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THE ECONOMICS OF FOREIGN DIRECT INVESTMENT AND TRADE WITH AN APPLICATION TO THE U.S. FOOD PROCESSING INDUSTRY

by
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The Economics of Foreign Direct Investment and Trade with an Application to the U.S. Food Processing Industry

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Abstract: This paper investigates the determinants of foreign direct investment (FDI) and its relationship to trade in the U.S. food processing industry. A representative multinational corporation maximizes profits by choosing between production in the home country, which is exported, and production in a foreign country. This introduces the possibility that foreign affiliate sales can be a substitute and/or complement for exports. The empirical framework consists of a system of four equations with foreign affiliate sales, exports, affiliate employment, and FDI as endogenous variables. The results confirm a small substitution between foreign affiliate sales and exports. The empirical evidence supports the hypothesis that FDI is also protection-jumping.

Introduction

The question of whether trade and foreign direct investment (FDI) are substitutes or complements has been addressed theoretically as well as empirically. This issue has been a concern for policy makers because of possible effects of outward FDI upon a country's balance of payments and employment of its work force. Based on a modified version of Heckscher-Ohlin-Samuelson (H-O-S) trade models, several studies have alluded to a negative relationship between outward FDI and exports (see Ruffin, 1984 for a survey). In particular, when the assumption of factor immobility is relaxed, exports and FDI turn into substitutes. This finding makes sense because trade flows within the H-O-S model are driven by differences in factor endowments, which remain fixed. As factors become mobile, the differences in factor endowments between countries become smaller, which has the effect of decreasing trade flows. Decline in exports and the associated loss in employment have long concerned labor unions and policy makers.

A contrary hypothesis is advanced by other research studies. The proponents of a complementary relationship between FDI and trade either follow a Ricardian tradition (Kemp 1966; Jones 1967; Markusen 1983) or relax the assumptions of fixed foreign markets and single product firms (Lipsey, 1994).[1] For instance, Graham (1996) argues that the home-country operations of a multinational firm can be vertically linked with the host-country operations such that an increase in the activity of the latter generates increased demand for intermediate goods from the former (Helpman 1984; Helpman and Krugman 1985). Lipsey and Weiss (1984) suggest that as foreign markets expand, presumably through income growth, it is possible for both exports and foreign affiliate sales to grow together and thus, benefit home country. To the extent that the shareholders of a multinational firm are nationals of the home country, the returns accruing to its foreign affiliates ultimately accrue to home country nationals through the parent organization.

Previous empirical investigations into the relationship between FDI and trade (Pfaffermayr, 1994) have relied on time series tests to identify whether they are complements or substitutes (see the Report to WTO Secretariat: Trade and Foreign Direct Investment for a comprehensive review). Graham (1996) notes that the real issue is whether the output of affiliates of U.S. firms created via FDI and trade are substitutes or complements. However, the empirical model proposed by several authors specify equations for direct investment abroad (an input) and trade in final output to estimate the relationship between the two by assuming that FDI is a surrogate for affiliate output (Graham 1996, Pfaffermayr 1996). Exceptions to this are Lipsey and Weiss (1981, 1984) who model exports and affiliate sales using cross-sectional and firm level data.

The case of the U.S. food processing industry is particularly interesting. As incomes have grown in several Asian and other developed countries, the composition of global agricultural trade has shifted towards high value processed food products, which account for two-thirds of $381 billion global trade in agricultural products and commodities (Henderson and Handy, 1994). There is an increasing concern that U.S. processed food exports have not kept pace with these changes in global markets. The U.S. share in global agricultural trade has fallen from 22 percent to under 15 percent, and processed foods account for less than 40 percent of total U.S. agricultural exports for the period 1962-94 (Gehlhar and Vollrath 1997). However, the United States accounted for 6 out of 10 of the world's largest food processing (multinational) firms and 21 out of 50 largest (Ruppel et al., 1996). In addition, sales by U.S. owned food processing affiliates are estimated to have reached $103 billion in 1994 (Neff et al., 1996). Declining export shares and the increasing role of U.S. owned multinational corporations (MNC) suggest some degree of substitution in the food processing industry.

The purpose of this study is to identify the relationship between foreign affiliate sales and exports in the U.S. food processing industry. This relationship has implications for who stands to gain from expansion in trade or international investment or both (labor or owners of capital). Our framework shares the views of Lipsey (1994) and focusses on foreign affiliate sales and exports, with FDI as an input into foreign production in a panel setting (ten countries for the period 1982-94). This approach has the added advantage of identifying the determinants of exports and FDI. Previous investigations into the relationship between FDI and trade in the U.S. processed food industry lack an analytical framework and, not surprisingly, have provided mixed results. Malanoski et al. (1995) find that the correlation between affiliate foreign sales and U.S. exports is negative for developed countries and positive for developing countries. The study by Overend et al. (1995) using firm-level data found two MNCs exhibiting a strategy of substitution between exports and FDI, while two other firms showed a complementary relationship.

In the next section, we present a model where a representative multinational firm chooses between exports and foreign sales to serve a host country market. The empirical framework section explains the approach taken to estimate the model. This is followed by a description of data. Finally, we discuss the empirical results and draw conclusions.

A Model of FDI and Exports

The main objective of this paper is to identify the relationship between exports from the home country (U.S.) and production in a host country by firms in the U.S. food processing industry. This is done by developing a theoretically consistent model of the determinants of foreign direct investment and the establishment of a linkage between the decisions to export and to invest. Specifically, it is assumed that a representative multinational corporation has two choices. These are: either to produce in the domestic market (x_1) for export, or to produce in the foreign country (Q_2). Together, domestic production for export and foreign production equal demand in the foreign market (x_2). Recently, Barrell and Pain (1996) proposed a model that focussed on demand for a commodity in both home and host countries, which allowed for production and sale in both markets. Our setup, a special case of the Barrell and Pain (1996) model, mimics a differentiated product monopolist with a foreign demand of x_2, which can be satisfied by home country production for export x_1 or production in a host country Q_2.[2] As our primary objective is on identifying the relationship between foreign sales (outward FDI) and exports, we restrict our attention to foreign demand only, which is consistent with most other studies on FDI and trade relationship (Lipsey, 1994). Moreover, about 80 percent of foreign production by U.S. owned multinational corporations in the food processing industry serves the host country market, and only a small amount (2 percent) is exported back to the United States. Thus, the profit maximization problem facing the multinational firm is:

$$\pi = \max_{x_1, Q_2} \{ P_1 x_1 + P_2(x_2,Q_2)Q_2 - TC_1(x_1) - TC_2(Q_2) - \lambda(x_1+Q_2-x_2) \}, \qquad (1)$$

where P_1 denotes export price, P_2 denotes domestic price in the foreign market, Q_2 denotes foreign production, and $TC(x_1)$ and $TC(Q_2)$ are the cost of producing x_1 and Q_2, respectively. For our empirical purposes, all costs and revenues are defined in a common currency, the U.S. dollar.

The identity $x_1 + Q_2 = x_2$ is not a constraint, but suggests that total demand in the foreign market (x_2), an endogenous variable of the model, is met by either exports or production in the foreign (host) country. Although it is obvious why exports and local production may be substitutes, it is not straightforward why they might be complements. For instance, if x_2 remained fixed at 100 units, then x_1 and Q_2 would move one-to-one in opposite directions (substitutes). However, if x_2 were to increase, as it can in our model, to 120 units, then x_1 and Q_2 could very well move together in the same direction.[3]

Note that the price in the export market (P_1) is assumed as given, while the firm behaves as a differentiated product monopolist in the host-country market. Since P_1 is a border price, it can differ from the internal price (P_2) to the extent that a country pursues protection policies. Moreover, in the presence of such barriers, it is likely that the border price reflects equilibrium in a broader world market.[4]

The first order conditions for a solution to the choice variables (x_1, Q_2, λ) are:

$$\pi_{x_1}: P_1 - \frac{\partial TC(x_1)}{\partial x_1} - \lambda = 0$$

(2)
$$\pi_{Q_2}: \frac{\partial P_2}{\partial Q_2} Q_2 + P_2(x_2, Q_2) - \frac{\partial TC(Q_2)}{\partial Q_2} - \lambda = 0$$

$$\pi_{\lambda}: x_1 + Q_2 = x_2.$$

There are 3 equations in 3 unknowns (x_1, Q_2, λ).[5] The traditional approach to the problem in (1) is to incorporate the identity, $x_1 + Q_2 = x_2$ into the objective function and perform an unconstrained optimization. However, we follow Barrell and Pain (1996) and explicitly model the identity to explain the intuition behind the Lagrangean multiplier (λ). Note that substituting for λ in π_{x1} from π_{Q2} equates the difference between marginal revenue and marginal cost across the two choices. Thus, the Lagrangean forces the marginal profit, the difference between marginal revenue and marginal cost, to be equal between the two choices (x_1 and Q_2). Otherwise, the firm will choose the option that yields the greater difference until this equality is achieved.

Applying the implicit function theorem to solve for these unknowns gives a closed form solution for these choice variables.[6] The resulting solutions for x_1 and Q_2 are:

$$\text{(3)} \qquad \begin{aligned} x_1 &= f(P_1, w_{L_1}, w_{K_1}, w_{I_1}, w_{L_2}, w_{K_2}, w_{I_2}, \psi_2) \\ Q_2 &= g(P_1, w_{L_2}, w_{K_2}, w_{I_2}, w_{L_1}, w_{K_1}, w_{I_1}, \psi_2), \end{aligned}$$

where P_1 is the export price, w are factor prices (from $TC(x_1)$ and $TC(Q_2)$), and ψ_2 are the characteristics of demand in foreign market. Since x_2 and P_2 are endogenous, the demand characteristics are included in equation (3). Note that the system of equations will be accompanied by optimal factor demand (L_i, K_i, I_i) for labor, capital and intermediate inputs, respectively, for exports (i=1) and foreign production (i=2). Given that $TC(x_1)$ and $TC(Q_2)$ are minimized costs, these equations take the form:

$$\text{(4)} \qquad \begin{aligned} L_1 &= L_1(P_1,\ w_{L_1},\ w_{K_1},\ w_{I_1},\ x_1); \quad & L_2 &= L_2(P_1,\ w_{L_2},\ w_{K_2},\ w_{I_2},\ Q_2) \\ K_1 &= K_1(P_1,\ w_{L_1},\ w_{K_1},\ w_{I_1},\ x_1); \quad & K_2 &= K_2(P_1,\ w_{L_2},\ w_{K_2},\ w_{I_2},\ Q_2) \\ I_1 &= I_1(P_1,\ w_{L_1},\ w_{K_1},\ w_{I_1},\ x_1); \quad & I_2 &= I_2(P_1,\ w_{L_2},\ w_{K_2},\ w_{I_2},\ Q_2). \end{aligned}$$

If the foreign production was denoted as $Q_2 = f(L_2, K_2, I_2)$, then K_2 denotes the inputs abroad financed by means of direct investment (Barrell and Pain, 1996). Ideally, one would want to estimate the set of equations in (3) and (4). However, we only estimate x_1, Q_2, L_2 and K_2, as data for other variables are not available.

Empirical Framework

The theory outlined above provides us with broad guidelines for model specification. The double-log functional form was chosen to specify the four estimable equations. In the following empirical counterparts of equations (x_1, Q_2, L_2, K_2) the subscripts for time (t) and country (i) have been dropped for exposition purposes.

$$
\begin{aligned}
\log Q_2 &= \alpha_0 + \alpha_1 \log P_1 + \alpha_2 \log w_{L_2} + \alpha_3 \log w_{K_1} + \alpha_4 \log w_{L_1} \\
&\quad + \alpha_5 \log w_{I_1} + \alpha_6 \log(\text{GNP/capita}) + \alpha_7 \log(\text{PSE}) + \alpha_8 \log(\text{EXRT}) + u_1, \\
\log x_1 &= \beta_0 + \beta_1 \log P_1 + \beta_2 \log w_{L_1} + \beta_3 \log w_{K_1} + \beta_4 \log w_{I_1} \\
&\quad + \beta_5 \log w_{L_2} + \beta_6 \log(\text{GNP/capita}) + \beta_7 \log(\text{PSE}) + \beta_8 \log(\text{EXRT}) + u_2, \\
\log L_2 &= \gamma_0 + \gamma_1 \log P_1 + \gamma_2 \log w_{L_2} + \gamma_3 \log w_{K_1} \\
&\quad + \gamma_4 \log(\text{GNP/capita}) + \gamma_5 \log Q_2 + \gamma_6 \log(\text{PSE}) + \gamma_7 \log(\text{EXRT}) + u_3, \\
\log K_2 &= \delta_0 + \delta_1 \log P_1 + \delta_2 \log w_{L_2} + \delta_3 \log w_{K_1} \\
&\quad + \delta_4 \log(\text{GNP/capita}) + \delta_5 \log Q_2 + \delta_6 \log(\text{PSE}) + \delta_7 \log(\text{EXRT}) + u_4.
\end{aligned}
\tag{5}
$$

Note that (5) contains four equations for each of the ten countries for the time period 1982-94 (see the next section for description of countries and data). The above specification differs in two distinct ways from previous research efforts in the U.S. manufacturing industries, and specifically in the U.S. food processing industry. First, the relationship between final outputs, i.e., foreign sales and exports is the subject matter of our investigation, unlike previous approaches that analyze the relationship between an input (FDI) and exports. Second, our approach controls for the effects of income levels and factor prices, while identifying the relationship between foreign sales and exports. Graham (1996) criticizes most of the previous investigations on FDI and trade relationship for ignoring the possible effects of simultaneous determination of FDI and exports. For example, exports and foreign investment may both be simultaneously used to target large and/or high income countries, while ignoring small and/or low income countries leading to complementarity.

Since GNP per capita was included in all four equations, we could neither use GNP nor population as an indicator of the size of the market. In addition to the variables specified by the theory outlined in the previous section, we have added two variables to these equations: producer subsidy equivalents, and exchange rates. The former is included to measure how changes in protection of domestic producers affect both exports and foreign direct investment in the food processing industry (see that data section for the definition of the protection measure). The nominal exchange rate (foreign currency per U.S. dollar) was included to capture the effects of broader economic policies on both exports and investment.[7] In a world characterized by perfectly mobile capital, exchange rate movements do not place either domestic or foreign investors at an advantage, because both have equal access to international capital markets. However, several studies have suggested that exchange rates negatively affect investment decisions by multinational corporations. Recently, Froot and Stein (1991) using an imperfect capital markets approach suggested the possibility that a firm's borrowing opportunities for financing overseas acquisitions may be a function of its net worth denominated in host country's currency. Their empirical results showed a negative relationship between FDI and exchange rates. Blonigen (1997) argued that foreign acquisitions may be impacted by exchange rate changes because the returns to investments can be denominated in currencies other than the currency used in the investment. While a majority of studies found a negative relationship between the U.S. dollar value and investment flows into the U.S., there are some (for e.g., Stevens, 1998) that contradict this relationship.

We let the country specific effects in the error specification, below, account for transportation costs as data on these costs are not available on a time-series basis. The time-series cross-section regression (TSCSREG) procedure in SAS was used to estimate each of the equations in (5), individually, as a panel model. Note that the system is recursive as Q_2 is on the right hand side of equations L_2 and K_2. Econometric packages such as LIMDEP allow for 2SLS estimation of time series-cross section (pooled) models in a step-wise procedure. First, Q_2 is fitted on all other exogenous variables in the model, and in the second stage the fitted values of Q_2 are used to estimate single equation models. In our case, the fit of Q_2 on other exogenous variables was found to be good, and so the fitted values of Q_2 were highly correlated with Q_2. Hence, we preferred to use SAS because of the options on error structure.

Unlike ordinary least squares, the error covariance matrix of pooled data models is non-diagonal. In equation (5), there are 10 cross-sections (countries) and 13 observations over time. All the countries included in the sample are high income countries and since several of them are part of the European Union, we expect contemporaneous correlation between cross-sections. We also anticipated serial correlation as the process on investment abroad is not necessarily instantaneous. There may be heteroskedasticity because the levels of FDI are different across the countries. To account for serial correlation, contemporaneous correlation between cross-sections and heteroskedasticity, we used two types of error structures available in SAS. The Parks (1967) method specifies errors as:

(6) $$u_{it} = \rho_i u_{i,t-1} + \epsilon_{it}.$$

This model assumes a first-order autoregressive error structure with contemporaneous correlation between cross sections and was used to estimate foreign sales (Q_2), exports (x_1) and affiliate labor demand (L_2) equations. However, we used the Da Silva (1975) method for the FDI equation (K_2), which specifies errors as:

(7) $$u_{it} = a_i + b_t + e_{it}, \text{ where } e_{it} = \mu_0\epsilon_t + \mu_1\epsilon_{t-1} + \ldots\ldots\ldots + \mu_m\epsilon_{t-m}.$$

This procedure is used to estimate a mixed variance-component moving average process for the errors. The moving average process of order m for e_{it} should satisfy $m \leq T-1$, where T is the total number of observations over time. The order m was chosen to be 7 although the results did not vary much for m ranging from 4 to 8.[8] This moving average process in addition to an error-component specification was chosen to account for the possible lag involved in the FDI process.

Data Used in Empirical Estimation

Since developed countries account for more than 75% of the total 29 billion dollars of U.S. direct investment abroad in the food processing industry, our analysis focusses primarily on high-income countries for the period 1982-94.[9] The ten countries included are Australia, Belgium, Canada, France, Germany, Japan, Netherlands, Italy, Spain, and the United Kingdom. Data on FDI variables were obtained from U.S. Department of Commerce. Annual estimates of the foreign direct investment position abroad for the food processing industry (SIC 20) were available for the period 1982-1994 from the Bureau of Economic Analysis in electronic form.[10] Data on sales by majority-owned foreign affiliates were taken from the annual *U.S. Direct Investment Abroad: Operations of Parent Companies and Their Foreign Affiliates* for the period 1982-1994. Employment and total compensation of employees are also available from this publication, which were used to create a wage index for affiliate production in the foreign country. Interest rates and nominal exchange rates were from various annual issues (1982-1994) of *International Financial Statistics* published by the International Monetary Fund.

The data on prices (unit values) and quantities of exports of processed food products were obtained from *Foreign Agricultural Trade of the U.S.*, published by the Economic Research Service of the U.S. Department of Agriculture (ERS/USDA). For each country, an aggregate export price index was derived as a share-weighted average of all prices of processed foods exported by the U.S. to that country.

Producer subsidy equivalents (PSE's), an aggregate measure of support to producers that summarizes the effects of a variety of government programs in a single number, are obtained from ERS/USDA and the Organization for Economic Cooperation and Development (OECD). The policies included in the computation of the PSE are direct government payments, input subsidies and other forms of marketing assistance. The PSE's were available for the primary agricultural sector, but not for the food processing industry. However, Roberts and De Remer (1997) argue that protection levels in primary agriculture provide a lower bound for protection in the food processing industry. The Global Trade Analysis Project (GTAP) database developed by McDougall (1997) further confirms that protection rates in food processing industries are relatively high as compared to primary agriculture. Hence, we use the PSE's for primary agriculture as proxies for the food processing industry and note that the results should be interpreted with caution. However, if the PSE were to be treated as they are, i.e., a measure of protection in the intermediate goods sector, then its affect on exports or affiliate sales by food processors would be reversed. For example, in a foreign market for breakfast cereals, protection of grain producers may raise a MNC's processing costs, possibly increasing exports from the home country rather than foreign production by affiliates.

The U.S. interest rate (w_{kj}) was used in all 4 equations because it represents the opportunity cost for U.S. producers investing abroad. The data source (U.S. Department of Commerce) indicates that these MNCs are majority owned and operated by U.S. nationals. As the returns from foreign operations ultimately accrue to the shareholders of these MNCs, who are U.S. nationals, the relevant opportunity cost is given by the U.S. interest rates. So, the lending interest rates in the U.S. were used in the estimation (IMF, *International Financial Statistics*).

Empirical Results

Tables 1 through 4 present the parameter estimates, t-ratios and R^2 for the equations in (5). In this section, we will first discuss the results for each equation and compare it with other studies, wherever applicable. We will then link the results together and draw implications for foreign sales, FDI, trade and their relationship.

Foreign Affiliate Sales (Q_2): Sales by foreign affiliates were expressed as a function of factor prices of home and host country (capital, labor and intermediates), price of exports, GNP per capita of host country and two policy related variables (protection and exchange rate).

Foreign affiliate sales of U.S. firms are a substitute for exports, at the aggregate food processing level. Table 1 reports that a 1% increase in the price of exports decreases foreign sales by 0.11%. This effect is small and it is possible that the increased demand for intermediates from home country could offset this effect. However, we are unable to identify any offsetting effects because data on the intermediate input demand by foreign affiliates were unavailable on a time series basis. Data on the share of intermediate inputs demanded from home country (U.S.) were unavailable as well. Hence, our results on substitutability hold with a caveat, as the effect through the increased demand for intermediate inputs from the home country is held constant.

Previous research on FDI in the food processing industry suggests that income level of a country is an important determinant of FDI and its consequence, affiliate sales (Connor, 1983). As incomes grow, it is hypothesized that the demand for qualities or attributes added to primary agricultural products increases. We find a positive relationship between affiliate sales and per capita income of a country. A one percent increase in the per capita income of a country leads to a 0.49% increase in the foreign affiliates sales of processed foods products, all else constant. This suggests that the level of development of a country could be key to the decision to produce abroad, which is not surprising as the demand for variety and quality of food tends to increase as incomes increase.

Several authors including Lipsey and Weiss (1983) claim that the most important missing variable in the empirical works relating FDI and trade is the host-country protection policies, which discourage exports and encourage establishment of foreign affiliates. To the extent that the agricultural protection measure (PSE) used here is a proxy for the food processing industry, we can support the notion that foreign sales increases as the protection by the foreign country of its domestic producers increases. For every one percent increase in protection, foreign affiliate sales increase by 0.29 percent. This is consistent with the hypothesis that foreign sales and thus, FDI is protection-jumping (Lipsey, 1994). We also find, as others have pointed out (Lipsey, 1994), that appreciation of the U.S. dollar will lead to a fall in foreign sales. A one percent appreciation in the U.S. dollar leads to a fall in foreign sales by 0.18 percent. The result on exchange rate effects is in line with those reported by Froot and Stein (1991) and Blonigen (1997).

The results on the effects of input prices are mixed. An increase in U.S. interest rates leads to a fall in foreign sales, as expected, but insignificantly.[11] Similarly, an increase in the price index for intermediates (primary agricultural commodities) in the U.S. increases sales by foreign affiliates. We experienced collinearity problems between home and host country wages while estimating the affiliate sales equation. As the correlation between wages in the U.S. food processing industry and those paid by foreign affiliates in host country is relatively high (partial correlation coefficient of 0.98), we dropped one of the two wage variables. Despite this, an increase in wages in the food processing industry of the foreign country has a positive effect on foreign sales.

<u>Exports</u> (x_1): The aggregate quantity index of processed food exports to a host country was specified as a function of its own price, factor prices of home and host countries, GNP per capita of host country, PSE and exchange rate (table 2). The factor prices were normalized by the export price (P_1) to alleviate multi-collinearity problems.

The own price response of exports is positive (0.06) and significant. The coefficients on home country factor prices have the expected negative sign. An increase in factor prices, interest rates and intermediate input prices (agricultural price), in the domestic economy decreases exports as one would expect the cost of production to increase. Similar to the affiliate sales equation, we experienced collinearity problems between home and host country wages. As we dropped one of these variables, we obtained a wrong negative sign on the effect of foreign affiliate wages. The most important determinant of exports appears to be the per capita income level of a country. For every one percent increase in the per capita income level, exports of processed food products from the U.S. increase by a 1.52%.

The coefficient on PSE has the opposite sign as in the foreign affiliate sales equation suggesting that protection hurts exports. This further confirms our prior notion that as protection measures become prohibitive, foreign production can be used to overcome these barriers. The magnitude of these two coefficients from the two equations is also interesting. For every 1% increase in protection, exports fall by 0.30%, but are offset by a 0.29% increase in sales by foreign affiliates. Thus, the net effect is small. The exchange rate variable did not yield the expected negative sign.

Affiliate Employment (L_2): The foreign affiliate's demand for labor is specified similarly to its sales equation (table 3). In addition to price of exports, factor prices, income and policy variables, this equation includes the quantity of sales (Q_2).

The price of exports (P_1) is found to have a negative effect on employment as foreign sales are a substitute for exports. As expected, a one percent increase in the wage index leads to 0.70 % decrease in employment. The higher the U.S. interest rates, the lower is the employment by foreign affiliates. However, GNP per capita negatively affects the demand for labor by foreign affiliates. In developed countries, the broader services sector (accounts for a major share of GNP) has bid up wages, which caused labor to exit agriculture and manufacturing despite overall growth in per capita income. Hence, it is possible to have a negative relation between GNP per capita and foreign affiliate labor demand in the food processing industry.

Although the exchange rate had a significant effect on foreign sales, its effect on labor demand is insignificant. All else constant, an increase in the protection of the industry hurts employment by foreign affiliates. Often times, protection by the host country may not include multinational corporations and so, employment might decline.

FDI equation (K_2): This equation had the same variables as that of the labor demand by foreign affiliates (table 4). The results indicate that input prices, per capita income level and affiliate sales appear to be the key variables determining the level of direct investment abroad. The effects of protection and exchange rate are small with the expected signs. However, the price of exports has a very small positive effect on FDI.

More specifically, as the U.S. interest rate increases it has a significant negative effect (-0.41) on direct investment abroad as the opportunity cost of investment elsewhere increases. A 1% increase in the per capita income level of a country increases FDI by 0.12 %, while it increases foreign sales by 0.28% (table 1). This, once again, is consistent with most casual studies of FDI in the U.S. food processing industry (Henderson and Handy, 1994). The effect of protection on FDI is insignificant. However, the effect of protection as passed through the affiliate sales (Q_2) will be significant because of its own sales. Similar to the results obtained by Froot and Stein (1991) and Blonigen (1997), the effect of exchange rate on FDI is negative, but small.

Determinants of FDI, Trade and Their Relationship:

From the above discussion, three important results stand out: (1) the relationship between exports and foreign sales is negative and small; (2) foreign production appears to be positively affected by protection measures of a host country; and (3) per capita income (level of development) is an important determinant of FDI and trade in the food processing industry.

Our results point to substitutability between foreign sales and exports, but its magnitude is small. Implicit in the comparative statics of our model is the expanding market assumption (x_2), and this could be one reason why our substitution effect is small. If the firm has more than one product and affiliates import intermediate products from the home country, then it is likely that the small substitution effect can be offset. However, a substitution between foreign sales and exports does not necessarily hurt the U.S. economy. This is because the MNCs investigated are majority owned by U.S. nationals and so, the returns accruing to the foreign affiliates of these MNCs ultimately accrue to home country (U.S.) nationals through the parent organization. Of course, there are implications for income distribution. Owners of capital gain more relative to work force, when substitution occurs.

Previous researchers who have extensively focussed on the relationship between FDI (foreign sales) and exports have not included protection policies as a possible explanatory variable. Our framework identifies that protection has a positive effect on foreign sales, while at the same time negatively affects exports.[12] This lends support to the protection-jumping hypothesis of FDI, although the net effect of protection appears to be small.

The income elasticity of demand for unprocessed agricultural products is relatively low (Engel's law), but the demand for attributes (qualities/services) added has been hypothesized in theory to have relatively large income effects. We found that the per capita income level of a country significantly determines both exports and foreign sales. Results from the FDI equation further confirm that per capita income has a positive effect on the decision to invest abroad.

Conclusions

This paper proposes a conceptual framework to analyze the choices facing a multinational corporation (MNC) in supplying a foreign market. A differentiated product monopolist chooses between exports (produced in home country) and overseas production to supply a foreign country. Data on ten developed countries for the time period 1982-94 are pooled to obtain a panel, which is then used to estimate the model.

There are three main conclusions to our study. First, the results indicate that foreign sales and exports are substitutes. We suggest caution in interpreting this result because this substitution occurs at the same product line. However, when firms produce more than one product, it is possible that foreign sales generate demand for intermediate products from the home country. The intermediate product exports from the home country may compensate for the fall in the exports of the final good. Moreover, substitution does not necessarily hurt the overall economy because the returns to foreign affiliate operations ultimately accrue to the owners (home country nationals) of MNCs. However, if substitution is confirmed after accounting for possible intermediate good effects, it suggests that owners of capital in this industry stand to gain more relative to the work force. Second, we find evidence that FDI is tariff-jumping in this industry. Protection as measured by producer subsidy equivalents in the agricultural sector increases foreign sales, while at the same time lowers exports to foreign countries. However, the net effect of protection appears to be negative. Finally, per capita income of a country is found to be a critical factor in determining FDI, foreign sales and exports in the U.S. food processing industry. Hence, declining U.S. trade shares in foreign agricultural markets does not translate into a loss in comparative advantage, as evidence shows an increasing role for MNCs in supplying foreign markets through host country production. Increasing barriers to commodity trade provide an additional thrust to the strategy of foreign production.

Future research may focus on modeling the effect of intermediate input demanded from home country by host country affiliates. This effect together with the direct substitution may provide more insight into the relationship between FDI, foreign sales and exports. Moreover, simultaneous modeling of outward and inward FDI, and exports and imports will further help our understanding of the determinants of FDI, trade and their relationship.

Table 1: Parameter Estimates for Foreign Affiliate Sales (Q_2) Equation

Variables	Parameter Estimate	t-ratio
Intercept	1.44	1.76
Price of Exports (P_1)	-0.11*	-12.4
Wage (w_{L2})	0.52*	7.71
Interest rate (w_{K1})	-0.09	-1.19
Agricultural Price (w_{I1})	0.19*	1.51
GNP Per Capita	0.49*	5.07
PSE	0.29*	7.35
Exchange rate	-0.18*	-13.36
R^2	0.89	
*Significant at 5% level		

Table 2: Parameter Estimates for Export (x_1) Equation

Variables	Parameter Estimate	t-ratio
Intercept	0.96	1.20
Price of Exports (P_1)	0.06*	7.66
Interest rate (w_{K1})	-0.88*	-15.8
Agricultural Price (w_{I1})	-0.32*	5.75
Wage (w_{L2})	-1.11*	-23.8
GNP Per Capita	1.52*	20.3
PSE	-0.30*	-6.18
Exchange rate	0.06	1.79
R^2	0.51	

*Significant at 5% level

Table 3: Parameter Estimates for Affiliate Employment (L_2) Equation

Variables	Parameter Estimate	t-ratio
Intercept	2.56	7.01
Price of Exports (P_1)	-0.09*	-11.92
Wage (w_{L2})	-0.70*	-14.22
Interest rate (w_{K1})	-0.26*	-7.14
GNP Per Capita	-0.31*	-6.27
Affiliate Sales (Q_2)	0.87*	24.98
PSE	-0.23*	-8.95
Exchange rate	-0.01	-1.65
R^2	0.97	

*Significant at 5% level

Table 4: Parameter Estimates for FDI Demand (K_2) Equation

Variables	Parameter Estimate	t-ratio
Intercept	-0.92	-2.34
Price of Exports (P_1)	0.03*	2.62
Wage (w_{L2})	-0.36*	-10.55
Interest rate (w_{K1})	-0.41*	-8.84
GNP Per Capita	0.12*	2.84
Affiliate Sales	1.05*	33.23
PSE	0.04	1.67
Exchange rate	-0.06*	-5.31
R^2	0.98	

*Significant at 5% level

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1.Kemp (1966) outlines the interdependence of trade and international investment and the gains from optimal tariff and optimal tax policies imposed simultaneously (see also Jones, 1967).

2. Although Barrell and Pain's (1996) model allows for both production and sale of a commodity in domestic and foreign markets, their empirical approach focussed only on outward FDI due to lack of data on both country- and industry-specific inward FDI.

3. James Markusen pointed to us that an alternate specifications to equation (1) would involve either dropping the identity $x_1 + Q_2 = x_2$ and rewriting the foreign market price equation as $P_2(x_1, Q_2)$, i.e., replacing x_2 by x_1, or rewriting the host-country cost function as $TC_2(Q_2, x_1)$. The former suggests that price in a host-country market is endogenous and depends on both exports and foreign production, while the latter implies that imports are partly or largely intermediate inputs, so higher levels of x_1 reduce the cost of producing a given amount of Q_2 ($\partial TC_2/ \partial x_1 < 0$). Of course, x_1 can appear in both demand (P_2) and cost functions (TC_2), and could conceivably be a substitute in consumption, but complementary in production. In any case, the empirical framework specified below is broad enough to be derived from a very general specification of the model.

4. The U.S. accounts for only 22 billions dollars of the total value of world trade of 250 billion dollars in processed foods For eight out of ten countries analyzed, the share of imports from the U.S. in total processed food imports is less than 5 percent. Moreover, for Canada and Japan the share of U.S. imports in total processed food consumption is less than 5 percent. Given these small shares, the assumption of price-taking behavior in export markets seems reasonable. Moreover, this assumption is crucial in assessing the relationship between exports and foreign sales because the price of exports (P_1) appears on the RHS of both equations.

5.The equilibrium condition in an industry consisting of firms producing differentiated products is described by Helpman and Krugman (1985, Ch. 7: Trade Structure, Equation 7.7). If there are no impediments to entry and exit, then zero profits will establish a single price which equals marginal costs. The implication, of course, is the equality of output levels across firms. As Helpman and Krugman point out, the only missing variable in the conditions describing equilibrium at the industry level is the number of firms, "n," an endogenous variable (p. 137). An additional equation relating all exogenous variables to "n" is not included in our system specified in equation (5), because data on number of firms investing overseas is not available as well, on a time series basis.

6. For the implicit function theorem to hold, we need the determinant of the Hessian not to equal zero (Varian, 1978). If we assume the cost function as non-linear, then the determinant will be non-zero.

7. The nominal exchange rate was used for two reasons. First, it reflects inflation and other distortionary policies of a host country. Second, the derivation of real exchange rate has been a subject of controversy, at least in trade theory, as the ratio of price of tradable to non-tradable lacks a clear empirical counterpart.

8. Using Parks method, we obtained qualitatively similar results for the FDI equation.

9. Latin American countries make up most of the remaining 25 percent of the FDI in the food processing industry. However, these countries have undergone substantial currency depreciation along with large inflation rates, which have greatly affected the quality of data.

10. We use firm-level theory to hypothesize the relationship between FDI and trade. The empirical results reported below, however, are at the industry level as firm-level data are not

available to test the hypothesis. This raises a possibility that for some firms, some commodities, and some countries in the food processing industry, FDI and exports may be substitutes while for others an opposite relationship holds. To the extent that the aggregate data mimic the behavior of a representative firm we attach confidence to the empirical results of this study. Of course, this caveat applies to all industry-level empirical studies.

11. As a reviewer pointed out, consistent with options theory, interest rates will have a weak effect on investment activity (Dixit and Pindyck, 1994).

12. This results should be interpreted with caution as the PSE's from primary agriculture are used as a proxy for food processing industry.

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