated.

References

Clark T., Kotabe M., & Rajaratnam D. (1999). Exchange rate pass-through and international pricing strategy: A conceptual framework and research propositions. *Journal of International Business Studies*, 30(2), 249-268

- Desiraju, R. & Shrikhande, M. (1996). *Exchange Rate Pass-Through and the Role of International Distribution Channels* (Working Paper No. 96-22). Atlanta: Federal Reserve Bank of Atlanta.
- Devereux, M. and Engel C. (2000). *Monetary Policy in the Open Economy Revisited: Price Setting and Exchange Rate Flexibility* (NBER Working Paper, No. 7665). Cambridge, MA.: National Bureau of Economic Research.
- Devereux, M., Engel C., & Tille, C. (1999), *Exchange rate pass-through and the welfare effects on the Euro* (NBER Working Paper, No. 7382). Cambridge, MA.: National Bureau of Economic Research.
- Dornbusch, R. (1987). Exchange Rates and Prices. *The American Economic Review*, 77, 93-106.
- Druska V. & Horrace, W.C. (2004) "Generalized Moments Estimation for Spatial Panel Data: Indonesian Rice Farming," *American Journal of Agricultural Economics*, 86(1), 185-198
- Engel, C. & Rogers, J.H. (1995). *Regional patterns in the Law of One Price: The roles of geography vs. currencies* (NBER Working Paper No. 5395), Cambridge, MA.: National Bureau of Economic Research.
- Engel, C. & Rogers, J.H. (1996). How wide is the border?. *American Economic Review*, 88(5), 1112-1125.
- Gron, A. and Swenson, D.L. (1996). Incomplete Exchange-Rate Pass-Through and Imperfect Competition: The Effect of Local Production. *The American Economic Review*, 86(2), 71-76.
- Isard, P. (1977). How far can we push the Law of One Price?. *The American Economic Review*, 942-948.
- Knetter, M.M. (1989). Price discrimination by U.S. and German exports. *The American Economic Review*, 79(1), 198-210.
- Knetter, M.M. (1992). *Exchange Rates and Corporate Pricing Strategies* (NBER Working Paper No. 4151), Cambridge, MA: National Bureau of Economic Analysis.
- Mann, C.L. (1986). Prices, Profit Margins, and Exchange Rates. *Federal Reserve Bulletin*, 72, 336-379.
- Marston, R. (1990). Pricing to Market in Japanese Manufacturing. *Journal of International Economics*, 29(3-4), 217-236.
- Oman, C. (2000). *Policy competition for foreign direct investment: A study of competition among governments to attract FDI*. Development Centre Studies, OECD Publications.
- Pholphirul, Piriya. (2006). "An International Duopoly Model of Multinational Enterprise And Exchange Rate Pass-Through Strategy: Business Implications and Policy Debates", *International Review of Business Research Paper*, 2(3), 1-21.
- Rangan, S. and Lawrence, R.Z. (1993). The Responses of U.S. Firms to Exchange Fluctuations: Piercing the Corporate Veil. *Brookings Paper on Economic Activity*, 1993(2), 341-369.
- Tille, C. (1999). *The role of consumption substitutability in the international transmission of shocks* (Working Paper No. 67). New York: The Federal Reserve Bank of New York.
- Tille, C. (2000). 'Beggars-thy-Neighbor' or 'Beggars-thyself'? *The income effect of exchange rate fluctuations* (Working Paper, No.112). New York: The Federal Reserve Bank of New York
- United Nations Conference on Trade and Development (2001). Promoting linkages. In UNCTAD, *World Investment Report*. New York and Geneva: United Nations.
- Yoshida, Y. (1999). *The Effect of Vertical Structure on Exchange Rate Pass- Through* (Discussion Paper Series No. 5): Tokyo, Japan: Faculty of Economics, Kyushu Sangyo University.
- Yoshida, Y. (2001). *Foreign Direct Investment and Exchange Rate Pass-Through: Access to Foreign Markets* (Discussion Paper Series No. 8). Tokyo, Japan: Faculty of Economics, Kyushu Sangyo University.

Notes

Note 1 See, for example Dornbusch (1987), Mann (1986), and Marston (1990)

Note 2 The markup power can be misinterpreted if the typical pass-through treats costs as directly observable, measured by the firms' marginal cost. For example, first, marginal cost can be changed from currency fluctuation if production cost depends on imported input factors. Second, currency fluctuation may also lead to a change of marginal cost and markup if the appreciation leads to a contraction in output due to reduced foreign demand, which would further reduce marginal costs if marginal costs were increasing in output.

Note 3 Because we are going to use annual 4-digit FAS unit value data to measure the port of export, net of transportation cost, tariffs, and other costs of distribution in the destination market, thus many dimensions of the transactions are identical, apart from the location of buyers. But it is likely that there is physical product differentiation within 4-digit classifications, hence, there is no guarantee that marginal cost is common to all destinations.

Note 4 Unit values are the only measure of price that is available on a destination-specific basis. This was firstly done by Isard (1977) to investigate the Law of One Price. However, Isard compared U.S. import unit values from Germany, Japan, and Canada in a given industry to the aggregate U.S. export unit values in the same industry. What we do here is compare unit FAS values from a single source country, which is U.S., across multiple destination markets

Note 5 Yoshida (2001) uses similar methodology by classifying local subsidiaries as subsidiaries for “production” and subsidiaries for “distribution”. He explains that the distribution subsidiaries of exporting firms have significant effects to the independent local distributors. The bargaining power should shift from independent local distributors to exporters and its own subsidiaries for distribution. We might call this effect as “power-shift” effect. In terms of exchange rate pass-through, power-shift effect is associated with decreasing pass-through.

Note 6 There is a paper by Engel and Rogers (1995 and 1996) which answers the first of these questions very clearly. They use CPI data for U.S. and Canadian cities to study two potentially important determinants of relative price volatility across locations: distance and border. The results show that distance does help explain the degree of price variation between city pairs, the U.S.- Canadian border, which is also very important

Note 7 Analysis of prices alone can only give minimal information about market power. A quantitative assessment of market power requires analysis of quantity response as well. The quantity fluctuations can be significant in representing true fluctuation in demand or consumption of the export good in destination markets. Anyhow, price discrimination across countries is still the most prominent in explaining markup ability and market power that export firms would have.

Note 8 The *Backward Linkages* exist when foreign affiliates acquire goods or services from domestic firms and the *Forward Linkages* happen when foreign affiliates sell goods or services to domestic firms. *Horizontal Linkages* involve interactions with domestic firms engaging in competing activities. Linkages can also be defined in term of non-business entities such as universities, training centers, research and technology institutes, or private institutes (UNCTAD, 2001).

Note 9 This tends to test the border or the contiguity effect has on international pricing. Even the distance effect is not applied to test for this spatial error components. Engel and Rogers (1995 and 1996) find that border is equivalent to approximately 1,780 miles in terms of its effect on relative price variability, in spite that there are practically no trade restrictions between the two countries.

Note 10 Based on Druska and Horrace (2004), $\hat{\lambda}_t$ and σ_t^2 can be estimated by using the Generalized Moments

Estimation method. And, $\hat{\Phi}_t = \frac{(I_N - \hat{\lambda}_t W_t)}{\sqrt{\hat{\sigma}_t^2}}$, if we impose the Partially Restricted Specification that weight matrix W_t

are not constant over time, so that $W_1 \neq \dots \neq W_T$, $\lambda_1 \neq \dots \neq \lambda_T$, and $\sigma_1^2 \neq \dots \neq \sigma_T^2$

Table 1. Result of Fully-Restricted Average Estimation of Spatial Panel Data: 3571 (Electronic Computer)

Independent Variables	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
- <i>e</i>	-0.008** (-1.64)	0.004 (0.23)	-0.007* (-1.49)	-0.014* (-1.50)	-0.007* (-1.45)	0.002 (0.11)	-0.009** (-1.68)	-0.009* (-1.62)
- <i>gdp</i>	0.021*** (2.27)	0.022*** (2.37)	0.021*** (2.25)	0.020*** (2.16)	0.020*** (2.19)	0.021*** (2.31)	0.020*** (2.23)	0.021*** (2.25)
- <i>PPI</i>	0.016 (0.36)	0.024 (0.32)	0.016 (0.36)	0.016 (0.37)	0.016 (0.36)	0.014 (0.32)	0.016 (0.36)	0.016 (0.36)
- <i>p_t(t-1)</i>	0.421*** (19.84)	0.420*** (19.76)	0.421*** (19.82)	0.418*** (19.68)	0.420*** (19.82)	0.417*** (19.63)	0.421*** (19.81)	0.421*** (19.82)
- <i>e*SUBSIDIARY1</i>	- -	-0.035* (-1.37)	- -	- -	- -	-0.047** (-1.57)	- -	- -
- <i>e*SUBSIDIARY2</i>	- -	0.045 (0.31)	- -	- -	- -	- (0.17)	0.024 (0.17)	- -
- <i>e*SUBSIDIARY3</i>	- -	0.001 (0.57)	- -	- -	- -	- -	- -	-0.001 (-0.15)
- <i>e*AFFILIATION1</i>	- -	- -	-0.005*** (-2.15)	- -	- -	0.019 (0.55)	- -	- -
- <i>e*AFFILIATION2</i>	- -	- -	-0.016 (-0.08)	- -	- -	- (-0.18)	-0.037 (-0.18)	- -
- <i>e*AFFILIATION3</i>	- -	- -	-0.037 (-0.62)	- -	- -	- -	- -	-0.052 (-0.83)
- <i>e*J_VENTURE1</i>	- -	- -	- -	-0.116** (-1.83)	- -	-0.082** (-1.64)	- -	- -
- <i>e*J_VENTURE2</i>	- -	- -	- -	0.115 (0.58)	- -	- -	0.081 (0.45)	- -
- <i>e*J_VENTURE3</i>	- -	- -	- -	-0.140* (-1.41)	- -	- -	- -	-0.010 (-0.12)
- <i>e*DIVISION1</i>	- -	- -	- -	- -	-0.018 (-0.54)	-0.027 (-1.04)	- -	- -
- <i>e*DIVISION2</i>	- -	- -	- -	- -	0.132 (0.40)	- -	0.117 (0.36)	- -
- <i>e*DIVISION3</i>	- -	- -	- -	- -	0.002 (0.39)	- -	- -	0.003 (0.38)
Adjust R-Square	.19	.19	.19	.19	.19	.19	.19	.19
Prob > F	.001	.001	.001	.001	.001	.001	.001	.001
Observations#	1,335	1,335	1,335	1,335	1,335	1,335	1,335	1,335

Note: Value enclosed in parentheses represents *t*-statistics. * $p < .20$. ** $p < .10$, *** $p < .05$. Estimated Coefficients of Year Dummies are not shown in this table

Table 2. Result of Fully-Restricted Average Estimation of Spatial Panel Data: 3661 (Telephone and Telegraph Apparatus)

Independent Variables	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
- <i>e</i>	0.016 (0.79)	0.010 (0.41)	0.013 (0.67)	0.019 (0.97)	0.015 (0.76)	0.012 (0.48)	0.015 (0.79)	0.012 (0.60)
- <i>gdp</i>	0.071*** (4.06)	0.073*** (3.96)	0.075*** (4.26)	0.068*** (3.85)	0.071*** (4.07)	0.073*** (3.97)	0.071*** (4.04)	0.077*** (4.23)
- <i>PPI</i>	0.166*** (3.08)	0.165*** (3.06)	0.165*** (3.07)	0.166*** (3.09)	0.166*** (3.08)	0.165*** (3.07)	0.165*** (3.07)	0.166*** (3.08)
- <i>p_i(t-1)</i>	0.187*** (7.91)	0.187*** (7.90)	0.185*** (7.80)	0.186*** (7.87)	0.187*** (7.91)	0.184*** (7.79)	0.186*** (7.88)	0.184*** (7.80)
- <i>e*SUBSIDIARY1</i>	- -	0.011 (0.29)	- -	- -	- -	0.008 (0.22)	- -	- -
- <i>e*SUBSIDIARY2</i>	- -	-0.021 (-0.10)	- -	- -	- -	- -	-0.016 (-0.07)	- -
- <i>e*SUBSIDIARY3</i>	- -	0.001 (0.14)	- -	- -	- -	- -	- -	0.002 (0.76)
- <i>e*AFFILIATION1</i>	- -	- -	0.060 (0.31)	- -	- -	-0.183* (-1.41)	- -	- -
- <i>e*AFFILIATION2</i>	- -	- -	0.255 (0.44)	- -	- -	- -	0.397 (0.71)	- -
- <i>e*AFFILIATION3</i>	- -	- -	0.087 (0.84)	- -	- -	- -	- -	-0.112* (-1.62)
- <i>e*J_VENTURE1</i>	- -	- -	- -	-0.069** (-1.65)	- -	-0.077* (-1.38)	- -	- -
- <i>e*J_VENTURE2</i>	- -	- -	- -	-0.078 (-0.22)	- -	- -	-0.206 (-0.63)	- -
- <i>e*J_VENTURE3</i>	- -	- -	- -	-0.047* (-1.52)	- -	- -	- -	-0.109* (-1.26)
- <i>e*DIVISION1</i>	- -	- -	- -	- -	0.041 (0.28)	0.038 (0.26)	- -	- -
- <i>e*DIVISION2</i>	- -	- -	- -	- -	- -	- -	- -	- -
- <i>e*DIVISION3</i>	- -	- -	- -	- -	0.042 (0.48)	- -	- -	0.036 (0.25)
Adjust R-Square	.17	.17	.17	.17	.17	.17	.17	.17
Prob > F	.001	.001	.001	.001	.001	.001	.001	.001
Observations#	1,201	1,201	1,201	1,201	1,201	1,201	1,201	1,201

Note: Value enclosed in parentheses represents *t*-statistics. **p* < .20. ***p* < .10, ****p* < .05. Estimated Coefficients of Year Dummies are not shown in this table

Table 3. Result of Fixed-Effect Panel Data Estimation: 3674 (Semiconductors and Related Devices)

Independent Variables	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
- <i>e</i>	-0.006*	-0.004	-0.001	0.002	0.004	-0.004	-0.002	0.012
	(-1.29)	(-1.12)	(-1.04)	(0.10)	(0.20)	(-1.10)	(-1.11)	(0.54)
- <i>gdp</i>	-0.256***	-0.281***	-0.226***	-0.262***	-0.275***	-0.272***	-0.256***	-0.284***
	(-9.21)	(-8.79)	(-9.00)	(-9.24)	(-9.02)	(-8.60)	(-9.13)	(-9.02)
- <i>PPI</i>	0.020***	0.022***	0.021***	0.021***	0.022***	0.021***	0.020***	0.022***
	(8.71)	(8.66)	(8.66)	(8.77)	(8.78)	(8.48)	(8.67)	(8.82)
- <i>p_t(t-1)</i>	0.314***	0.308***	0.312***	0.312***	0.310***	0.310***	0.313***	0.309***
	(11.55)	(11.33)	(11.48)	(11.44)	(11.38)	(11.39)	(11.52)	(11.34)
- <i>e</i> *SUBSIDIARY1	-	0.033	-	-	-	0.018	-	-
	-	(0.80)	-	-	-	(0.45)	-	-
- <i>e</i> *SUBSIDIARY2	-	-0.118*	-	-	-	-	-0.091**	-
	-	(-1.25)	-	-	-	-	(-1.90)	-
- <i>e</i> *SUBSIDIARY3	-	-0.002***	-	-	-	-	-	-0.002***
	-	(-2.31)	-	-	-	-	-	(-2.04)
- <i>e</i> *AFFILIATION1	-	-	-0.070	-	-	-0.027	-	-
	-	-	(-0.73)	-	-	(-0.35)	-	-
- <i>e</i> *AFFILIATION2	-	-	-0.104	-	-	-	-0.156	-
	-	-	(-0.24)	-	-	-	(-0.36)	-
- <i>e</i> *AFFILIATION3	-	-	0.007	-	-	-	-	0.066
	-	-	(0.08)	-	-	-	-	(0.42)
- <i>e</i> *J_VENTURE1	-	-	-	-0.077*	-	-0.050	-	-
	-	-	-	(-1.27)	-	(-0.87)	-	-
- <i>e</i> *J_VENTURE2	-	-	-	0.002	-	-	-0.040	-
	-	-	-	(0.01)	-	-	(-0.22)	-
- <i>e</i> *J_VENTURE3	-	-	-	0.023	-	-	-	0.005
	-	-	-	(0.32)	-	-	-	(0.08)
- <i>e</i> *DIVISION1	-	-	-	-	-0.004	-0.046	-	-
	-	-	-	-	(-0.06)	(-0.76)	-	-
- <i>e</i> *DIVISION2	-	-	-	-	0.004	-	-0.013	-
	-	-	-	-	(0.02)	-	(-0.06)	-
- <i>e</i> *DIVISION3	-	-	-	-	-0.021**	-	-	-0.011
	-	-	-	-	(-1.65)	-	-	(-0.66)
Adjust R-Square	.74	.74	.74	.73	.74	.73	.74	.74
Prob > F	.001	.001	.001	.001	.001	.001	.001	.001
Observations#	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114

Note: Value enclosed in parentheses represents *t*-statistics. * $p < .20$. ** $p < .10$, *** $p < .05$. Estimated Coefficients of Year Dummies are not shown in this table

Table 4. Result of Fully-Restricted Average Estimation of Spatial Panel Data: 3711 (Motor Vehicles and Passenger Car Bodies)

Independent Variables	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
- <i>e</i>	-0.014 [*] (-1.63)	-0.016 ^{**} (-1.67)	-0.016 ^{**} (-1.68)	-0.014 [*] (-1.62)	-0.015 ^{**} (-1.64)	-0.016 ^{**} (-1.67)	-0.014 [*] (-1.63)	-0.016 ^{**} (-1.70)
- <i>gdp</i>	0.135 ^{***} (6.61)	0.136 ^{***} (6.55)	0.136 ^{***} (6.60)	0.135 ^{***} (6.54)	0.135 ^{***} (6.58)	0.135 ^{***} (5.49)	0.135 ^{***} (6.59)	0.137 ^{***} (6.57)
- <i>PPI</i>	0.044 ^{***} (2.17)	0.044 ^{***} (2.18)	0.044 ^{***} (2.17)	0.044 ^{***} (2.18)	0.044 ^{***} (2.18)	0.044 ^{***} (2.17)	0.044 ^{***} (2.17)	0.044 ^{***} (2.18)
- <i>p_t(t-1)</i>	0.363 ^{***} (16.50)	0.364 ^{***} (16.49)	0.363 ^{***} (16.48)	0.363 ^{***} (16.49)	0.363 ^{***} (16.49)	0.363 ^{***} (16.47)	0.363 ^{***} (16.49)	0.363 (16.48)
- <i>e</i> *SUBSIDIARY1	- -	0.001 (0.01)	- -	- -	- -	0.005 (0.05)	- -	- -
- <i>e</i> *SUBSIDIARY2	- -	-0.367 ^{**} (-1.72)	- -	- -	- -	- -	-0.610 ^{**} (-1.84)	- -
- <i>e</i> *SUBSIDIARY3	- -	0.002 (0.39)	- -	- -	- -	- -	- -	0.001 (0.27)
- <i>e</i> *AFFILIATION1	- -	- -	0.012 (0.11)	- -	- -	0.056 (0.43)	- -	- -
- <i>e</i> *AFFILIATION2	- -	- -	0.006 (0.01)	- -	- -	- -	0.029 (0.05)	- -
- <i>e</i> *AFFILIATION3	- -	- -	0.016 (0.17)	- -	- -	- -	- -	0.015 (0.21)
- <i>e</i> *J_VENTURE1	- -	- -	- -	-0.025 (-1.22)	- -	-0.056 [*] (-1.43)	- -	- -
- <i>e</i> *J_VENTURE2	- -	- -	- -	-0.060 (-0.23)	- -	- -	-0.078 (-0.29)	- -
- <i>e</i> *J_VENTURE3	- -	- -	- -	0.035 (0.32)	- -	- -	- -	-0.004 (-0.04)
- <i>e</i> *DIVISION1	- -	- -	- -	- -	-0.022 (-0.11)	-0.006 (-0.04)	- -	- -
- <i>e</i> *DIVISION2	- -	- -	- -	- -	- -	- -	- -	- -
- <i>e</i> *DIVISION3	- -	- -	- -	- -	0.009 (0.25)	- -	- -	0.004 (0.15)
Adjust R-Square	.18	.18	.18	.18	.18	.18	.18	.18
Prob > F	.001	.001	.001	.001	.001	.001	.001	.001
Observations#	1,310	1,310	1,310	1,310	1,310	1,310	1,310	1,310

Note: Value enclosed in parentheses represents *t*-statistics. * $p < .20$. ** $p < .10$, *** $p < .05$. Estimated Coefficients of Year Dummies are not shown in this table

Table 5. Result of Fixed-Effect Panel Data Estimation: 3721 (Aircraft)

Independent Variables	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
- <i>e</i>	-0.083*** (-2.69)	-0.183*** (-5.43)	-0.085*** (-2.74)	-0.090*** (-2.84)	-0.090*** (-2.87)	-0.181*** (-5.37)	-0.084*** (-2.71)	-0.103*** (-3.27)
- <i>gdp</i>	0.031 (0.78)	0.022 (0.58)	0.028 (0.72)	0.033 (0.85)	0.031 (0.79)	0.017 (0.43)	0.029 (0.74)	0.024 (0.63)
- <i>PPI</i>	0.106*** (15.63)	0.108*** (16.32)	0.106*** (15.60)	0.107*** (15.62)	0.105*** (15.62)	0.108*** (16.33)	0.107*** (15.63)	0.107*** (15.91)
- <i>p_t(t-1)</i>	0.118*** (3.08)	0.114*** (3.05)	0.121*** (3.14)	0.118*** (3.06)	0.128*** (3.37)	0.115*** (3.07)	0.118*** (3.05)	0.123*** (3.24)
- <i>e*SUBSIDIARY1</i>	-	-0.255*** (-5.16)	-	-	-	-0.282*** (-5.91)	-	-
- <i>e*SUBSIDIARY2</i>	-	-0.066 (0.29)	-	-	-	-	0.094 (0.41)	-
- <i>e*SUBSIDIARY3</i>	-	0.008 (0.80)	-	-	-	-	-	0.043*** (3.70)
- <i>e*AFFILIATION1</i>	-	-	0.330 (0.75)	-	-	-0.030 (-0.13)	-	-
- <i>e*AFFILIATION2</i>	-	-	0.143 (0.56)	-	-	-	0.143 (0.56)	-
- <i>e*AFFILIATION3</i>	-	-	-0.076 (-0.30)	-	-	-	-	-0.006 (-0.05)
- <i>e*J_VENTURE1</i>	-	-	-	-0.003 (-0.03)	-	-0.142* (-1.48)	-	-
- <i>e*J_VENTURE2</i>	-	-	-	-0.289 (-0.87)	-	-	-0.289 (-0.87)	-
- <i>e*J_VENTURE3</i>	-	-	-	0.165 (0.97)	-	-	-	-0.267** (-1.64)
- <i>e*DIVISION1</i>	-	-	-	-	0.199*** (2.72)	0.064 (0.75)	-	-
- <i>e*DIVISION2</i>	-	-	-	-	0.402 (0.75)	-	0.459 (0.85)	-
- <i>e*DIVISION3</i>	-	-	-	-	-0.190*** (-3.25)	-	-	-0.173*** (-2.96)
Adjust R-Square	.35	.36	.34	.34	.37	.37	.34	.38
Prob > F	.001	.001	.001	.001	.001	.001	.001	.001
Observations#	969	969	969	969	969	969	969	969

Note: Value enclosed in parentheses represents *t*-statistics. **p* < .20. ***p* < .10, ****p* < .05. Estimated Coefficients of Year Dummies are not shown in this table

Table A1. Estimates of spatial error coefficients (λ_t), Moran's I Statistic (ϕ_t), Z-value of Moran's I Statistic (z_t), and Variance (σ_t^2) of Non-Monetary Unit Foreign Direct Investment): Electronic Computer (3571)

Year	λ_t	ϕ_t	z_t	σ_t^2
1989	0.190	0.118	1.859	0.011
1990	0.281*	0.172	2.651*	0.010
1991	0.280*	0.127	1.991*	0.014
1992	0.416*	0.213	3.273*	0.012
1993	0.288*	0.149	2.317*	0.019
1994	0.571*	0.181	2.795*	0.010
1995	0.492*	0.232	3.543*	0.014
1996	0.238	0.041	0.716	0.030
1997	0.492*	0.197	3.032*	0.015
1998	0.442*	0.213	3.272*	0.013
1999	0.528*	0.239	3.649*	0.013
2000	0.668*	0.271	4.122*	0.014

Note. * $p < .05$, spatial correlation existing in the error term

Table A2. Estimates of spatial error coefficients (λ_t), Moran's I Statistic (ϕ_t), Z-value of Moran's I Statistic (z_t), and Variance (σ_t^2) of Non-Monetary Unit Foreign Direct Investment): Telephone and Telegraph Apparatus (3661)

Year	λ_t	ϕ_t	z_t	σ_t^2
1989	0.461*	0.194	2.859*	0.015
1990	0.230	0.091	1.396	0.017
1991	0.121	0.039	0.653	0.022
1992	0.159	0.034	0.587	0.032
1993	0.410*	0.198	2.909*	0.013
1994	0.395*	0.164	2.430*	0.016
1995	0.351*	0.150	2.231*	0.015
1996	0.024	0.007	0.204	0.024
1997	0.433*	0.143	2.131*	0.020
1998	0.075	0.025	0.457	0.021
1999	0.357	0.096	1.459	0.025
2000	0.327*	0.111	1.675	0.020

Note. * $p < .05$, spatial correlation existing in the error term

Table A3. Estimates of spatial error coefficients (λ_t), Moran's I Statistic (ϕ_t), Z-value of Moran's I Statistic (z_t), and Variance (σ_t^2) of Non-Monetary Unit Foreign Direct Investment): Semiconductors and Related Devices (3674)

Year	λ_t	ϕ_t	z_t	σ_t^2
1989	0.138	0.063	1.006	0.016
1990	0.072	0.029	0.512	0.018
1991	-0.122	-0.045	-0.538	0.019
1992	-0.048	-0.020	-0.182	0.017
1993	0.032	0.015	0.311	0.016
1994	0.010	0.004	0.163	0.017
1995	0.031	0.013	0.296	0.016
1996	-0.017	-0.007	0.007	0.018
1997	0.116	0.050	0.822	0.016
1998	0.072	0.030	0.537	0.017
1999	0.099	0.043	0.711	0.017
2000	0.113	0.058	0.923	0.014

Note. * $p < .05$, spatial correlation existing in the error term

Table A4. Estimates of spatial error coefficients (λ_t), Moran's I Statistic (ϕ_t), Z-value of Moran's I Statistic (z_t), and Variance (σ_t^2) of Non-Monetary Unit Foreign Direct Investment): Motor Vehicle Parts and Accessories (3711)

Year	λ_t	ϕ_t	z_t	σ_t^2
1989	0.500*	0.232	3.499*	0.013
1990	0.342*	0.223	3.359*	0.010
1991	0.348*	0.198	3.000*	0.011
1992	0.469*	0.231	3.483*	0.012
1993	0.302	0.085	1.351	0.022
1994	0.296*	0.152	2.331*	0.013
1995	0.436*	0.191	2.894*	0.014
1996	0.479*	0.205	3.093*	0.014
1997	0.510*	0.180	2.735*	0.018
1998	0.601*	0.246	3.697*	0.014
1999	0.498*	0.156	2.378*	0.020
2000	0.380*	0.173	2.631*	0.014

Note. * $p < .05$, spatial correlation existing in the error term

Table A5. Estimates of spatial error coefficients (λ_t), Moran's I Statistic (ϕ_t), Z-value of Moran's I Statistic (z_t), and Variance (σ_t^2) of Non-Monetary Unit Foreign Direct Investment): Aircraft (3721)

Year	λ_t	ϕ_t	z_t	σ_t^2
1989	-0.141	-0.069	-0.729	0.017
1990	-0.189	-0.077	-0.826	0.021
1991	-0.026	-0.014	-0.062	0.016
1992	-0.181	-0.077	-0.826	0.020
1993	-0.029	-0.015	-0.076	0.017
1994	-0.147	-0.091	-0.987	0.014
1995	-0.060	-0.025	-0.200	0.021
1996	-0.260	-0.044	-0.429	0.050
1997	-0.128	-0.014	-0.069	0.076
1998	-0.148	-0.027	-0.218	0.047
1999	-0.010	-0.001	-0.094	0.112
2000	-0.084	-0.007	-0.023	0.107

Note. * $p < .05$, spatial correlation existing in the error term.