

INTERNATIONAL TRADE, FOREIGN DIRECT INVESTMENT, AND DOMESTIC MARKET PERFORMANCE

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INTRODUCTION

Expanding trade, growing foreign investment and evolving multinational corporations are forcing the integration of industrial organization and international economics. Unified analyses have to account for the influence of trade on domestic markets as well as the impact of imperfect competition on trade flows and foreign direct investment. This consolidation is particularly relevant as economies become more open and as policy proposals surface for relaxation of antitrust or restoration of trade barriers to improve trade balances and/or industry profitability. A number of studies have already begun to integrate the two fields.¹ We join this literature by developing a model that links domestic profits, trade flows and outward foreign direct investment in a simultaneous four-equation system.

Our model augments existing studies in two important respects. First, with only a few exceptions, previous research findings have been based on single-equation models. These models neglect the endogeneity of key variables. Our model, on the other hand, consists of four simultaneous equations that incorporate a full set of market structure variables with endogenous trade flows and a foreign investment variable.

Second, as De Ghellinck, Geroski, and Jacquemin [1988] point out, most previous research assumes that the effect of trade on profit is constant and independent of domestic market structure. They overcome this problem by introducing "openness" variables that interact with other market structure variables in explaining the oscillation of profits across industries. Their "openness" variables, however, consist of endogenous import and export shares and a binary variable that reflects their opinions about price-taking behavior in each industry. In contrast, we deal with this problem by formulating an index of market seclusion that is estimated from data on

tariffs, nontariff barriers, and exchange rate responsiveness. Our index is then allowed to interact with other market structure variables to explain profits.

The determinants of international transactions and market performance are many, and the linkages among the variables complex. We attempt to model the multiple relationships by including a large number of relevant variables within a simultaneous equation system. Nevertheless, our focus will be on a few major and sometimes controversial hypotheses.

(1) *Higher concentration among domestic producers leads to higher imports and lower exports.* Although the popular opposing view that bigger domestic firms compete more effectively with foreign firms receives no support in the literature, the evidence for the hypothesis is mixed. Pagoulatos and Sorenson [1976] and Marvel [1980] validated the hypothesis for imports but not for exports. On the other hand, Nolle [1991] and Clark, et al. [1990] validated the hypothesis for exports but not imports. Our results confirm the latter findings.

(2) *Larger imports (exports) tend to decrease (increase) the profits of domestic producers.* Many studies have found support for the hypothesis that imports impose a discipline on profits. To our knowledge only a couple of articles have validated the positive relationship between exports and profits [Nolle, 1991; Pagoulatos and Sorenson, 1976]. Our results confirm the hypotheses for both imports and exports, an important replication given the theoretical ambiguity of the export-profit relation.

(3) *Excess domestic profits attract imports.* Our results contradict those of Esposito and Esposito [1971], Marvel [1980] and Pugel [1978] who validated this hypothesis.

(4) *Scale economies enlarge both imports and exports.* Economies of scale could form entry barriers that inhibit the entrance of foreign (domestic) firms into domestic (foreign) markets. Nevertheless, previous estimates support the view that firms attempt to exploit scale economies through international trade. We confirm these findings.

(5) *Higher outward foreign direct investment (OFDI) is associated with lower exports.* Caves [1985] characterizes OFDI and exports as alternative means of entering foreign markets. Other studies, however, find that the relationship between OFDI and exports is positive, a finding that might be explained by the tendency of multinationals to engage in intra-firm trade. Our results support the latter view.

THE MODEL

Our study examines the linkages among (1) the ratio of imports to domestic shipments (import shares designated by IMP_i), (2) the ratio of exports to domestic shipments (export shares designated by EXP_i), (3) outward foreign direct investment ($OFDI_i$), and (4) a price-cost margin (domestic profits designated by $PROF_i$) for a cross section of 248 U.S. manufacturing industries. To test the interaction between trade and domestic market performance, we formulate the following system of four simultaneous equations:

$$(1) \quad IMP_i = \rho_1 PROF_i + \sum_{k=0}^{K^{IMP}} \xi_k X_{ik}^{IMP} + \varepsilon_i,$$

$$(2) \quad EXP_i = \sum_{k=0}^{K^{EXP}} \delta_k X_{ik}^{EXP} + \mu_i,$$

$$(3) \quad OFDI_i = \omega_1 EXP_i + \sum_{k=0}^{K^{OFDI}} \gamma_k X_{ik}^{OFDI} + \tau_i,$$

$$(4) \quad PROF_i = (1 - SEC_i) \{ \phi_1 + \phi_1 IMP_i + \phi_2 EXP_i + \phi_3 OFDI_i \} \\ + \sum_{k=0}^{K^n} \{ \alpha_k^0 + (\alpha_k^c - \alpha_k^0) SEC_i \} X_{ik}^n + \{ SEC_i (v_i^c - v_i^0) + v_i^0 \}.$$

where X_{ik}^j are vectors of exogenous variables defined precisely in Appendix A.²

The first three equations are simply linear combinations of endogenous and exogenous variables. The profit equation (4) is more complex: it is a weighted linear expression of profitability in a completely open economy, $PROF_i^o$, and profitability in a completely closed economy, $PROF_i^c$. An index of seclusion (SEC_i) weights the two profit states so that $PROF_i$ may be written as

$$(5) \quad PROF_i = SEC_i PROF_i^c + [1 - SEC_i] PROF_i^o.$$

Notationally, open-economy profits, $PROF_i^o$, are modeled as:

$$(6) \quad PROF_i^o = \phi_1 IMP_i + \phi_2 EXP_i + \phi_3 OFDI_i + \sum_{k=0}^{K^n} \alpha_k^0 X_{ik}^n + v_i^0,$$

Closed-economy profits, $PROF_i^c$, are modeled as:

$$(7) \quad PROF_i^c = \sum_{k=0}^{K^n} \alpha_k^c X_{ik}^n + v_i^c,$$

The two hypothetical and unobservable profit states (for the open and closed economies) are weighted by an indicator (SEC_i) of each industry's degree of seclusion from international trade. SEC_i is assumed to be a linear function of impediments to imports:

$$(8) \quad SEC_i = \beta_0 TAR_i + \beta_1 NTB_i + (1 - \beta_0 - \beta_1) ER.$$

The first variable in the seclusion index (equation (8)) is the industry effective tariff rate (TAR_i). The effective tariff rate measures the degree of protection given to domestic value added in each industry as estimated by the U.S. Department of Com-

merce. Although nominal tariffs are no longer very high in comparison to non-tariff barriers, effective tariff rates on manufacturers are usually higher than those on retailers or wholesalers because raw materials are imported either duty-free or at much lower rates of duty than finished goods.

The second variable (NTB_i) in equation (8) is a dummy variable that proxies non-tariff barriers to imports. If an industry is protected by any non-tariff barrier, NTB_i equals 1; otherwise, NTB_i equals zero. Non-tariff barriers have become much more important as tariffs have been reduced over the last two decades. Among the developed countries, the U.S. is the largest user of voluntary export restraints (VERs), as well as antidumping and countervailing measures.

The third variable in equation (8) is defined as the percentage change in value added induced by a one-percent depreciation of the dollar. This variable reflects responsiveness to exchange rate changes. Depreciation of the currency raises import prices and lowers the foreign prices of exports. The price changes induce foreign buyers to purchase larger quantities of exports and domestic buyers to substitute domestic products for foreign goods. Offsetting this positive effect on domestic value added, however, would be the rise in price of importable intermediate goods. The positive effects of currency depreciation are lessened if an industry has a larger share of the world market and if it is more dependent on imported inputs. The ER_i estimates attempt to measure the net effects of depreciation. Because the trade-balance effects are generally positive, we expect a larger ER_i to indicate greater seclusion of the domestic market from imports. Exchange rate responsiveness (ER_i) also appears explicitly as one of the exogenous variables in the X_i^{EXP} vector of the export share equation (2).

ESTIMATION AND DATA

Since the index of seclusion, SEC , is unobservable, equations (6), (7) and (8) are substituted into the profit equation (5), in order to estimate profits and seclusion simultaneously. This procedure yields the profit equation (9):

$$(9) \quad \begin{aligned} PROF_i = & (1 - [\beta_0 TAR_i - \beta_T NTB_i + (1 - \beta_0 - \beta_1) ER]) (\phi_I IMP_i \\ & + \phi_2 EXP_i + \phi_3 OFDI_i) + \sum_{k=1}^{K^n} \{ \alpha_k^c + (\alpha_k^c - \alpha_k^o) [\beta_0 TAR_i \\ & + \beta_T NTB_i + (1 - \beta_0 - \beta_1) ER] \} X_{ik}^n + \{ [\beta_0 TAR_i + \beta_T NTB_i \\ & + (1 - \beta_0 - \beta_1) ER] (v_i^c - v_i^o) + v_i^o \}. \end{aligned}$$

As constructed, equation (9) estimates parameters in the open-economy profits equation, the closed-economy profits equation, and the index of seclusion. Equation (9) is combined with the import share, export share, and foreign direct investment equa-

tions, (1) (2) and (3), respectively, to form an estimable simultaneous equation system.

Nonlinear three-stage least squares is used to estimate the system of equations. This estimation procedure takes into account the simultaneity among equations and the correlation among disturbances.

Hausman and Taylor [1983] discuss the choice of instruments to be used in nonlinear simultaneous equation estimation. Unlike the linear case, there is no reduced-form specification that allows the separation of the endogenous variables into functions of predetermined variables and disturbances. Therefore, they suggest forming instruments out of linear and nonlinear combinations of the predetermined variables. For this estimation, the squares and cross products of the predetermined variables are used as instruments.

The basic unit of analysis for this study is the four-digit Standard Industrial Classification (SIC) industry. From an initial sample of 452 industries, a number of poorly defined or miscellaneous industry classes labeled "not elsewhere classified" are omitted because they are not good proxies for markets. 385 four-digit SIC industries remain in the sample. Several industries lacking domestic data and industries with no matching import or export data were omitted from the original sample, leaving 248 industries for analysis. The year 1982, the latest year for which both trade and Census data were available, was chosen. The data are described in Appendix A.

RESULTS

Results for each equation are shown in Table 1.³ For ease in interpretation, parameter estimates for the seclusion index, closed-economy profits, open-economy profits, import intensity, export intensity, and outward foreign-direct investment are shown separately. The associated *t*-statistics are shown in parentheses directly below the coefficient estimates.

Index of Seclusion

The index of seclusion (SEC_i) is estimated from a combination of impediments to trade. As shown in the first row of Table 1, the effective tariff variable (TAR_i) is positive and significant at the 90 percent level, and the exchange rate variable (ER_i) is positive and significant at the 99 percent level. These results suggest that domestic markets can be insulated from trade either through tariffs or currency devaluation. Non-tariff barriers (NTB_i) are not significant, perhaps because of the crudeness of the binary variable used to indicate the presence of nontariff barriers.

Profits in Open and Closed Markets

The empirical results for the closed-economy profit equation ($PROF_i^c$) and open-economy profit equation ($PROF_i^o$) are reported in the second and third rows, respectively, of Table 1.

TABLE 1
Results of Simultaneous Equation Analysis

Seclusion Index				
(1) $SEC_i =$	(+) 0.0197 ^c TAR_i (1.68)	- 0.020 NTB_i (0.16)	(+) 1.002 ^a ER_i (8.27)	
Closed-Economy Profits				
(2) $PROF_i^c =$	0.421 ^b (2.09)	- 0.011 CR_i^c (0.09)	(+) 0.031 ^b ADV_i (2.34)	(+) 1.032 MES_i (0.83)
	(-) 0.278 LI_i (0.38)	(-) 1.638 KI_i (0.53)	- 0.213 $GROW_i$ (1.13)	(-) 0.0002 RD_i (0.43)
Open-Economy Profits				
(3) $PROF_i^o =$	0.026 (0.35)	(+) 0.024 ^a ADV_i (3.70)	(+) 0.033 MES_i (0.06)	+ 0.940 ^a LI_i (3.34)
	- 1.089 KI_i (0.88)	+ 0.217 ^a $GROW_i$ (2.85)	(-) 0.0002 RD_i (0.87)	(-) 0.226 ^a IMP_i (4.92)
	+ 0.520 ^a EXP_i 3.05	- 0.098 $OFDI_i$ 0.74		
Import Share				
(4) $IMP_i =$	0.437 ^a (5.33)	- 0.533 ^a CR_i^o (5.35)	(+) 0.055 ^a ADV_i (4.52)	(+) 3.648 ^a MES_i (7.16)
	(+) 1.469 ^a LI_i (4.00)	+ 0.457 KI_i (0.61)	(+) 0.062 $GROW_i$ (1.01)	(-) 0.0003 RD_i (1.45)
	(+) 0.022 $ELAS_{md, i}$ (0.92)	- 1.819 ^a $PROF_i$ (4.24)		
Export Share				
(5) $EXP_i =$	0.069 ^a (3.56)	(-) 0.081 ^b CR_i^o (2.41)	(-) 0.005 ^b ADV_i (2.12)	(+) 0.695 ^a MES_i (3.88)
	(-) 0.288 ^a LI_i (3.12)	(+) 0.678 ^a KI_i (2.94)	- 0.001 RD_i (0.44)	
	(+) 0.160 ^a ER_i (4.42)	(+) 0.022 ^a CA_i (2.94)		
Outward Foreign-Direct Investment				
(6) $OFDI_i =$	-0.086 (0.63)	(+) 0.281 ^a CR_i^o (5.33)	(+) 0.017 ^a ADV_i (4.04)	
	(-) 0.891 ^a MES_i (2.94)	(+) 0.020 $GROW_i$ (0.86)	- 0.0003 RD_i (0.99)	
	(+) 0.0007 $PPSR_i$ (0.50)	+ 0.0001 PRD_i (0.16)	+ 1.176 ^a EXP_i (7.52)	

When expected signs and estimated signs are the same, estimated signs are shown in brackets.
a, b, c indicate significance at the 1, 5, and 10 percent levels, respectively.

The closed-economy profit results are surprising. Only advertising (ADV_i) has a positive and significant influence on profits. The open-economy profit results, however, are more in line with expectations. Advertising intensity, market growth ($GROW_i$) and labor intensity (LI_i) increase profits as expected. Research and development (RD_i), scale economies (MES_i), and capital intensity (KI_i) have no effect on open-economy profits.

Import share (IMP_i) is highly significant and has the expected negative impact on open-economy profits. Export share (EXP_i) is also significant at the 99 percent level and displays the expected positive sign. These last two results confirm an important hypothesis that trade flows do impact domestic market profits.

Import and Export Shares

The coefficient estimates for import-share and export-share are displayed in rows four and five of Table 1, respectively. The equations provide support for the Heckscher-Ohlin theory: capital intensity (KI_i) is positively and significantly related to export share while labor intensity (LI_i) is positively and significantly related to import share. The U.S. exports capital-intensive goods, where it has a comparative advantage, and imports labor-intensive goods, where it has a comparative disadvantage.

The open-economy concentration variable (CR_i^o) is negative and significant in both the import- and export-share equations. Firms in highly concentrated industries may be better able to defend themselves from import competition than firms in less-concentrated industries. They are less apt to enter foreign markets with exports, however. Our result contradicts the findings of many studies for imports, but supports the recent estimates of Clark, et al. [1990], for both imports and exports.

Advertising intensity is positive and significant for the import equation and negative and significant for the export equation. These results combined do not support the idea that product differentiation increases trade in both directions. The negative relationship between advertising and exports may be explained by the difference between firms that export and those which enter a market through foreign direct investment. There is evidence that firms selling less advertised, homogeneous products depend on exports to supply international markets, whereas those selling highly differentiated, heavily advertised products tend to supply foreign markets primarily from foreign plants. Results from the foreign direct investment equation support this hypothesis as well.

Minimum efficient scale (MES_i) in both the import and export equation is positive and highly significant. An important result, this indicates that scale economies encourage both foreign and domestic firms to expand production through exports.

Surprisingly, import share is negatively related to the price-cost margin ($PROF_i$). Theoretically, industries with higher profit margins would attract greater imports, but current profitability might not be the appropriate profitability measure here. Perhaps expected profitability would be the most important inducement to imports, and since 1982 was a recession year, perhaps many of those expectations were unrealized. Dumping in a recession year could also explain why depressed profit margins led to high imports.

Other variables which are positively and significantly related to export share include the exchange-rate responsiveness variable (ER_i), and a variable used as a proxy for interindustry comparative advantage (CA_i). Both of these variables are consistent with theoretical expectations.

Outward Foreign Direct Investment

The outward foreign direct investment ($OFDI_i$) results are shown in row six of Table 1. Overall, these results display some interesting contrasts to the trade equation results. Here, plant scale economies (MES_i) are significant and negatively related to $OFDI_i$, as expected. When scale matters, firms prefer to export than to invest abroad.

The relationship between advertising intensity (ADV_i) and $OFDI_i$ is positive and significant. This result is consistent with the advertising/export results above and again supports the idea that the U.S. tends to export homogeneous intermediate goods and provide differentiated consumer goods abroad via investment in foreign plants.

$OFDI_i$ and open-economy concentration (CR_i^o) are directly related, whereas trade and concentration are inversely related. Therefore, it seems that foreign investment rather than exporting is favored in concentrated industries.

Export share is found to be significantly and positively associated with $OFDI_i$. This result may reflect the presence of intra-firm trade which is complementary to foreign investment.

CONCLUSION

This paper models the interrelationships among international trade flows, profit performance and outward foreign direct investment for a sample of 248 American manufacturing industries. A unique feature of the nonlinear simultaneous equation model is that it contains trade-barrier variables that interact with domestic market structure variables in explaining the variance in profits across industries. We find effective protection from tariffs and exchange rates to be significant positive influences on profits. This suggests that industries may be able to protect domestic profits through tariff and exchange rate policies.

Trade flows seem to influence domestic profits. As expected, domestic profits fall with increases in imports and rise with increases in exports.

Exports are relatively high for capital intensive goods and imports are relatively high for labor-intensive goods. This reflects the Hecksher-Ohlin theory in that the U.S. is a relatively capital-abundant economy.

An unusual result is that imports respond inversely, rather than directly, to concentration and profits. We speculate that this result may reflect dumping or unrealized profit expectations in the weak economy of 1982.

Imports respond positively to advertising, but exports respond negatively. This result is consistent with the notion that advanced industrial economies such as the United States tend to import highly differentiated consumer goods and export less-

differentiated intermediate products. Trade flows also respond positively to a measure of minimum efficient scale, while outward foreign direct investment responds negatively. This is a reasonable result suggesting that when scale economies matter, firms prefer to export rather than invest abroad.

The results also extend our knowledge of the influence of concentration on foreign investment. While concentration tends to reduce exporting, it significantly increases foreign direct investment. For any given level of concentration, however, exports and foreign direct investment are positively related, suggesting that intra-firm trade is important for multinationals.

Although our results illustrate the value of simultaneous equations and of interactive trade-barrier variables, there is obvious room for improvement. The stability of the relationships that we have estimated across industries needs to be assessed over time. The measures of nontariff barriers and capital intensity at the industry level need refinement. An indicator of expected profits might improve the import equation. It would be helpful to have estimates of multi-plant economies of scale or what Ethier [1982] calls international scale economies and estimates of total research and development activity. Other endogeneities besides the ones we explored may be worthy of consideration. Certainly, in view of the differing empirical estimates and continuing political debate over the efficacy of industrial policies, further improvements in modeling domestic and international market interaction would be worthwhile.

APPENDIX A
Description of the Data

- $PROF_i$** Industry price-cost margin is calculated as the sum of value of shipments minus payrolls minus cost of materials, all divided by value of shipments. *Census of Manufacturers*, U.S. Dept. of Commerce.
- CR_i^c** Closed-economy four-firm concentration ratio for 1982 less exports in numerator and denominator. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- CR_i^o** Open-economy four-firm concentration ratio for 1982 including exports in numerator and imports plus domestic industry alignments in denominator. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- ADV_i** Advertising to sales ratio. Source: Thanks to Richard T. Rogers for providing this variable. Derived from *Leading National Advertisers Data*, 1967.
- MES_i** Minimum efficient scale - average shipments from the largest plants producing 50 percent of industry shipments divided by total industry shipments for 1977. Source: Derived from 1977 *Census of Manufacturers*, U.S. Dept. of Commerce.
- $GROW_i$** Growth of the market, - 1982 value of shipments minus 1977 value of shipments, all divided by 1977 value of shipments. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- $PPSR_i$** Outbound diversification - the inverse of the primary product specification ratio, the ratio of primary product shipments to total product shipments for 1982. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- KI_i** Capital intensity - expenditures for new plant and equipment divided by the value of shipments, 1982. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- LI_i** Labor-intensity - production worker wages divided by the value of shipments, 1982. Source: *Census of Manufacturers*, U.S. Dept. of Commerce.
- RD_i** Research and development - private research and development in SIC 2-digit industries. Source: F.M. Scherer [1982].
- IMP_i** Import share - ratio of value of imports to the value of shipments, 1982. Source: *TradeNet, U.S. Census Trade Data*, U.S. Dept. of Commerce.

- EXP_i Export share - ratio of value of exports to the value of shipments, 1982. Source: *TradeNet, U.S. Census Trade Data*, U.S. Dept. of Commerce.
- $OFDI_i$ Outward foreign direct investment - sales of U.S. subsidiaries overseas divided by industry value of shipments, 1982. Source: *U.S. Direct Investment Abroad*, U.S. Dept. of Commerce.
- TAR_i Effective tariff rate, 1982. Source: *TradeNet, U.S. Census Trade Data*, U.S. Dept. of Commerce.
- NTB_i Non-tariff barrier dummy variable. Source: Derived from the UNCTAD Data Base on Trade Measures for the USA, 1990.
- ER_i Protection or change in value added due to a 1 percent devaluation of the exchange rate. Source: Deardorff and Stern [1986].
- CA_i An index of comparative advantage of an industry, defined as (exports - imports)/total trade. Source: Caves, et al. [1980].
- $ELAS_{md,i}$ The elasticity of substitution in demand between imports and domestically-produced goods for industry I. Reported in Shiells, Stern, and Deardorff [1986].
- PRD_i The percentage process R & D within the industry. Reported in Scherer [1982].

NOTES

Barbara El-Osta is an agricultural economist with the U.S. General Accounting Office. The views expressed in this paper are the authors' and do not necessarily reflect the views of the GAO.

1. For a review, see Krugman [1989].
2. To save space, when the expected signs of the parameters contained in the X_i vectors are the same as the estimated signs, those signs are shown in parentheses in Table 1.
3. Recall that signs in parentheses indicate that expected and estimated parameter signs are the same.

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