U.S. Foreign Direct Investment and Trade: Substitutes or Complements? The Case of the Food Processing Industry

Agapi Somwaru and Christine Bolling

Abstract

The role of foreign direct investment as a complement or substitute to foreign trade continues to be debated in regard to the food processing industry. This study extends earlier work to demonstrate that FDI and trade depend on the stage and the similarities of the economic development of the host countries, as macroeconomic factors--such as exchange rate fluctuations and income growth-- act differently in developing vs. developed countries, and exporting vs. importing countries.

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U.S. foreign direct investment (FDI) in processed food increased from $15 billion in 1990 to $32 billion in 1995. Over 75 percent of the US FDI in food processing is in the European Union (EU), and in NAFTA, APEC, and MERCOSUR countries (see figures 1 and 2). During the same period, sales from U.S. foreign direct investment were much larger than U.S. exports of processed food to these trading blocs (see figure 3).

The extent of U.S. FDI varies by region and country. U.S. foreign direct investment to the APEC processed food industry has more than doubled since 1990, reaching $13.8 billion in 1996. Canada, Mexico, Australia, and Japan are the principal host countries for U.S. foreign direct investment in processed food in the APEC region. In addition, the United States is a host country for a considerable amount of Canadian and Japanese foreign direct investment. U.S. foreign direct investment has also increased substantially in Argentina and Brazil, the principal trading partners of MERCOSUR.

Different studies disagree on the expected relationship between FDI and trade. Frankel (1997) stated that trade causes investment, rather than the other way around (p. 132). In other words, trade and FDI are expected to have a strong complementary relationship, especially after the Uruguay Round, as the establishment of more openness in trade has also led to liberalized rules for FDI. In contrast, several studies based on the Heckscher-Ohlin theory of comparative advantage suggest a negative relationship between FDI and trade. These studies argue that poor countries produce goods intensive in unskilled labor, and trade them to rich countries for goods intensive in capital and skilled labor. These studies have suggested a negative relationship between outward FDI and exports (see Ruffin, 1984).

On the other hand, the Linder (1961) hypothesis, along with Deardorff (1997) and Markusen (1986) state that capital rich countries will trade more with other capital rich countries than with capital poor countries, with a complementary relationship between trade and FDI prevailing. The Linder-style hypothesis states that countries with similar levels of per capita income will have similar preferences and similar but differentiated products, and thus will trade more with each other. Finally, the Helpman-Krugman hypothesis predicts that trade and FDI stem from economic development, not from similarity of the stage of development (Frankel, 1997, page 59). Countries with similar levels of output per capita will trade more than countries with dissimilar levels.

U.S. FDI and Processed Food Trade

Analytical work on the relationship between FDI and trade in the U.S. processed food industry provides mixed conclusions. Malanowski, et al. (1995) found evidence that exports may serve as a precursor to foreign direct investment. Overend, et al. (1995) explored the relationship between exports and FDI for six food manufacturing firms and found three disparate patterns among firms, suggesting that the export-FDI relationship is ambiguous. Gopinath, et al. (1998), using OECD countries as a sample, concluded substitutability between FDI and exports.

The purpose of this paper is to gain insights into FDI, foreign affiliate sales, and exports of the US food processing industry. Specifically, we attempt to associate U.S. foreign direct investment in processed food industries abroad first with the *stage of development* of the host countries under study, i.e. developed vs. developing, and second, with *similarities of the development of the countries*, i.e. net importers vs. exporters of processed food. We attempt to identify the factors affecting exports and FDI and identify their relationship under different stages of development and with the economic similarities of the countries involved. Previous studies on FDI, affiliate foreign sales, and trade in the U.S. food processing industry (Gopinath, et al., 1998, Malanowski, et al. (1995), Overend, et. al. (1995)) focus primarily on analyzing the determinants of FDI, foreign sales, and exports, and identifying the relationship between foreign sales and

trade. We go a step further by accounting for the stage of development and similarities in economic development.

In the next section we present the theoretical model and its empirical specification. Finally, we present analysis of the results and conclusions.

Theoretical Considerations

Numerous model specifications exist that allow for both production and sales in domestic and foreign markets while encompassing both outward and inward FDI. However, a theoretically sound model captures and simultaneously determines foreign direct investment and the linkages between exports and the decisions to invest and produce in the host countries. Barrell and Pain (1996) proposed a model that associates production and sales in both the home and host countries and allows for their consistent estimation. Their empirical model focuses on outward FDI. Gopinath, et al. (1998) adopted a special case of the Barrell and Pain (1996) model to identify the relationship between foreign sales and exports. Our specification follows Barrell and Pain (1996) and Gopinath, et al. (1998), where a differentiated product multinational monopolist exists with a foreign demand of $x_{2,}$ which can be satisfied by home production for export (x_1) or production in a foreign country (Q_2). The profit maximization problem facing the multinational firm is:

$$\Pi = \underset{x_1, Q_2}{\text{Max}} \{ P_1 x_1 + P_2(x_2, Q_2) Q_2 - TC_1(x_1) - TC_2(Q_2) - \lambda (x_1 + Q_2 - x_2) \} \qquad (1)$$

where P_1 is the export price, P_2 is the domestic price in the foreign market, Q_2 is foreign production and $TC_1(x_1)$ and $TC_2(Q_2)$ are the cost of producing x_1 and $Q_{2,}$ respectively. Applying the implicit function theorem we obtain the resulting solutions for x_1 and Q_2 utilizing a closed form solution (see Barrell and Pain (1996)). The resulting expression provides the marginal conditions for x_1 and Q_2:

$$\begin{aligned} x_1 &= f(P_{1,} \omega_{L1,} \omega_{K1,} \omega_{I1,} \omega_{L2,} \omega_{K2,} \omega_{I2,} \psi_2) \\ Q_2 &= g(P_{1,} \omega_{L2,} \omega_{K2,} \omega_{I2,} \omega_{L1,} \omega_{K1,} \omega_{I1,} \psi_2) \end{aligned} \qquad (2)$$

where P_1 is the export price, ω are the factor prices associated with the total costs at home and abroad, $TC_1(x_1)$ and $TC_2(Q_2)$, respectively, and ψ_2 represent the overall level of demand characteristics in the host market. The system of equations will yield optimal factor demand for labor (Li), capital (Ki), and intermediate (Ii) inputs for exports (i = 1) and foreign production (i = 2). If costs are minimized these marginal conditions, along with the associated cost minimization dual, yield the following reduced form equation system for FDI:

$$\begin{array}{ll} L_1 = L_1 (P_1, \omega_{L1}, \omega_{K1}, \omega_{I1}, x_1), & L_2 = L_2 (P_2, \omega_{L2}, \omega_{K2}, \omega_{I2}, Q_2) \\ K_1 = K_1 (P_1, \omega_{L1}, \omega_{K1}, \omega_{I1}, x_1), & K_2 = K_2 (P_2, \omega_{L2}, \omega_{K2}, \omega_{I2}, Q_2) \\ I_1 = I_1 (P_1, \omega_{L1}, \omega_{K1}, \omega_{I1}, x_1), & I_2 = I_2 (P_2, \omega_{L2}, \omega_{K2}, \omega_{I2}, Q_2). \end{array} \qquad (3)$$

Since foreign production is expressed as $Q_2 = f(L_2, K_2, I_2)$, then K_2 represents the inputs abroad financed by means of direct investment (Barrell and Pain (1996)). Due to data limitations, we only estimate x_1, Q_2, L_2, K_2, i.e. outward FDI . The theoretical approach delineated above provides us with the following empirical specification of the equations (x_1, Q_2, L_2, K_2):

$$\begin{array}{l} Q_2 = f (P_1, \omega_{L1}, \omega_{K1}, \omega_{I1}, \omega_{L2}, (GDP/capita), PSE, (XRT), u_1) \\ x_1 = f (P_1, \omega_{L1}, \omega_{K1}, \omega_{I1}, \omega_{L2}, (GDP/capita), PSE, (XRT), u_2) \\ L_2 = f (P_1, Q_2, \omega_{K1}, \omega_{L2}, (GDP/capita), PSE, (XRT), u_3) \\ K_2 = f (P_1, Q_2, \omega_{K1}, \omega_{L2}, (GDP/capita), PSE, (XRT), u_4) \end{array} \qquad (4)$$

where GDP/capita is the per capita income variable for the host country, PSE is the measure of protection for the host, and XRT is the U.S. dollar exchange rate for the foreign country.

Model specification

Both the Barrell and Pain (1996) and the Gopinath, et al. (1998) empirical analyses focus on outward FDI and cover primarily OECD countries and ignore other cases, such as the stage of development and similarities in economic development.

For our purpose, we choose the theoretical and empirical approach developed by Barrell and Pain (1996) and its special case adopted by Gopinath, et al. (1998). Our model estimation allows us to draw conclusions regarding FDI, export preferences, and similarities in the levels of

per capita income between the home and host countries. Also, the model is used to evaluate North-South trade patterns and to examine if trade, and FDI, stem from the stage of economic development and not from the similarity in the stage of development.

We used a time-series cross-section regression (TSCSREG) procedure in SAS to estimate each of the equations in (5) individually and as a panel model. To account for three error structural problems--heteroskedasticity regarding the differential levels of FDI in various countries, serial correlation, and contemporaneous correlation between cross-sections-- we used two types of error structures available in SAS. Specifically, the Parks (1967) method, which assumes a first order auto-regressive error structure with contemporaneous correlation between cross sections, and the Fuller and Battesse method were used to estimate a mixed variance moving average process for the errors.

Data Used in Empirical Estimation

The study covered the years 1984-94. Data on FDI were obtained from the U.S. Department of Commerce. Data on the foreign direct investment positions abroad for the food processing industry (SIC 20) were obtained from the *Survey of Current Business.* Data on sales by FDI affiliates, employment, and employment compensation were obtained from the annual *U.S. Direct Investment Abroad: Operations of Parent Companies and Their Foreign Affiliates.* Price and quantity indexes of U.S. processed food exports were calculated from the quantity and value of 30 processed foods obtained from annual issues of *Foreign Agricultural Trade of the United States*, published by the Economic Research Service.

Producer Subsidy Equivalents (PSE) data were obtained from the Organization for Economic Cooperation and Development (OECD), Economic Research Service (ERS), and World Bank (Brazil and Argentina), and were used as a proxy to represent effective levels of protection for the food industries of the respective countries.

The U.S. interest rate, the host countries' populations, and exchange rates were obtained from *International Financial Statistics*, published by the International Monetary Fund. Real GDP data series expressed in 1987 dollars were originally obtained from the World Bank and supplemented with ERS data.

Model Results

We first estimated the four-panel specification accounting for the stage of development. We separately estimated the four-panel equations for the developed countries (Canada, Australia, Japan, and Korea) and developing countries (Mexico, Brazil, and Argentina). Second, controlling for similarities in the stage of development, we separately estimated the four-panel equations for exporting (Canada, Brazil, Australia, and Argentina) and importing countries (Japan and Korea).

Developing vs. Developed

Significant differences arise in the model results in a comparison between developing countries--here defined as Mexico, Brazil, and Argentina, and developed APEC countries-- Japan, Korea, Australia, and Canada (see table 1).

In the equation estimating FDI affiliate sales, U.S. exports to the developing countries are complementary rather than competitive. In the developing countries panel equations, real GDP growth is negatively related to FDI sales. This relationship is characteristic of a host country that exports processed products back to its home country, in this case the United States. This is a typical case of developing countries. A complementary relationship also exists for intermediate goods that are further processed in the host country. In contrast, real GDP growth is positively related in the developed countries, illustrating a competitive relationship.

The results of the U.S. export equation are robust and have the expected negative relationships between U.S. exports and U.S. export prices and the exchange rate. While real GDP is expected to be positively related to U.S. processed food exports, the estimated coefficient is negative for both the developing and developed countries, but not significant.

The labor demand equations for both groups are similar, and in both equations, wage rates and FDI sales are the most significant variables. Interest rate and protection policies are negatively related with labor demand in both the host developing and developed countries.

Finally, in the demand equations for FDI investment capital, the results of the developed and developing countries are different. The estimated coefficients of the developed countries are in line with those reported by the Gopinath, et al. (1998) analysis, which was concentrated exclusively on OECD countries. The most important difference between the developed and developing countries is on how the exchange rate affects FDI. As the US dollar appreciates in the developed, mostly APEC, countries, FDI increases in those countries (such as Australia and Canada). In the developing countries, the exchange rate variable is negative but insignificant.

Exporting vs. Importing

When countries are specifically divided between food exporters and food importers, some relationships are more sharply delineated. Exporters are defined as Brazil, Argentina, Canada, and Australia. Importers are given as Japan and Korea. Mexico was difficult to classify because it is alternatively a net exporter and net importer of food.

In the estimating equation for affiliate sales, the exchange rate appears to be significantly different between exporting and importing countries (see table 2). As the U.S. dollar appreciates, FDI sales increased in exporting countries, but declines in importing countries.

In both exporting and importing countries, the negative relationship between U.S. export prices and U.S. exports prevails in the U.S. export demand equation. The exchange rate also behaves the same as in the equation determining sales of U.S. processed food affiliates.

In the demand equation for labor, the determinants are strongest for importing countries. The PSE and exchange rate play opposing roles in determining demand for labor between importing and exporting countries.

In the demand equation for FDI, the exchange rate again plays a different role between exporting and importing countries. The equation reinforces the conclusion that as the dollar depreciates vis-à-vis the currencies of importing countries, FDI becomes more attractive in those

countries. In exporting countries, the opposite prevails. As the dollar appreciates, demand for FDI increases in exporting countries, as their prices become more competitive due to exchange rate fluctuations. Wage rates and U.S. domestic farm prices are also significant determinants of U.S. FDI in exporting countries.

Conclusions

This study attempts to gain insights into U.S. foreign direct investment in processed food and foreign trade, and questions the role of FDI as a complement or substitute to foreign trade. We extend earlier analytical work and demonstrate that U.S. FDI and trade in processed food depend on the stage and similarities of the economic development of the host countries as macroeconomic factors play different roles in developed vs. developing countries, and in exporting vs. importing countries.

Income growth is a positive determinant of U.S. foreign direct investment in processed food in most countries. Growth in income is a prerequisite driving consumer demand, whether it is satisfied by imports or foreign affiliate sales. There is also an opposing situation where some countries play a role as an important source of imports because they are low cost producers. The income growth-increase and FDI relationship in this case is not as robust, when the purpose of FDI is to establish an export platform in a host country rather than to serve the host country's domestic market.

The conditions in money markets have a strong impact on FDI particularly in the developing and importing countries. Depreciation of the dollar leads to an increase in U.S. foreign direct investment abroad in these countries and U.S. processed food exports and affiliate sales also increase. This is to say that U.S. companies position themselves in countries where earnings are expected to increase also on the basis of currency appreciation. The contrary reason comes into play in Canada/Australia, where an appreciation of the U.S. dollar leads to an increase in FDI. This may be because of their important roles as exporters of processed foods, where appreciation of the dollar makes their export products less expensive. In addition, the PSE, as a

measurement of protection, plays an important role in determining FDI and appears negatively related to foreign direct investment in all cases.

In conclusion, most variables determine FDI and trade in the same way. But there are some significant differences that appear, such as how exchange rate fluctuations, U.S. export prices for processed foods, and PSE's affect FDI and FDI foreign affiliate sales. The most statistically significant differences appear to relate to whether a country is a net exporter or importer of U.S. processed food products.

Table 1—Empirical Results From the Model, Developing vs. Developed countries

Equation 1: Determinants of Affiliate Sales from FDI Q2 (per capita GDP)				
	Developing Countries		**Developed Countries**	
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	-525.912	1729.854	-859.688	2379.713
P1	0.865	0.616	-2.031	1.999
Wages	59.548	39.497	-28.673*	7.241
Interest rate	-12.278	39.308	-35.699	53.541
US agricultural prices	42.932*	17.905	42.381*	17.915
Real GDP	-.928*	0.246	.154*	0.051
PSE	2.193	6.399	1.063	14.491
Exchange rate	519.832*	184.62	-2.776*	1.191
R2	0.822		0.898	
Equation 2: Determinants of U.S. Processed Food Exports x1 (per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	548.085	265.114	-287.198*	56.715
P1	-.220**	0.114	-.301*	0.117
Wages	14.901*	6.464	0.247	0.249
Interest rate	-13.223**	7.215	-1.507	1.484
US agricultural prices	-3.785	2.975	5.328*	0.488
Real GDP	-0.028	0.044	-0.005	0.001
PSE	-1.562	0.945	.552*	0.262
Exchange rate	44.696**	23.726	-.164*	0.038
R2	0.742		0.845	
Equation 3: Demand for Labor in Foreign Affiliates L2 (Per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	65.921	10.63	14.928*	5.433
P1	0.002	0.007	0.006	0.015
Wages	-.763*	0.425	-.154**	0.082
Interest rate	-1.087*	0.512	-0.014	0.298
FDI sales	.009*	0.001	.005*	0.001
Real GDP	-.014*	0.003	-0.001	0.001
PSE	-0.076	0.073	-0.241	0.065
Exchange rate	3.131	2.209	0.002	0.008
R2	0.883		0.888	
Equation 4: Demand for FDI Investment capital (per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	466.56	324.32	32.311	289.109
P1	0.091	0.256	-1.999	1.261
Wages	-12.266	14.201	1.463	5.081
Interest rate	-58.800*	15.8	-11.128	12.988
FDI sales	.443*	0.06	.371*	0.038
Real GDP	-0.024	0.112	0.027	0.019
PSE	-4.876*	2.102	-22.512*	4.335
Exchange rate	-30.93	54.199	2.151*	0.542
R2	0.915		0.878	

Developing countries model description: 3 cross sections and 11 time series length

Developed countries model description: 4 cross sections and 11 time series length

Table 2—Empirical Results from the model Importing vs. Exporting Countries

Equation 1: Determinants of Affiliate Sales from Foreign Direct Investment Q2 (per capita GDP)				
	Importing Countries		**Exporting Countries**	
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	-401.411	1247.011	-8117.745	1409.966
P1	0.522**	1.675	0.682*	0.305
Wages	-18.231	5.623	-26.293*	12.621
Interest rate	-57.829	35.523	-45.037	47.628
US agricultural prices	36.401**	11.865	91.902**	15.145
Real GDP	0.404	0.194	11.929	0.882
PSE	24.548**	6.464	5.248	3.199
Exchange rate	-4.581**	0.674	335.727**	112.102
R2	0.966		0.945	
Equation 2: Determinants of U.S. Processed Food Exports x1 (per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	80.659	195.809	-401.441**	83.187
P1	-0.461*	0.235	-0.162*	0.078
Wages	0.015	0.377	1.362*	0.793
Interest rate	-0.491	4.964	-13.204**	2.043
US agricultural prices	1.538	1.901	6.739**	0.867
Real GDP	-0.038	0.024	-0.075	0.057
PSE	0.535	0.967	-0.849*	0.511
Exchange rate	-0.154	0.097	8.962	6.789
R2	0.365		0.901	
Equation 3: Demand for Labor in Foreign Affiliates L2 (Per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	33.656**	8.942	23.765**	6.077
P1	0.018**	0.011	0.002	0.008
Wages	-0.095**	0.044	-0.723**	0.207
Interest rate	-0.376**	0.244	-0.514	0.451
FDI sales	0.001**	0.001	0.005**	0.001
Real GDP	-0.005**	0.002	-0.003	0.013
PSE	-0.137**	0.091	0.005	0.065
Exchange rate	-0.022**	0.008	5.785	2.455
R2	0.991		0.907	
Equation 4: Demand for FDI Investment Capital (per capita GDP)				
Variable	Parameter estimates	Standard error	Parameter estimates	Standard error
Intercept	1324.232**	195.692	218.441	185.201
P1	-0.874**	0.405	0.177	0.214
Wages	1.819	1.911	-11.365*	5.699
Interest rate	-26.946**	9.384	-43.154*	17.547
FDI sales	-0.039	0.034	0.191**	0.051
Real GDP	0.038	0.059	2.556**	0.755
PSE	-6.701**	2.125	-2.471	1.984
Exchange rate	-0.534*	0.226	171.986*	69.531
R2	0.808		0.906	

Developed countries model description: 4 cross sections and 11 time series length

Developing countries model description: 3 cross sections and 11 time series length

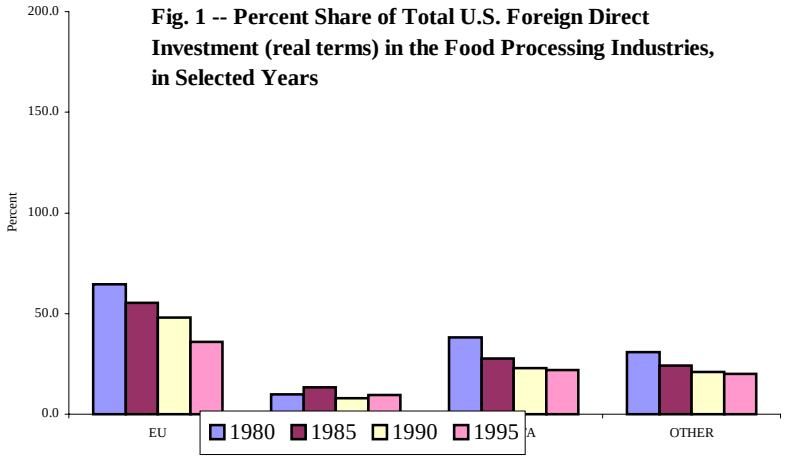

Fig. 1 -- Percent Share of Total U.S. Foreign Direct Investment (real terms) in the Food Processing Industries, in Selected Years

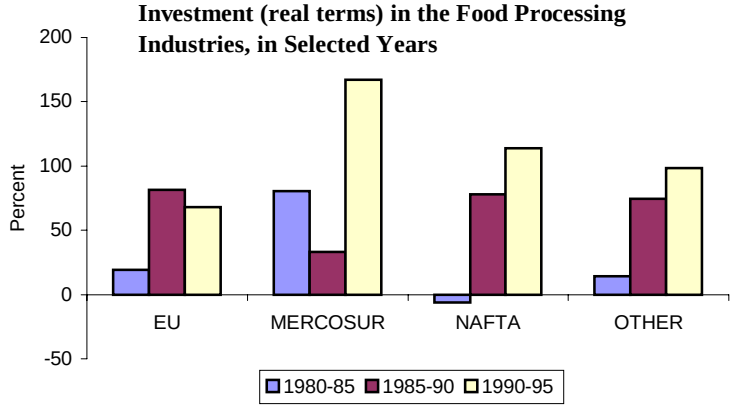

Fig. 2-- Percent Growth in U.S. Foreign Direct Investment (real terms) in the Food Processing Industries, in Selected Years

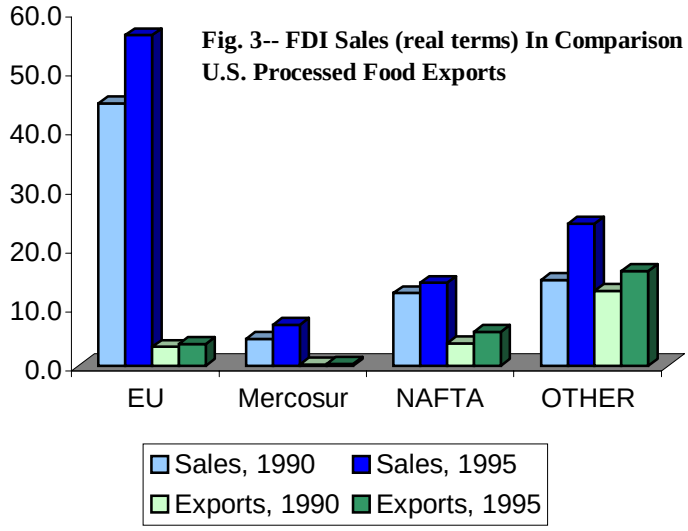

Fig. 3-- FDI Sales (real terms) In Comparison to U.S. Processed Food Exports

References

Barrell, Ray and Nigel Pain. "An Econometric Analysis of U.S. Foreign Direct Investment," The Review of Economics and Statistics, Vol. 78, No.2, pp.200-207, 1996.

Bolling, Christine, Steve Neff, and Charles Handy. *U.S. Foreign Direct Investment in the Western Hemisphere Processed Food Industry*. ERS Agr. Res. Report No. 760, Washington, DC, Mar. 1998.

Deardorff, Alan. "Determinants of Bilateral Trade: Does Gravity Work in a Classical World?," in the *Regionalization of the World Economy*, in Jeffrey Frankel (ed.), University of Chicago Press, Chicago, 1997.

Frankel, Jeffrey. *Regional Trading Blocks*, Institute for International Economics, Washington, DC, October 1997.

Gopinath, Musisamy, Daniel Pick, and Utpal Vasavada, "The Economics of Foreign Direct Investment and Trade with Implications for the Food Processing Industry. Selected Principal Paper, AAEA, Salt Lake City, Utah, 1998.

Helpman E. and P.R. Krugman, *Market Structure and Foreign Trade; Increasing Returns, Imperfect Competition and the International Economy*, MIT Press, Cambridge, Massachusetts, 1985.

Henderson, Dennis R., Charles R. Handy, and Steven A. Neff, eds. *Globalization of the Processed Foods Market*. U.S. Dept. Agr., Econ. Res. Serv., AER-742, Sept. 1996.

International Monetary Fund, *International Financial Statistics*, Selected Issues, Washington, DC, 1960-98.

Linder, S.B. *An Essay on Trade and Transformation*, New York, John Wiley and Sons, 1961.

Malanowski, M., C.K. Handy, and D.R. Henderson. "Time Dependent Relationships in U.S. Processed Food Trade and Foreign Direct Investment," NCR-182 Conference, Foreign Direct Investment and Processed Food Trade, Arlington, VA, Mar. 9-10, 1995.

Markusen, James R. "Explaining the Volume of Trade: An Eclectic Approach," *American Economic Review,* Vol. 76, pp. 1002-11, 1986.

Overend, C., J. M. Connor, and V. Salin. "Foreign Direct Investment and U.S. Exports of U.S. Processed Foods: Complements or Substitutes?" NCR-182 Conference, Foreign Direct Investment and Processed Food Trade, Arlington, VA, Mar. 9-10, 1995.

Pacific Economic Cooperative Council (PECC), *Survey of the Impediments to Trade and Investments in the APEC Area, 1995*.

Ruffin, R. J. International Factor Movements, In Jones, R.W. and P.B. Kenen (eds), *Handbook of International Economics*, North-Holland, Amsterdam, 1984.

U.S. Department of Agriculture, Economic Research Service. “Processed Foods Trade Data Set,” based on U.S. Department of Commerce SIC Export and Import Data. Washington, DC, undated.

World Trade Organization. *Canada 1996*, Geneva, pp.21-22.