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U.S. Foreign Direct Investment In Food Processing Industries of Latin American Countries: A Dynamic Approach

Anatoliy Skripnitchenko
Won W. Koo

Center for Agricultural Policy and Trade Studies
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, North Dakota

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Abstract

In this report, we apply a dynamic cost minimization model of U.S. foreign direct investment in food processing industries to nine Latin American countries. Estimation of the first order condition (Euler equation) using a consistent rational expectation assumption showed that dynamic structure explains the investment process in food processing industries quite well. U.S. food processors in Latin America are driven by the host country's level of demand and by labor cost considerations. They can adjust their investment position quickly. We also quantified short and long-run effects of shocks to exogenous variables on foreign direct investment position.

Keywords: foreign direct investment, dynamic, Latin America, adjustment costs, processed food, Euler equation.

U.S. FOREIGN DIRECT INVESTMENT IN FOOD PROCESSING INDUSTRIES OF LATIN AMERICAN COUNTRIES: A DYNAMIC APPROACH

Anatoliy Skripnitchenko and Won W. Koo*

INTRODUCTION

The purpose of this article is to examine the determinants of U.S. foreign direct investment (FDI) in food processing industries of Latin American countries using a dynamic investment model. While past literature has addressed U.S. FDI in food processing to a great extent, most of the studies focused on U.S. food processing investment in developed countries (e.g. Ning and Reed (1995); Gopinath et al. (1999); Marchant et al. (2002)). This interest is explained by the fact that the developed countries were destinations for the majority of U.S. investment capital. According to data from the Bureau of Economic Analysis, about 70 percent of processed food FDI in 2001 went to developed countries. The European Union (EU) held 50 percent of the total $35.5 billion foreign direct investment stock, the Western Hemisphere – 37 percent, and Asia – 11 percent. Canada alone received 35 percent of the Western Hemisphere's share. However, certain developing countries received a significant amount of U.S. FDI as well. In 2001, Mexico held 34 percent of the entire U.S. food processing direct investment in the Western Hemisphere, and Brazil held 10 percent. Despite maintaining a relatively small share of U.S. food processing FDI, the U.S. food processing investment position experienced rapid growth in Latin American countries from 1988 until 1996 (Mattson and Koo, 2002).

Studying U.S. direct food processing investment in Latin America is important in light of the Free Trade Area of Americas (FTAA) under negotiation. It is expected that the FTAA will significantly reduce trade and investment barriers between countries of the Western Hemisphere and likely affect economic conditions in many host countries (e.g. wages, demand for processed food, FDI receptiveness, taxes, exchange rates, etc.) that will influence foreign investment decisions by U.S. multinationals. In this study, we calculate short-run and long-run effects of changes in selected exogenous variables on the U.S. FDI position in food processing industries in Latin America.

To the best of our knowledge, studies that address FDI in food processing have used a static framework to model the investment process. However, the assumptions that capital investment is independent across time, and that capital investing is frictionless, may not accurately represent reality. Approaching investment modeling from a dynamic perspective is more realistic.

Dynamic investment models were widely used to study investments and the capital adjustment process (Chirinko (1993); Summers (1981); Pindyck and Rotemberg (1983); Shapiro (1986); Morrison (1986)). They found evidence that the adjustment costs of investment mandate the use of dynamics in modeling firms' decision process. In the presence of frictions, firms tend to spread their investment activities over time because it may become costly to try to achieve an investment position target within a relatively short period of time. Adjustment costs have to

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* Research Assistant Professor, and Professor and Director, in the Center for Agricultural Policy and Trade Studies, North Dakota State University.

grow at an increasing rate with the level of investment in order to be effective. If this condition does not hold, firms invest all at once or nothing at all. The same intuition can be applied to investment abroad (Skripnitchenko, 2003). When making foreign investment decisions, U.S. multinationals mostly consider factors that influence investment in host countries. Introduction of adjustment costs is quite natural in the case of foreign investment because the larger the amount of investment, the more costly it becomes to adopt investment capital, and a certain portion of those costs may grow at an increasing rate.

The existence of investment adjustment costs can be explained by various economic and social conditions. Examples of adjustment costs include overtime labor costs associated with expedited installation of new machinery, legal costs, re-training of personal, economic instability (e.g. exchange rate risks that influence the costs of capital), and taxes. Host countries that are more open to foreign capital investment potentially have lower capital adjustment costs. Larger market sizes and higher local demand for multinationals' output may help firms to overcome adjustment costs if there are economies of scale (multinationals can absorb higher adjustment costs at the expense of lower per-unit production costs). We use several proxy variables to capture investment conditions in Latin American countries. The variables we chose were real GDP (representing market size), tax levels, exchange rates, and percentage of overall FDI in host countries' GDP (measuring countries' openness to FDI).

In addition to macro variables, the model contains a set of standard variables used in FDI literature to determine production costs using two inputs – capital and labor. These variables are real wages, real interest rates, and real sales. Real wages and real interest rates are expected to have a negative relationship with the FDI position since increase in those variables means higher costs of production. Real sales are expected to influence the investment position positively since an increase in demand for processed food in host countries will likely lead to more FDI.

We can also hypothesize the effects of macro variables on the direct investment positions of U.S. food processing multinationals in Latin American countries. GDP and FDI openness will likely have a positive effect on capital accumulation since higher values of those variables would indicate a higher demand potential and favorable business environment for foreign investment. Tax levels are likely to have a negative impact on foreign capital because they increase the costs of investment. Nominal exchange rates (local currency per U.S. dollar) may positively influence capital accumulation because the costs of investment in terms of U.S. dollars decrease. However, depreciation of the local currency, resulting in higher exchange rates may also be an indicator of an inflationary economic environment. This contributes to general economic instability, and thus may have a negative impact on expansion of foreign capital position.

In this article, we base our dynamic model on cost minimization. The model is designed to explain U.S. foreign investment in Latin American countries and includes macro variables that measure barriers to investment which result in sluggish adjustment of investment capital. Studying FDI from the perspective of cost minimization has its advantage since, unlike other studies, we do not have to make assumptions regarding the nature of competition in foreign processed food markets, or take optimal output as given (Pindyck and Rotemberg, 1983). Another advantage of using a real output variable in the model is that it incorporates changes in demand due to fluctuations in various local factors, giving us an opportunity to avoid modeling demand explicitly.

MODEL

In this section, we develop a model that minimizes long-run expected costs of a multinational enterprise. In the model, foreign investment capital is the only variable that is subject to sluggish adjustment over time. We can use a short-run cost function that represents optimal costs of labor in the short-run. This cost function includes foreign investment capital as one of its variables. The total cost of production in a host country is the sum of labor costs, foreign investment capital, and the costs of adapting new investment. An expected dynamic cost minimization problem at time τ for a representative multi-national enterprise is

$$\min_{K} C_{\tau} = E_{\tau} \sum_{t=\tau}^{\infty} (1+\rho)^{\tau-t} \left[c(w_t, K_t, Y_t) + r_t K_t + g(K_t - (1-\delta)K_{t-1}, \theta_t) \right]. \tag{1}$$

The first two terms ($c(\cdot)$ and $r_t K_t$) represent a standard, one-period cost function. $c(\cdot)$ depends on the real price of foreign labor (w_t), foreign direct investment stock (K_t), and final output (Y_t). $c(\cdot)$ is assumed to be increasing and concave in real wages and decreasing and convex in FDI stock. The third term ($g(\cdot)$) is an adjustment cost function that represents costs of adjusting foreign capital stock through investment ($I_t = K_t - (1-\delta)K_{t-1}$). $g(\cdot)$ is assumed to be increasing and convex in investments. θ_t stands for various country-specific factors that may influence the cost of adjustment. ρ is a discount factor, and δ is a depreciation rate. r_t is the real price of capital. E_{τ} is an expectation operator.

The first order conditions for the cost minimization problem yield the Euler equation as

$$E_t \left\{ c'_{K_t}(w_t, K_t, Y_t) + r_t + g'_{K_t}(I_t, \theta_t) - \frac{1-\delta}{1+\rho} g'_{K_t}(I_t, \theta_{t+1}) \right\} = 0. \tag{2}$$

The Euler equation (Equation 2) represents a rule of optimal allocation of foreign investment capital over time, stating that the marginal cost of investing an additional unit of capital at time t must equal the marginal adjustment cost at time $t+1$, appropriately discounted. The transversality condition suggests that in the limit, the present value of marginal costs must equal zero.

The Euler equation provides us with a general relationship between the foreign investment position and those factors that influence the position. For estimation purposes, it is convenient to write the Euler equation in a linear form. In particular, we choose to express expected foreign investment position at time $t+1$ as a function of past foreign investment positions (K_t and

K_{t-1}), sales (Y_t), wages (w_t), interest rates (r_t), and factors that influence capital adjustment (θ_{t+1} and θ_t), as follows:

$$E_t K_{t+1} = a_0 + a_1 K_t + a_2 K_{t-1} + a_3 w_t + a_4 r_t + a_5 Y_t + \sum_{i=1}^{n} \left[a_{6i}\theta_{it} + a_{7i} E_t \theta_{it+1} \right]. \tag{3}$$

A linearized Euler equation can be solved using lag transformations for capital as a function of expected future values of exogenous variables (e.g., Sargent (1979)) as follows:

$$K_t = \lambda_1 K_{t-1} + \frac{\lambda_1}{a_2} \sum_{j=0}^{\infty} \left(\frac{1}{\lambda_2} \right)^j \left[\boldsymbol{aE_t X'_{t+j}} + \sum_{i=1}^{n} \left[a_{6i} E_t \theta_{it+j} + a_{7i} E_t \theta_{it+j+1} \right] \right] \tag{4}$$

where $\boldsymbol{E_t X_{t+j}} = \left[1, E_t w_{t+j}, E_t r_{t+j}, E_t Y_{t+j} \right]$ and $\boldsymbol{a} = \left[a_0, a_3, a_4, a_5 \right]$.

In Equation 4, λ_1 and λ_2 represent roots of the Euler equation. For a converging solution, one of them needs to be between zero and unity and another one must be greater than unity. In our case $0 < \lambda_1 < 1$ and $\lambda_2 > 1$. The smaller root is an indicator of the speed of foreign investment adjustment. The closer it is to one, the slower the adjustment process. We also assume that exogenous future expected variables have non-exploding paths.

λ_1 and λ_2 can be derived from the parameters of the Euler equation (Equation 3) $\lambda_{1,2} = \left(a_1 \mp \sqrt{a_1^2 + 4a_2} \right) / 2$.

The solution for capital with respect to future values of variables allows us to calculate the response of FDI positions to a shock affecting future values of exogenous variables (real wages, real interest rates, sales, and macro variables). The length of the shock can vary. If the shock is temporary, then it lasts only for a limited number of periods (T). Let us consider a temporary shock to real wages (Topel and Rosen (1988)). Derivations of the effects of shocks in interest rate and sales are analogous to those in real wage. It has the following effect on the current FDI position:

$$\left. \frac{dK_t}{dw} \right|_T = \lambda_1 \sum_{i=0}^{T} \left(\frac{1}{\lambda_2} \right)^i \frac{a_3}{a_2} = \lambda_1 \frac{a_3}{a_2} \frac{(1 - (1/\lambda_2)^{T+1})}{(1 - 1/\lambda_2)}. \tag{5}$$

If the shock is permanent, then $T \to \infty$ and the effect of a permanent real wage change on the current FDI stock becomes:

$$\left.\frac{dK_t}{dw}\right|_{T\to\infty} = \lambda_1 \frac{a_3}{a_2} \frac{1}{(1-1/\lambda_2)}. \tag{6}$$

The formula for calculating the effects of macro variable shocks on the FDI position differs from the formula for real wages, interest rates, and sales, since the Euler equation contains both current and lagged values of macro variables. A temporary shock to a macro variable that lasts first T periods has the following effect on the FDI position:

$$\left.\frac{dK_t}{d\theta_j}\right|_T = \frac{\lambda_1}{a_2} \frac{(a_{6j}(1-(1/\lambda_2)^{T+1}) + a_{7j}(1-(1/\lambda_2)^T))}{(1-1/\lambda_2)}. \tag{7}$$

The effect of a permanent shock becomes

$$\left.\frac{dK_t}{d\theta_j}\right|_{T\to\infty} = \frac{\lambda_1}{a_2} \frac{(a_{6j} + a_{7j})}{(1-1/\lambda_2)}. \tag{8}$$

In the empirical portion of this study, we present the effects of shocks to expected variables on the FDI position in the form of elasticities, using data averages.

ECONOMETRIC SPECIFICATION AND ESTIMATION PROCEDURE

The Euler equation contains expectation variables that cannot be obtained from the data. For the purpose of estimation, we assume that the cost minimizing behavior of U.S. food processing firms follows consistent rational expectations. In this case, we can substitute observed values for expected values. Equation 9 represents an econometric specification of the Euler equation.

$$K_{it} = a_0 + a_1 K_{it-1} + a_2 K_{it-2} + a_3 w_{it-1} + a_4 r_{t-1} + a_5 Y_{it-1} + \sum_{j=1}^{n} \left[a_{6j}\theta_{jit-1} + a_{7j}\theta_{jit}\right] + v_i + \varepsilon_{it}, \tag{9}$$

where i indexes countries.

Theoretically, the error term in the econometric specification of the Euler equation is not correlated with the variables observed at time $t-1$, because it represents surprise information that is not predictable at time $t-1$. For this reason, consistent rational expectation models are traditionally estimated using the Generalized Method of Moments procedure developed by Hansen (1982) that minimizes correlation between the error term and the variables at time $t-1$ (instruments).

In practice, the error term $v_i + \varepsilon_{it}$ may contain measurement and specification errors that can result in serial correlation in the residuals (Shapiro, 1986). Measurement and specification errors are likely to be correlated with the error term (Pindyck and Rotemberg, 1983). Under these circumstances, only variables at time $t-2$ can serve as valid instruments.

The estimation is complicated by the fact that the dataset is a panel and the Euler equation contains lagged dependent variables (foreign investment position). Because of the nature of panel data, the error term may contain a random effect (v_i). In the absence of specification or measurement errors, the random effect should not be present in the residuals even if the data is panel, because consistent rational expectation assumption prevents the error term from being correlated over time.

If measurement and/or specification errors are present in the residuals that result in random effects, then conventional General Method of Moments (GMM) estimations are inappropriate. The presence of random effects introduces correlation between lagged dependent variables and the error term. We use the Arellano-Bond GMM procedure to resolve this (Arellano and Bond, 1991; Stata, 2003). This procedure is designed to estimate linear models with lagged dependent variables using panel data. The Arellano-Bond procedure uses first differencing to eliminate random (and fixed) effects from the model. It then estimates the model using a GMM estimator, with variables lagged three times serving as instruments because of the differencing.

According to the assumptions of the Arellano-Bond estimation procedure, the random effect and the common error term are i.i.d. However, this procedure can produce estimates that are robust to the presence of heteroskedasticity in the residuals. Serial correlation in the differenced residuals can bias the results. In the presence of the first-order autocorrelation in differenced residuals, the estimates are still consistent. However, second order autocorrelation in the residuals causes inconsistent estimates. Thus, tests for autocorrelation are necessary to verify the consistency of the results.

DATA

Nine Latin American countries – Argentina, Brazil, Chile, Columbia, Ecuador, Mexico, Panama, Peru, and Venezuela – were chosen for estimation. The panel data ranged from the year 1983 to 2000. FDI position, wages, and sales of foreign affiliates were obtained from the Bureau of Economic Analysis. The FDI position was measured on a historical-cost basis that tends to underestimate the market value of foreign capital stock. In order to calculate the real value of capital stock, we first converted historical-base estimates to market value estimates by multiplying the original figures by the ratio of current U.S. nominal interest rate to nominal interest rate lagged 10 years. Then, the estimated market value was divided by the price index of U.S. food processing machinery from the Bureau of Labor Statistics to get a physical capital estimate. A period of 10 years was chosen for the lagged interest rate because, according to the Bureau of Labor Statistics, machinery in the food processing industry depreciates in 20 years. A 10-year lag is a reasonable choice since older capital has a smaller share in the current historical-base position, as compared to more recently acquired capital, due to depreciation.

Nominal wages were calculated as a ratio of the compensation of employees working at Latin American subsidiaries, and the number of employees. Nominal wages were then converted to real wages, using nominal exchange rates and the consumer price index in Latin American countries. Nominal exchanges rates were taken from the website of the Economic Research Service, USDA, and Latin American consumer price indices were taken from the World Development Indicators published by the World Bank.

The cost of foreign investment capital was measured by U.S. real interest rates since the financing of the FDI in food processing is implemented by U.S. multinationals. The source of U.S. real interest rates was the World Development Indicators database.

Real sales of processed food were obtained by dividing nominal foreign affiliate sales by food price indices from the World Development Indicators database, adjusted by nominal exchange rates. The food price index for Brazil was unreliable and was replaced with a consumer price index.

Country-specific factors that may influence adjustment of foreign capital stock were taken from the World Development Indicators database. These included: market size measured by real GDP; taxes on income, profits, and capital gains as percentage of current revenue; nominal exchange rates; and the level of FDI in a country as a percentage of GDP.

The dataset used in estimations contained a few missed observations. Some were missing because the data did not exist, others because the data was not disclosed. This did not create a problem for our estimations since the Arellano-Bond GMM procedure for dynamic panel data implemented in STATA 8.0 has the ability to conduct estimation despite missing data in the middle of the panel.

ESTIMATIONS AND RESULTS

In this section, we apply the application of the theoretical model developed above to the data from several Latin American countries. First, we discuss the results of the Euler equation estimation, and then analyze the effects of shocks to the future expected variables on the foreign investment position of U.S. multinationals involved in food processing.

Estimation of the Euler Equation

Table 1 presents the estimation results of the Euler equation, using data from Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Peru, and Venezuela. The table includes two sets of estimated standard errors, corresponding to a homoskedastic error term assumption and robust to the presence of heteroskedasticity in the residuals.

The estimated coefficients constitute the base for calculating the effects of changes in the expected values of the variables (wages, interest rates, and macro variables influencing adjustment of capital) on the FDI position in the food processing industry.

Table 1. Estimation Results

Dependent Variable - FDP, t			
Variable	Coefficient	Standard Error	Robust Standard Error
FDP, t-1	1.214	***0.121	***0.116
FDP, t-2	-0.156	0.113	0.095
Exchange Rate, t	0.864	2.701	2.925
Exchange Rate, t-1	-1.556	2.969	2.983
Tax, t	-0.135	**0.066	0.105
Tax, t-1	0.022	0.067	0.050
GDP, t	0.210	0.334	0.353
GDP, t-1	-0.124	0.385	0.707
FDI Openness, t	-0.049	0.152	0.101
FDI Openness, t-1	-0.336	**0.163	*0.190
Wage, t-1	2.272	***0.596	**0.941
Interest Rate, t-1	0.392	0.295	*0.230
Sales, t-1	-2.577	***0.583	**1.101
Constant	0.563	*0.289	0.449
Arellano-Bond test of average autocovariance in residuals	Error Term	First Order	Second Order
	Homoskedastic	t=-2.31 Pr>t=0.0211	t=-1.39 Pr>t=0.1654
	Heteroskedastic	t=-1.22 Pr>t=0.2213	t=-1.11 Pr>t=0.2688
Sargan test (homoskedastic case)			χ^2 (227)=85.04

*** - significant at 1%
** - significant at 5%
* - significant at 10%

The Arellano-Bond GMM procedure that we used to estimate the Euler equation is inconsistent if the second order autocorrelation exists in differenced residuals. However, first order autocorrelation does not interfere with the consistency of the estimates. In both homoskedastic and robust cases, the test did not reject the null hypothesis of no first and second order autocorrelation at the 10 percent level (see Table 1). However, the null of no first order autocorrelation was rejected at the 5 percent level in the homoskedastic case.

Since the estimation procedure relies on instrumental variables, it is also necessary to test whether they impose valid over-identifying restrictions on the estimation. We used the Sargan test to determine the validity of over-identifying restrictions. The test did not reject the null hypothesis that over-identifying restrictions are valid (see Table 1). Note that the Sargan over-identification test is valid only under a homoskedastic error term assumption. The Sargan statistic will have asymptotic χ^2 distribution. If the estimates are robust, the distribution of the Sargan test statistic is generally unknown.

The results of the Sargan test support our assumption of a homoskedastic error term. Arellano and Bond (1991) showed evidence of the Sargan test over-rejecting the null that over-identifying restrictions are valid if the error term is heteroskedastic. However, in our case, the Sargan test did not reject over-identifying restrictions and its statistic had a low value. This result suggests that heteroskedasticity may not be a problem in our estimations. The choice of countries also supports this conclusion because the countries do not differ greatly in terms of economic conditions, geographical location, and levels of development.

The Euler regression revealed dynamic trends in the data. Let us first discuss the results of estimations under a homoskedastic assumption. Coefficients on the variables representing FDI positions lagged one year were statistically significant at 1 percent. Statistical significance of the lagged FDI position variables supports the hypothesis that capital investment decisions are likely to be interrelated across time, and modeling FDI in a food processing industry dynamic setting is appropriate.

Macro variables yielded mixed results in the regression. Current nominal exchange rate and lagged exchange rate were not statistically significant. The variable measuring the level of taxes paid in Latin American countries in the current period was statistically significant at 5 percent. However, lagged tax levels were not statistically significantly different from zero. Real GDP, measuring the size of the market for U.S. food processing firms, was not statistically significant at current and lagged levels. The one year lag for the general openness of Latin American countries to FDI (measured as a percentage of gross FDI in countries' GDP) was statistically significant at the 5 percent level.

The real interest rate, representing the costs of FDI, was not statistically significant at conventional levels. Real wages and processed food sales were statistically significant at 1 percent.

The U.S. food processing multinationals did not seem to consider the host country's market size, although it varied significantly. Instead, the multinationals appeared to target only specific groups of customers and were more concerned about their demand. Because of this, the level of sales turned out to be a much better explanatory variable than overall market size.

U.S. multinationals also capitalized on a traditional advantage of producing in developing countries, which is inexpensive labor. Lower labor costs, as compared to those in developed countries, were an important factor in investment decisions. This was reflected in the statistical significance of real wage coefficients.

The signs on the coefficients in FDI regressions (Table 1) should not be interpreted as positive or negative effects of independent variables on the current FDI position, since the correct effects of changes in exogenous variables are obtained after the Euler equation is solved.

The estimates of standard errors robust to the presence of heteroskedasticity in the error term changed the significance of some variables. The current tax level became statistically insignificant, and the lag of FDI openness decreased its significance from 5 percent to 10 percent. The coefficients on real wages and sales also decreased their significance from

1 percent to 5 percent. However, the real interest rate became significant at 10 percent. The fact that some of the variables lost their statistical significance can be attributed to the robust estimation procedure that tends to inflate standard errors, indicating loss of efficiency (Stata, 2003). However, homoskedastic and robust estimates produce the same estimates of the coefficients. Hence, there were indications that the model is indeed homoskedastic.

Overall, the Euler regression showed that U.S. FDI in food processing exhibited strong dynamic trends and was driven by demand forces and labor costs. These results were robust under different assumptions about the structure of the error term (whether the variance of the error term remained the same across countries or varied). Tax levels and FDI openness proved to be important factors affecting the capital accumulation process under a homoskedastic assumption. Robust estimates of standard errors diminished the significance of these macro variables. Such an outcome is typical for robust estimates since they tend to have higher standard errors.

Having obtained coefficient estimates, we need to verify that the model has a converging solution. To do this, we calculated the roots of the Euler equation (see Table 2). The smaller root (λ_1) calculated for the estimated Euler equation lies in the required range between zero and one and equals 0.146. The larger root equals 1.068 and is greater than unity; it therefore complies with convergence requirements.

Table 2. Elasticity Estimates

	Exchange Rate	Tax	GDP	FDI Openness	Wage	Interest Rate	Sales
$T = 1$	0.34	0.46	0.09	0.40	-1.21	-0.87	1.73
$T = 10$	0.95	4.21	-1.81	1.79	-5.05	-3.63	7.25
$T = \infty$	1.71	8.89	-4.18	3.52	-9.84	-7.09	14.13
Roots of the Euler Equation				λ_1=0.146		λ_2=1.068	

The value of the smaller root, being close to zero, suggests very fast adjustment of investment in food processing industries in Latin American countries. Such fast adjustment can be a result of the structure of foreign investment. It is likely that U.S. multinationals simply buy already existing production facilities in foreign countries. If this is the case, the foreign investment consists of a simple transfer of funds and does not result in building new production facilities in most cases. Thus, the adjustment costs did not seem to slow the investment process significantly.

Effects of the Shocks on Investment Decisions

Now let us turn to the model's projection regarding the effects of changes in the future exogenous variables on the FDI position. Introducing a free trade agreement that will encompass most of the Western Hemisphere countries (FTAA) is a good example of possible changes. It is important to discern the effects on U.S. food processing foreign investment.

The estimated coefficients by themselves do not directly show the effects of changes in exogenous variables on the FDI position of U.S. multinational firms. We use Equations 5, 6, 7, and 8, that represent effects of shocks on FDI position, and multiplied them by ratios of data means from each country's panel to show the effects of changes in exogenous variables (wages, interest rates, sales, and macro variables) on FDI position in the form of elasticities. Since the model is dynamic, we calculate both temporary and permanent effects of shocks. The elasticities are presented in Table 2.

We chose to calculate elasticities corresponding to short, medium, and long-runs. The short-run is represented by $T = 1$, medium-run by $T = 10$, and long-run by $T = \infty$. The elasticities of the foreign investment position were calculated with respect to exchange rates, tax levels, real GDP, FDI openness, real wages, real interest rates, and sales.

Elasticities with respect to traditional variables that determine production costs (wages, interest rates, and sales) have expected signs. According to the estimations, an increase in real wages and real interest rates result in the reduction of direct investment capacity in a host country. This result is intuitive and consistent with cost minimizing behavior of the multinationals.

The short-run response of the direct investment position with respect to wage is elastic and equals -1.21. The medium-run wage elasticity is -5.05, and the long-run wage elasticity is -9.84.

The effects of a shock to interest rates, that represent the direct costs of capital, are not as prominent as the real wage shock. The long-run real interest rate elasticity is -7.09, while medium and short-run elasticities are -3.63 and -0.87, respectively.

Demand factors, represented by real sales in a host country, were important in determining the FDI position of U.S. multinationals according to the estimation results. Expansion in demand requires more production capacity, and therefore more FDI. Accordingly, the output/sales elasticities are positive. The long-run elasticity with respect to real sales equals 14.13, which is the largest long-run response when compared to the responses to other factors. The medium-run sales elasticity is 7.25, and the short-run elasticity is 1.73.

Macro variables have mixed effects on FDI in food processing. The overall level of FDI as a share of GDP in a host country (FDI openness) has a positive effect on food processing investment levels, although the elasticities are not as high as for most other variables. When measuring FDI openness, FDI includes investment from various countries and is not limited to U.S. food processing investment. FDI openness indicates the general receptiveness of the host country to foreign capital. Higher levels of FDI openness signal the presence of a favorable business environment and economic stability, encouraging multinationals to invest. The short-run response of the FDI position in food processing to a change in FDI openness is inelastic and equals 0.4. The medium-run elasticity is 1.79, and the long-run elasticity is 3.52.

Market size, proxied by real GDP, is negatively related to food processing foreign investment in the long and medium terms. This result is somewhat surprising because one would expect better sales opportunities in larger markets. The short-run response to a change in GDP is positive but small, and the elasticity equals 0.09. However, the medium and long-run elasticities are negative and equal -1.81 and -4.18, respectively. Negative elasticities are possible because U.S.

multinationals may respond to only certain groups of customers whose demand is better represented by sales of processed food than by overall GDP.

Tax levels in a host country are another variable that yielded unexpected results. Foreign direct investments were positively related to the level of taxes. The short-run tax elasticity equals 0.46, and the medium and long-run elasticity equal 4.21 and 8.89, respectively. Intuitively, high taxes should discourage foreign investment because of the cost considerations. However, it may be the case that an economy-wide indicator of tax level does not well-represent tax policies that host countries' governments implement with respect to foreign investment. High taxes may also signify Latin American governments' involvement in providing efficient infrastructure and creating a good investment environment.

Exchanges rates have a positive effect on the FDI position. The short and medium-run responses of the FDI position in food processing to exchange rate change are inelastic and equal 0.34 and 0.95, respectively. The long-run elasticity is 1.71.

The effect of exchange rate on foreign investment position in the context of the model can be mixed because while higher exchange rates make investment in a host country less expensive, they can also be a result of inflation that is associated with economic instability, which can lead to investment risks. In the case of Latin American countries, the opportunity to acquire capital at lower prices outweighs economic instability considerations.

CONCLUSIONS

In this study, we applied a dynamic cost minimization model of U.S. foreign direct investment (FDI) in food processing industries to the cases of nine Latin American countries. The dynamic approach to modeling FDI is inherently superior to traditional static models because barriers to investment (adjustment costs) exist that prevent multinational companies from instantly achieving the target investment position. Foreign investment in food processing is no exception.

Estimation of the first order condition (Euler equation) using a consistent rational expectation assumption showed that the dynamic structure explains the investment process in food processing industries well. In particular, the lagged variable of the FDI position had high explanatory power. The other variables that represented demand forces (such as real wages and sales) were highly significant as well. This indicates that U.S. food processors are driven by demand in a host country and labor cost considerations.

The model included several macro variables, representing the state of host countries' economies, that served as proxies for investment barriers. They were: FDI openness (measured as a percentage of overall FDI in host countries' GDP), exchange rates, real GDP, and general tax levels. Taxes and FDI openness were statistically significant, while real GDP and exchange rates were not. The explanatory power of the first two macro variables suggests that they indeed have influence on the timing of foreign investment in food processing.

Estimations results revealed a relatively high speed of adjustment of FDI, indicating that U.S. food processing multinationals are quite flexible in terms of adjusting their production capacities. This can happen because multinationals buy existing production facilities instead of setting up their own, which can take more time and be more expensive.

In the last portion of the study, we quantified the effects of temporary and permanent shocks to exogenous variables on the FDI position. Such shocks can be a result of introducing preferential trade agreements like the FTAA that may affect the factors influencing FDI decisions and facilitate movements of capital between countries.

Higher wages and interest rates would decrease the FDI position of U.S. multinationals, while an increase in demand for output would improve it. FDI openness and the exchange rate were found to have a positive effect on investments. Real GDP and tax levels were estimated to have effects on food processing investment that were counterintuitive. However, a lack of statistical significance in case of the real GDP variable and an inability to reflect specific taxes on FDI in the case of the general tax level variable can explain these results.

The FDI position of U.S. multinationals in the food processing industry has increased substantially over the last two decades. The main objectives of the FDI have been: 1) to reduce production costs by using cheap labor in foreign countries, and 2) to effectively penetrate foreign markets. This study indicates that U.S. FDI in the food processing industry would increase substantially if Western Hemisphere countries reach an agreement on an FTAA. In addition, there will be more inter-industry trade between the United States and Latin American countries, based on the principle of comparative advantage, mainly because of differences in resource endowments between the United States and these countries. However, U.S. trade with Canada would be more intra-industry trade, rather than inter-industry trade, because of similarities in their resource endowments. This implies that U.S. FDI in Latin American countries may grow faster than that in Canada.

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