U.S. Food Manufacturing Industry: The Choice of Exports vs. FDI

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Abstract

A system of four equations is estimated simultaneously to examine the relationship between U.S. processed foods export to and FDI in Canada, China, France, Japan, Korea, Mexico, Netherlands, and United Kingdom. Primary empirical results show that foreign affiliate sales has a substitution relationship with exports.

Background

Many U.S. food processing companies are among the top twenty five multinational enterprises (MNEs) in the world and located the majority of their affiliates in Europe. Similarly European firms are mainly interested to invest in the United States (Reed 2001). A profit maximizing multinational corporation has two options of producing at home and export or producing at host country which introduces the question that whether foreign direct investment (FDI) substitutes and/or complements exports (Gopinath, Pick, and Vasavada 1999).

Enterprises exploit benefits of their FDI through ownership, location, and internalization. Ownership advantages help MNEs exploit their considerable financial resources, organizational skills and market power in host countries. Locational advantages relate differences in factor and transportation costs, endowments, market size, etc. to firms' decision on FDI as a substitute for trade in goods. Internalization can make FDI profitable in case MNEs could sell its advantages through licensing and receive loyalty payments from firms in host country and derive cost savings from economies of scope (Reed 2001). The relationship between FDI and international trade determines whether FDI outflows benefit the home country as well as the host. In a broad sense, *horizontal* FDI substitutes exports which might adversely affect home country's balance of payments and employment, whereas *vertical* FDI have complementary relationship with trade and therefore more benefits would transfer to home country (Reed 2001; Gopinath, Pick, and Vasavada 1999).

United States Department of Commerce, Bureau of Economic Analysis reported a 5 percent increase in annual growth of U.S. total FDI and 1.6 percent in U.S. FDI in food manufacturing, reaching to $65.7 billion in 2014 (Jenniges and Fetzer 2015). Food processing industry in the U.S. had experienced a steady growth since 1989 in both foreign direct investment and exports while former has been always higher (Figure 1). There is a positive trend for both exports and FDI which may imply a complementary relationship.

<< Figure 1 >>

Figure 2 and 3 show the trend of U.S. food processing exports to and FDI in major destinations. Canada, Mexico, Japan, China, and South Korea are top five destinations for U.S. processed food exports (USDA 2015).

<< Figure 2 >>

On the other hand, U.S. multinational firms prefer to invest in Canada, United Kingdom, Mexico, Netherlands, and France. Food consumption pattern, however, has changed toward convenience foods and fast-food is more popular around the world. Eastern Asia is recently catching up with European countries in their competition to absorb U.S. investments in food manufacturing industry (BEA 2015).

<< Figure 3 >>

It is interesting that, ignoring Canada and Mexico as traditional and regional trade partners, East Asia is United States' top destination for exports of processed foods while Europe is favorite destination for investment in food manufacturing. Considerable U.S. FDI flowed to Europe after dismantling non-tariff trade barriers inside the EU would justified this trend. Neary (2009) explains, using export-platform model, how intra-bloc trade liberalization encourages FDI since this it asserts that the decision of locating a new plant depends on the size of trade-cost-adjusted market rather than just the size of the host-country market. Exploring the process of choosing between exports and FDI as market access strategies at the firm level is a difficult task due to the restricted access to data, however, it can be done at the country level using home and host country data. I include top five export and top five FDI destinations for U.S. food processing industry to examine whether the two strategies substitute or complement each other. Since Canada and Mexico are common in both lists, so the final list is finalized with eight countries.[1]

Empirical studies on the relationship between FDI and exports in processed food industry reported mixed results. Gopinath, Pick, and Vasavada (1999), hence GPV (1999), confirm a

[1] Canada, Mexico, Japan, China, Korea, United Kingdom, Netherlands, and France.

substitution relationship while several others concluded a complementary relationship between the two (Marchant, Cornell and Koo 2002; Mattson and Koo 2002; Marchant, Saghaina and Vickner 1999). GPV (1999) used historical data for ten high income countries, seven European countries plus Japan, Australia, and Canada, to estimated two production functions, derived from the profit maximization problem that a representative firm faces, and two demand functions, derived from cost minimization problem, individually. Marchant, Saghaina and Vickner (1999) focused only on China and Marchant, Cornell and Koo (2002), hence MCK (2002), included five East Asian countries and specified empirical equations for U.S. export and FDI. Both studies used simultaneous equation estimator to investigate the relationship between the two strategies. Mattson and Koo (2002) applied a similar approach using the data on countries on Western Hemisphere. Aside from the differences in their estimation methods, these studies focused on countries with different levels of development which might be the reason for contradicting results.

In this study eight countries, that had highest share of the U.S. foreign direct investment in food manufacturing industry since 1989, are included to investigate the relationship between FDI and exports in U.S. food processing industry. The main focus of this study is to 1) identify main determinants of U.S. exports and FDI in food processing industry; and 2) determine the relationship between exports and FDI. I should note that this is a work in progress and empirical results are preliminary and has not been finalized yet. There are remaining empirical questions that will be added to the manuscript upon completion of the analysis.

Theoretical Framework

Previous literature on determinants of FDI, exports and the relationship between them either specified empirical equations for FDI and exports, using multinational enterprise and trade theories, separately (Pfaffermayr 1994; Marchant, Saghaina and Vickner 1999; Carter and Yilmaz 1999; Yeaple 2003) or considered a representative firm and estimated derived equations from profit maximization (cost minimization) theory (Bajo-Rubio and Sosvilla-Rivero 1994; Barrel and Pain1996; Gopinath, Pick, and Vasavada 1999; Marchant, Cornell and Koo 2002; Neary 2009).

GPV (1999) assumes a representative multinational corporation is choosing between FDI and exports through a profit-maximization problem where total demand in the foreign market, x_2, is met by exports, x_1, and/or production in host country, Q_2:

$$\pi = \max_{x_1, Q_2}\{P_1 x_1 + P_2(x_1 + Q_2)Q_2 - TC_1(\boldsymbol{w_1}, x_1) - TC_2(\boldsymbol{w_2}, Q_2)\} \qquad (1.1)$$

where P_1 is export price, P_2 is host market price, w is input price and *TC*s are minimized production costs. From the first order conditions, accompanied by optimal factor demand functions, they drive a set of eight equations as follows:

$$x_1 = f(P_1, w_1, w_2, \psi_2) \qquad (1.2)$$
$$Q_2 = g(P_1, w_1, w_2, \psi_2)$$

$$L_1 = L_1(w_1, x_1); \qquad L_2 = L_2(w_2, Q_2) \qquad (1.3)$$
$$K_1 = K_1(w_1, x_1); \qquad K_2 = K_2(w_2, Q_2)$$
$$I_1 = I_1(w_1, x_1); \qquad I_2 = I_2(w_2, Q_2)$$

in which ψ_2 is demand characteristics of host market; and *L*, *K*, and *I* denote factor demand for labor, capital and intermediate inputs, respectively. However, they only specify and estimate each of x_1, Q_2, L_2, and K_2, individually which is in contrast with simultaneity of decision making at firms about various market penetration strategies. MCK (2002), on the other hand, estimate the two behavioral models, defined as FDI and exports, simultaneously. They introduce the FDI model as the result of cost minimization behavior of the representative firm in both domestic and foreign production. Therefore:

$$\min C = \alpha_d(Q_d)Q_d + \alpha_f(Q_f)Q_f \qquad (2.1)$$
$$\text{s.t } Q_d + Q_f = \bar{D}$$

where *C* denotes total cost of producing at home, Q_d, and in a foreign plant, Q_f, with unit costs of α_d and α_f, respectively. The firm minimizes its costs subject to total demand, $\bar{D}$. At the same time, the representative firms decides on the quantity of inputs (labor, L_f, and capital, K_f) used in producing Q_f. considering *w* and *k* as wage and cost of capital in the host country:

$$\min C_f = w_f L_f + w_f K_f \qquad (2.2)$$
$$\text{s.t } Q_f = L_f^a K_f^b$$

Deriving the firs order conditions from 2.1 and 2.2 and solving for K_f, capital stock, gives the behavioral equation which implies that *FDI* is a function of total demand, *D*, and unit production costs, *UC*:

$$FDI = \Phi(K_f) = f(D, UC) \quad (2.3)$$

They augmented 2.3 by adding trade barriers (*TB*), *GDP*, exchange rate (*EX*), unit labor cost (*C*), and capital cost (*IR*). In order to capture the simultaneity with FDI, they included exports (*XQ*) to the model and thus specify and estimate equation 2.4 as follows:

$$FDI = f(GDP, C, IR, TB, ER, XQ) \quad (2.4)$$

They specified export equation using consumer behavior theory and included *FDI* as the endogenous variable to capture simultaneity of firm's decision making.

$$XQ = f(GDP, XP, ER, FDI) \quad (2.5)$$

where XP denotes export price. They estimated 2.4 and 2.5 as a simultaneous system of equations.

While GPV (1999) found a substitution relationship between exports and FDI in U.S. processed food industry, MCK (2002) concluded a complementary relationship.

In this study I assume a profit maximizer representative multinational enterprise and derive equations 1.2 and 1.3 from the first order conditions.[2] However I estimate the specified equations as a simultaneous system using a three stage least square estimator. Next section explains how the behavioral equations are specified, augmented, and estimated.

Empirical Results

From the system of equations depicted in 1.2 and 1.3, I am estimating only four equations, regarding limited available data on other variables, which are specified in logarithm. In the following equations, t denotes time (1989 to 2014) and i denotes countries included in the study (Canada, China, France, Japan, Korea, Mexico, Netherlands, and United Kingdom). The empirical model is as follows:

$$lnSALES_{it} = \beta_0 + \beta_1 lnXPRICE_{it} + \beta_2 lnIR_{it} + \beta_3 lnER_{it} + \beta_4 lnGDPc_{it} + \beta_5 WAGE_{it} + \beta_6 lnPSE_{it} + \varepsilon_{1t} \quad (3.1)$$

[2] See Gopinath, Pick, and Vasavada (1999) for details on the derivation of first order conditions from equation 1.1

$$lnEXPORT_{it} = \alpha_0 + \alpha_1 lnXPRICE_{it} + \alpha_2 lnIR_{it} + \alpha_3 lnER_{it} + \alpha_4 lnGDPc_{it} + \alpha_5 WAGE_{it} + \alpha_6 lnPSE_{it} + \alpha_7 lnURB_{it} + \varepsilon_{2t} \quad (3.2)$$

$$lnEMP_{it} = \delta_0 + \alpha\delta_1 lnXPRICE_{it} + \delta_2 lnSALES_{it} + \delta_3 lnIR_{it} + \delta_4 lnGDPc_{it} + \delta_5 WAGE_{it} + \delta_6 lnPSE_{it} + \varepsilon_{3t} \quad (3.3)$$

$$lnFDI_{it} = \gamma_0 + \gamma_1 lnXPRICE_{it} + \gamma_2 lnSALES_{it} + \gamma_3 lnIR_{it} + \gamma_4 lnER_{it} + \gamma_5 lnGDPc_{it} + \gamma_6 WAGE_{it} + \varepsilon_{4t} \quad (3.4)$$

where *SALES* is the value of total foreign affiliate sales in food manufacturing industry; *XPRICE* is the unit value of processed foods exported to host countries which is considered as the proxy for export price; *IR* is a proxy for the cost of capital measured as the ratio of long term interest rate in hosting countries to long term interest rate in the U.S.; *ER* is nominal exchange rates index (1989=100); *GDPc* is the gross domestic product per capita; *WAGE* is a proxy for labor cost in host countries, calculated as the ratio of total employment compensations to total employment, by U.S. foreign affiliates in food manufacturing industry. *PSE*, Producer Support Equivalent, is an indicator of the annual monetary value of gross transfers from consumers and taxpayers to support agricultural producers, measured at farm gate level, arising from policy measures, regardless of their nature, objectives or impacts on farm production or income (OECD 2015). Empirical studies suggest that trade policies in host countries significantly affect decisions to invest abroad by U.S. food processors and clearly impact export flow to the host countries (Makki, Somwaru, and Bolling 2004; Marchant and Kumar 2004; Fung and Iizaka 2002). *EXPORT* is the quantity of U.S. processed food exports; and *URB* is urban population rate in host countries and is a proxy for development level of countries. Marchant and Kumar (2004) found that level of urbanization has a significant and positive effect on U.S. export of processed foods. *EMP* is total employment by U.S. foreign affiliates in food manufacturing industry; *FDI* is total foreign direct investment of United States in host countries in food manufacturing industry.

Data for U.S. processed food exports, total value and unit value, is obtained from USDA, Foreign Agricultural Service (USDA-FAS 2015) and real exchange rates from Economic Research Service (USDA-ERS 2015). Data for GDP per capita and interest rates are obtained from International Monetary Fund (IMF 2015) and urbanization ratio from the World Bank statistic database (World Bank 2015). Value of foreign direct investment and also affiliate sales and compensation to the employment by U.S. firms in food manufacturing industry is obtained from U.S. Department of Commerce, Bureau of Economic Analysis (BEA 2015). Producer support equivalent indicators are obtained from Organization for Economic Cooperation and Development statistics (OECD 2015). Table 1 represents the summary statistics of the variables used in the empirical model.

<< Table 1 >>

Table 2 represents the estimation results, standard errors and R^2 for the empirical model specified in equation 3.1 through 3.4 and estimated as a simultaneous equation system using 3SLS estimator in STATA. Since all variables are log transformed, parameter estimates are elasticities.

<< Table 2 >>

Considering column 2 and 3 of table 2, foreign affiliate sales are a substitute for exports in the U.S. processed food industry. The estimated coefficient for the export price is significant for both foreign affiliate sales and export equations, positive for the former and negative for the latter. Thus, one percent increase in price of exports increase foreign affiliate sales by 0.28 percent but reduces export quantity by 0.94 percent. This result is consistent with findings of GVP (1999), however they found alternative sign for estimated export price coefficient in the corresponding equations. This result holds with a caveat that I did not account for demand for intermediate goods, from home country, by foreign affiliates and therefore any possible impact of exporting intermediate goods, to be used in production process abroad, on the substitution relationship here is ignored. Interest rate has a negative but insignificant coefficient in both equations. Exchange rate is positive but only significant in exports equation. The estimated coefficient implies that 1 percent appreciation of U.S. dollar would increase exports by 0.57 percent. GDP per capita, as an indicator of development level of a country, is estimated to have a positive and significant effect on foreign affiliate sales and exports of U.S. processed food industry. However, income elasticity of foreign affiliate sales is nearly half of that for export quantity, 0.59 comparing to 1, which is similar to GVP (1999) findings. Wage, measured as total compensation for a worker in processed food industry by a U.S. foreign affiliate, has a significant and negative impact on sales. It implies that 1 percent increase in labor cost would decrease the sales by 0.59 percent. The magnitude of the coefficient is very similar to that of

GPV (1999) although they estimated the coefficient with the wrong, positive, sign. It is expected that protection policies have positive effect on affiliate sales and negative effect on exports, encourage investment and discourage trade. However I find a negative and significant estimate for Producer Support Equivalent (PSE) which is in contrast with the hypothesis that foreign sales and therefore FDI is protection-jumping. Urbanization rate has a significant and rather strong negative impact on exports quantity. Each additional increase in rate of urbanization reduces export quantities by 2 percent. This result might be highly correlated with the combination of the countries in our sample. Aside from Canada and Mexico, European countries with high urbanization rate are atop in FDI list and Asian countries with lower urbanization rates are importing the most. Therefore it confirms the preferences of U.S. firms to invest in Europe and export to East Asia. This would make sense particularly if non-tariff trade barriers, highly restricting regulation against GMO products, is considered. It is harder for U.S. food industry to export to Europe rather than Asia.

The last two columns of table 2 represent the estimation results of input demand, labor and capital, for producing in host countries. Since increase in export price, holding everything else constant, would increase foreign affiliate sales it is expected to have a positive and significant effect on demand for inputs also. The estimated coefficients in last two equations confirm that. Interest rate is not significant in input demand but exchange rate has a significant and positive effect on capital demand. The latter variable is not included in the demand for labor since GVP (1999) suggest that it is insignificant. Income elasticity of labor and capital demand is similar and about 1.55 and 1.51, respectively. As expected increase in wage would decrease demand for inputs. The sign for foreign affiliate sales is unexpectedly negative. Although the R2 for all estimated equations are relatively high, further investigation and robustness check is necessary to clarify and confirm the empirical result. So, it is highly recommended to interpret these results with caution and any citation is postponed to improved versions of the manuscript.

Conclusion

This study examines the relationship between U.S. processed foods export to and FDI in eight major destinations. A profit maximizer representative firm is assumed to construct a system of four equations which are estimated simultaneously using the annual data from 1989 to 2014. The preliminary estimation results show a substitute relationship between exports and FDI which is consistent with the results in Gopinath, Pick, and Vasavada (1999).

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Tables and Figures

Table 1 Descriptive Statistics of Variables

Variable	Unit	Mean	Std. Dev.	Min	Max
Foreign Affiliate Sales	Million dollars	7509.29	6395.69	97	34006
Export price	Dollar per MT	2415.6	1527.93	581	9699.6
Foreign long term interest rate	Percent	6.55	5.75	0.52	59.43
U.S. long term interest rate	Percent	5.1	1.85	1.80	8.55
Nominal exchange rate	Foreign per U.S. dollar	143.55	340.60	0.50	1401.44
GDP per capita	Dollar per person	23832.89	15311.99	343.3	57197.22
Employee compensation	Dollar per worker	25.60	25.15	0.8	160.4
Producer support equivalent (PSE)	U.S. dollars	21260.96	35421.2	-8483.58	292592.9
Nominal Assistance Coefficient (NAC)	Ratio	1.62	0.61	0.96	4.06
Nominal Protection Coefficient (NPC)	Ratio	1.50	0.614	0.91	4.02
Export Quantity	Thousands MT	997153.6	1350840	2393.6	6022240
Urbanization rate	Percent	73.85	14.27	25.70	93.02
Employment	Worker	805.84	648.65	4	2359
Foreign Direct Investment	Million dollars	2304.29	2282.03	10	13207

Table 2 3SLS estimation of the system

	Foreign Affiliate Sales (or FDI)	Exports Quantity	Affiliate Employment	FDI Demand
Export price	0.279* (0.163)	-0.940*** (0.0680)	0.204* (0.113)	0.856*** (0.221)
Interest rate (foreign/US ratio)	-0.201 (0.205)	-0.0869 (0.0879)	0.123 (0.131)	0.237 (0.260)
Exchange rate	0.128 (0.203)	0.573*** (0.0930)	-	0.575** (0.283)
GDP per capita	0.586** (0.293)	1.001*** (0.137)	1.546*** (0.271)	1.510*** (0.237)
Wage	-0.586*** (0.155)	0.0528 (0.0659)	-0.695*** (0.146)	-0.958*** (0.262)
PSE	-0.203** (0.103)	0.0457 (0.0550)	-0.126 (0.103)	
Urbanization rate	-	-2.002*** (0.449)	-	-
Foreign Affiliate Sales	-	-	-0.431** (0.203)	-1.168*** (0.286)
constant	4.906 (2.997)	16.30*** (2.072)	-1.645 (1.938)	-1.422 (3.703)
R^2	0.86	0.98	0.92	0.67

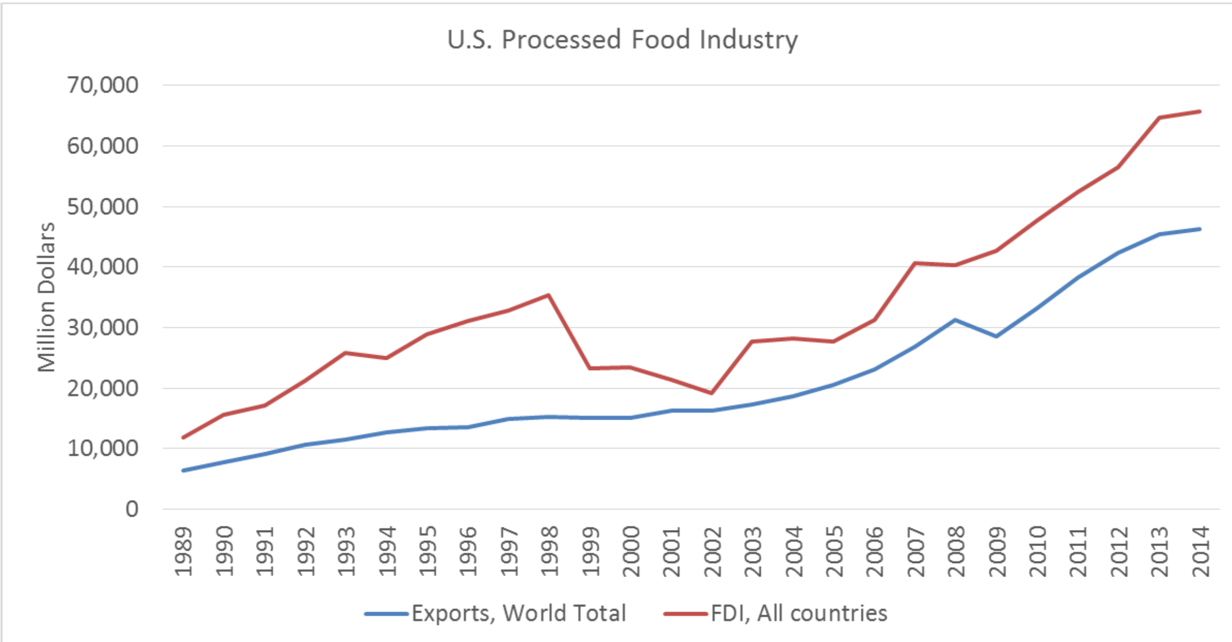

Figure 1 U.S. processed food exports and FDI

Source: USDA and BEA

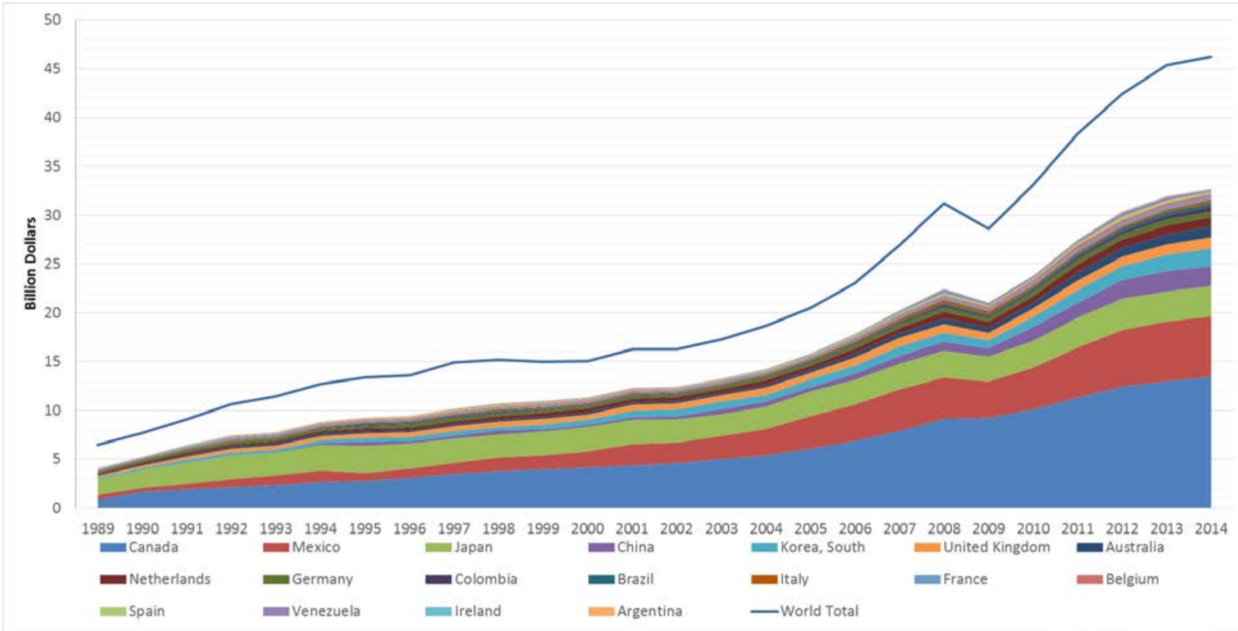

Figure 2 U.S. processed food export to major destinations

Source: USDA

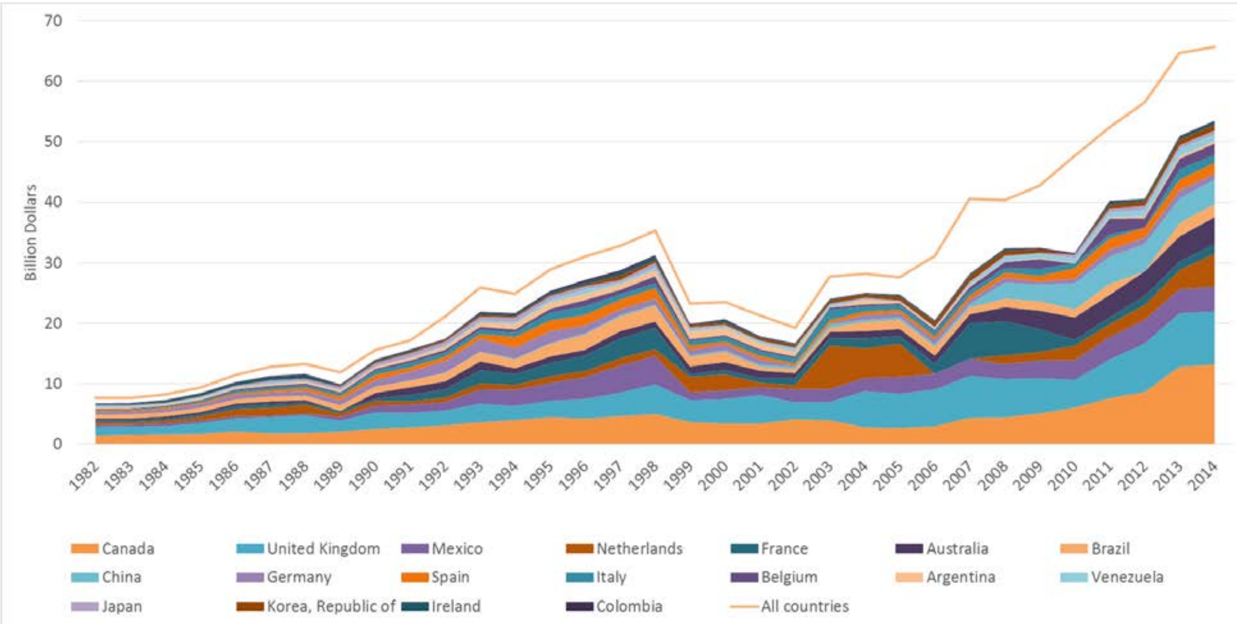

Figure 3 U.S. Direct Investment in Food Manufacturing (Historical-Cost Basis)

Source: U.S. Department of Commerce, BEA