

# The Complementarity Between U.S. Foreign Direct Investment Stock and Trade

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*Within a gravity model framework, this paper will establish that trade and foreign direct investment (FDI) are complementary, using trade and FDI stock data on a bilateral basis between the U.S. and 51 other countries over the period 1982 to 1994. U.S. outward FDI is found to have a larger predicted impact on U.S. exports than does inward FDI. On the other hand, inward FDI is found to have a larger predicted impact on U.S. imports than does U.S. outward FDI. These results are directly linked to patterns of intrafirm trade within the multinational enterprise (MNE), a result consistent with the transactions cost theory of MNEs. In addition, a sectoral analysis indicates that U.S. outward FDI in manufacturing has a large predicted impact on both exports and imports, whereas U.S. outward FDI in services has a large predicted impact on U.S. exports but little or no predicted impact on imports. (JEL F2, F4) Atlantic Econ. J., 29(4): pp. 420-437, Dec. 01. ©All Rights Reserved*

## Introduction

It is often assumed that foreign direct investment (FDI) is an important source of international technology transfer and economic growth for the host economy [Hejazi and Safarian, 1999; Balasubramanyam et al., 1996; Borensztein et al., 1998; McFetridge, 1991; Safarian, 1985].<sup>1</sup> On the outward side, there is concern in some home countries, including the U.S., that FDI transfers production to locations with relatively inexpensive labor, such as Mexico or China. Reduced exports to such countries and increased imports from them are said to lower home country output, employment, and capital formation as well as increase income inequality.<sup>2</sup>

This paper argues this is not necessarily the case. The major reason is that the presence of FDI stocks (domestic and abroad) facilitates the flow of intrafirm information on a broad front, reducing the costs of conducting business and leading to increases in international trade. To test this view, a gravity model is used to estimate the link between outward and inward U.S. FDI stocks and U.S. exports and imports on a bilateral basis to 51 countries over the period 1982 to 1994. The results indicate that outward FDI to a particular country causes exports and imports to increase with that country. FDI in the U.S. is also found to stimulate

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\*University of Toronto—Canada. The authors acknowledge financial support from Industry Canada, the Ford Foundation, and the Centre for International Studies of the University of Toronto. Detailed comments and suggestions were provided by Joe Daniels, Albert Berry, and seminar participants at the University of Toronto, York University, Industry Canada, and the 1999 annual Canadian Economics Association meeting. Research assistance was provided by George Georgopoulos and Anthony Yao. The authors are responsible for any remaining errors.

exports and imports. A major conclusion is that trade and FDI are complementary, a result consistent with the transactions costs theory of MNEs.

The empirical analysis finds that both outward and inward FDI cause increases in U.S. exports, but the former effect is larger. This can be explained by patterns of intrafirm trade. In 1992, U.S. exports between U.S. parents and their foreign affiliates were twice the size of U.S. exports between U.S. affiliates and their foreign parent.<sup>3</sup> The opposite result occurs on the import side, in that inward FDI has a larger predicted impact on imports than does outward FDI. The explanation lies once more in the larger role of intrafirm trade between U.S. affiliates and their foreign-owned parents than is the case for U.S. parents and their foreign affiliates.

Regionally, the U.S. exports and imports more with its adjacent trading partners, Mexico and Canada, and with East Asia and Japan than is predicted by the standard gravity model, but less with Europe. U.S. exports and imports with Latin America accord with the predictions of the gravity model. Adding patterns of FDI to the gravity model as a determinant of international trade helps to improve the gravity model's ability to explain excess amounts of exports between the U.S. and Japan as well as imports with its adjacent partners. However, it does little to improve the explanation for other areas. These results are also explained by considering patterns of intrafirm trade between the U.S. and its trading partners.

At the sectoral level, U.S. outward FDI in manufacturing stimulates large increases in both overall exports and imports, whereas U.S. outward FDI in services stimulates large increases in exports but has little or no impact on imports. U.S. outward FDI in petroleum has a small or insignificant impact on both exports and imports. Data limitations prevent the use of U.S. inward FDI for the sectoral analysis.

The first major conclusion of this paper is that the impact of FDI on trade depends very much on the sectoral distribution as well as the role of intrafirm trade both across industries and across countries. Using aggregate data can be misleading for the great majority of countries for which sectoral data on FDI and intrafirm trade are not available. Second, FDI increases the U.S. trade surplus, other things equal. Additionally, concentration on the trade balance would be quite misleading in welfare terms. For example, total trade has increased, and an increase in the trade surplus, other things equal, implies an increased net outflow of capital. Nevertheless, the issue of the home country effects of outward FDI is often put in terms of the effects on the trade balance. In any case, there is an interesting theoretical issue involved in terms of the complementarity or substitutability of trade and investment.

This paper is organized as follows. The second section reviews the literature, and the third section distinguishes the current study from the existing literature. The fourth section states the motivation for the approach utilized. The fifth section examines the model used to measure links between trade and FDI, and the sixth section provides empirical estimates of these links. The seventh section presents conclusions and qualifications.

### **Literature Review**

The empirical literature on international trade and on FDI is vast, but the literature that considers links between trade and FDI is more limited.<sup>4</sup> Some of the major findings are outlined here. While standard trade theory regards trade and factor mobility as substitutes

[Mundell, 1957], subsequent developments have left the issue unresolved: everything depends upon the model being used. A survey of historical experience from 1870 to 1940 rejects substitutability and leans toward complementarity but does not resolve the issue for recent experience [Collins et al., 1997].

Concentrating on FDI, the results are still ambiguous, depending on the model, type of trade, and country experience. Much of the earlier literature on inward FDI assumed substitutability in the case of manufacturing, particularly in the case of protection-induced FDI. However, FDI in the natural resource sector was often considered trade increasing both in terms of an inflow of goods financed by international investment and the eventual export of part of the resource. The change from decentralized to network-based multinational enterprises (MNEs) might be expected to increase foreign trade since resource duplication across geographic markets is reduced through specialization [Malnight, 1996].

Regarding manufacturing, a review of some recent work illustrates the difficulty in arriving at a clear answer on the issue of the links between trade and FDI. Graham [1994] suggests the evidence points to modest support for the idea that FDI abroad leads to an increase in net exports and to a positive contribution to the balance of payments. However, as Hufbauer and Adler [1968] demonstrated empirically in a classic study, the results depend heavily on how firms abroad respond in supplying the foreign market if the home FDI does not occur. The results also vary by regions.

Pfaffermayr [1994] uses impulse response analysis and variance decompositions to examine the dynamic relationship between trade and FDI flows. For Austria, he finds a very slow dynamic response of each variable to exogenous shocks to the other. Tests by Rao et al. [1994] find that exports and outward Canadian FDI are complementary.

Brainard [1997] points out several problems with studies that consider the link between trade and FDI flows or stocks. She argues that exports and FDI are a conceptual mismatch since the correct comparison is between exports and multinational foreign production (or foreign sales). Some studies are not subject to this criticism. Lipsey and Weiss [1981] use a gravity model and data for 1970. They conclude that U.S. affiliate production is positively related to U.S. exports to that country in the same industry and negatively related to exports of rival producers. Lipsey and Weiss [1984] use firm-level data to disaggregate further by industry, location of FDI, and destination of exports, reinforcing their earlier results. Swedenborg [1979] uses firm-level data on Swedish MNEs to show that MNE sales and exports are complements at the level of the firm. Blomström et al. [1988] use industry-level data on U.S. and Swedish MNEs and find that exports and foreign production are complementary.

### **Differences to Other Studies**

This literature survey indicates there is evidence that outward FDI and exports are complementary although far from universal, as shown by Caves [1996]. The contribution made by this paper is in more fully evaluating an important policy question regarding the effects of FDI. For example, it is broader in statistical terms than most other studies by using a panel data set covering 51 countries and 13 years. It is also explicitly based on the idea that the gravity model is a transactions cost model but that sectoral and regional breakdowns are necessary to incorporate the different motivations for FDI.

There is also an important difference in the motivation for considering FDI stocks. The reasoning is that the presence of FDI would reduce the information costs of doing business between economies and lead to an increase in both exports and imports. The criticism levied by Brainard [1997] does not apply to this study. FDI stocks do not proxy for foreign production here. They measure MNE presence in foreign markets, with a reduction in information costs and an increase in trade. Furthermore, the issue of simultaneity, which plagues most studies that consider links between trade and FDI, is not relevant here. Since FDI stocks proxy foreign market penetration, there is no theoretical need to treat FDI stocks and trade flows simultaneously as would be the case if FDI stocks were meant to proxy foreign production.

### Motivation for the Approach Utilized

The first step in analyzing the causal link between trade and FDI is to consider a formal model of international trade. This paper utilizes the gravity model, which has been used to explain bilateral trade flows among many countries over long periods [Frankel et al., 1995; Hejazi and Trefler, 1996]. The analysis is then extended to take FDI into account as an additional determinant of trade. This will indicate whether trade and FDI are substitutes or complements after controlling for comparative advantage. Deardorff [1995] shows that the gravity model can in fact be derived from and hence is a testable implication of both the Heckscher-Ohlin and monopolistic competition models of international trade.

In the gravity model, comparative advantage is determined by transactions costs broadly defined. The presence of FDI stocks facilitates the intrafirm flow of information on a broad front, as internalization approaches to FDI have long argued.

MNEs are also deeply involved in the spreading alliance forms of business organization.<sup>5</sup> Moreover, spillovers of knowledge through FDI often rival the production of knowledge locally [Hejazi and Safarian, 1999]. Also, a large part of international trade is intrafirm and such trade may respond differently to price and exchange rate changes than would arms-length trade [Zeile, 1997]. All of this suggests that the presence of MNEs not only affects trade patterns but also reduces the costs of conducting business and leads to increases in international trade.

### Modeling the Links Between Trade and FDI: The Gravity Model for Trade

Let  $t$  denote years,  $U$  is the U.S., and  $i$  is the trading partner country. Let  $X_{Uit}$  denote bilateral exports from the U.S. to country  $i$  in year  $t$ ;  $M_{Uit}$  denotes bilateral imports from country  $i$  into the U.S.;  $T_{Uit}$  denotes transactions costs broadly defined; and  $D_{Ui}$  denotes regional dummy variables. The gravity model for exports becomes:

$$\log(X_{Uit}) = \alpha + \log(T_{Uit})\beta + D_{Ui}\delta_1 + \varepsilon_{Uit} \quad , \quad (1)$$

and for imports:

$$\log(M_{Uit}) = \alpha + \log(T_{Uit})\beta + D_{Ui}\delta_1 + \varepsilon_{Uit} \quad . \quad (2)$$

The transactions costs and dummy variables are shown in Table 1.

Countries of similar size and per capita GDP are expected to have similar needs both in terms of intermediate inputs [Ethier, 1982] and consumption patterns. Trade between two countries should be positively related to their incomes.<sup>6</sup> Countries that are geographically close and those with similar languages should have lower transactions costs and correspondingly larger levels of bilateral trade. Increases in the value of the U.S. dollar are expected to increase U.S. imports but reduce exports.

**TABLE 1**  
**Transactions Costs and Dummy Variables**

| Variables                        | Description   | Expected Sign                   |
|----------------------------------|---|---------------------------------|
| $GDPPC_{U_t} \times GDPPC_{i_t}$ | Product of per capita GDP in countries $U$ and $i$  | +                               |
| $GDP_{U_t} \times GDP_{i_t}$     | Product of GDP in countries $U$ and $i$   | +                               |
| $distance_{U_i}$                 | A measure of distance between countries $U$ and $i$   | -                               |
| $language_{U_i}$                 | 1 if countries $U$ and $i$ share the same language, 0 otherwise                                 | +                               |
| Exchange Rate                    | Value of the U.S. dollar in terms of foreign currency (on a real purchasing power parity basis) | - for exports,<br>+ for imports |
| Dummy Variables                  |   |                                 |
| Adjacency                        | 1 for Canada and Mexico, 0 otherwise  | +                               |
| Europe                           | 1 for countries in Europe, 0 otherwise  | ?                               |
| East Asia                        | 1 for countries in East Asia, 0 otherwise   | ?                               |
| Latin America                    | 1 for countries in Latin America, 0 otherwise   | ?                               |
| Japan                            | 1 for Japan, 0 otherwise  | ?                               |

Notes: GDP denotes gross domestic product.

Dummy variables are included for several regional groupings as well as an adjacency dummy which reflects the special geographic relationship of the U.S. with Canada and Mexico. Note that these dummy variables are capturing residuals in the model, that is, trade which is unexplained by the model. If the standard variables captured all the determinants of international trade, the dummy variables would be statistically insignificant.

Next, outward and inward FDI are added as a determinant of trade:

$$\log(X_{Uit}) = \alpha + \log(T_{Uit})\beta + D_{Uit}\delta_1 + \log(OUTFDI_{Uit})\delta_2 + \log(INFDI_{Uit})\delta_3 + \varepsilon_{Uit} \quad (3)$$

and

$$\begin{aligned} \log(M_{Uit}) = & \alpha + \log(T_{Uit})\beta + D_{Ui}\delta_1 \\ & + \log(OUTFDI_{Uit})\delta_2 + \log(INFDI_{Uit})\delta_3 + \varepsilon_{Uit} \end{aligned} \quad (4)$$

where  $OUTFDI_{Uit}$  is the stock of U.S. FDI located in country  $i$  in year  $t$ , and  $INFDI_{Uit}$  is the stock of country  $i$ 's FDI located in the U.S. The presence of FDI reduces the costs associated with trade. It is unclear, however, whether exports or imports should increase more.<sup>7</sup>

### Estimation and Interpretation of the Results

Bilateral U.S. FDI stocks were obtained from the Bureau of Economic Analysis and bilateral U.S. merchandise exports and imports from the International Monetary Fund's *Direction of Trade Statistics* [various]. Purchasing power parity-based exchange rates, GDPs, and population data were obtained from the Penn world tables [Summers and Heston, 1991]. Distance and language dummies were those used in Hejazi and Trefler [1996]. The sample size of the tests is 663 (51 countries times 13 years per country). All data have been converted to real values except FDI stock data.<sup>8</sup>

#### *Testing the Link Between FDI and Exports*

Table 2 provides estimates of the gravity model for exports.<sup>9</sup> Column A includes only the standard variables, all of which have the expected sign. U.S. exports are positively related to the product of GDPs and GDPs per capita and to language similarities. They are negatively related to the distance between countries and exchange rates, although the latter relation is statistically insignificant. Column B adds the dummy variables. The signs on the initial variables are unchanged, but the coefficient for the exchange rate increases dramatically and is now significant. The results indicate that the U.S. exports more to adjacent countries, East Asia, and Japan than is predicted by the gravity model but less to Europe. U.S. exports to Latin America conform to the predictions of the gravity model.

Column C adds U.S. outward FDI as a determinant of U.S. exports. This increases the explanatory power (adjusted  $R^2$ ) of the model by 6 percentage points (.783 to .844). The coefficient on the FDI variable is positive and strongly significant, indicating that increased FDI to a country increases U.S. exports to that country. The most notable impact is that language becomes an insignificant determinant of U.S. exports.

The addition of FDI reduces the amount of unexplained exports from the U.S. to its adjacent countries, East Asia, and Japan but increases unexplained exports to Europe and Latin America. Column D shows the results are not significantly affected if foreign sales are used rather than FDI stock. Data limitations reduce the sample size in this case from 663 to 507.

What role does FDI play in the U.S.? Column E adds inward stocks to the standard gravity specification with strong positive effects on U.S. exports. Most obvious is the dramatic increase in the adjacency dummy and the insignificance of the Japan dummy. Column F adds U.S. outward and inward stocks of FDI simultaneously. The Japan dummy remains insignificant while the adjacency dummy is reduced.<sup>10</sup>

**TABLE 2**  
**Gravity Model Regressions for U.S. Exports and FDI: 1982-94**

| Independent Variables      | Dependent Variable: Bilateral Exports |                   |                    |                   |                    |                    |
|----------------------------|---------------------------------------|-------------------|--------------------|-------------------|--------------------|--------------------|
|                            | A                                     | B                 | C                  | D                 | E                  | F                  |
| Product of Per Capita GDPs | .408<br>(7.100)                       | .425<br>(8.510)   | .162<br>(3.370)    | .181<br>(2.890)   | .112<br>(1.190)    | .076<br>(.830)     |
| Product of GDPs            | .648<br>(32.190)                      | .628<br>(33.390)  | .390<br>(17.080)   | .219<br>(5.440)   | .478<br>(20.270)   | .334<br>(10.530)   |
| Distance                   | -.541<br>(-9.600)                     | -.619<br>(-7.570) | -.695<br>(-11.430) | -.496<br>(-6.400) | -.240<br>(-2.400)  | -.373<br>(-3.590)  |
| Language                   | .513<br>(8.570)                       | .391<br>(7.010)   | .069<br>(1.190)    | .014<br>(.220)    | .037<br>(.570)     | -.328<br>(-4.660)  |
| Exchange Rates             | -.055<br>(-.610)                      | -.480<br>(-5.740) | -.183<br>(-2.510)  | .109<br>(1.170)   | .211<br>(1.900)    | .325<br>(2.950)    |
| Adjacency                  |                                       | .695<br>(4.900)   | .356<br>(2.750)    | .431<br>(3.370)   | .930<br>(5.810)    | .603<br>(3.200)    |
| Europe                     |                                       | -.561<br>(-6.370) | -.788<br>(-11.300) | -.684<br>(-7.650) | -.772<br>(-10.340) | -.889<br>(-12.190) |
| East Asia                  |                                       | .799<br>(10.550)  | .447<br>(5.420)    | .378<br>(3.640)   | .784<br>(6.400)    | .631<br>(5.270)    |
| Latin America              |                                       | .052<br>(.520)    | -.574<br>(-6.230)  | -2.66<br>(-2.550) | -.344<br>(-3.110)  | -.720<br>(-5.960)  |
| Japan                      |                                       | .507<br>(5.180)   | .443<br>(5.480)    | .398<br>(4.030)   | -.192<br>(-1.830)  | -.003<br>(-.020)   |
| Outward FDI                |                                       |                   | .341<br>(14.350)   |                   |                    | .278<br>(7.840)    |
| Inward FDI                 |                                       |                   |                    |                   | .285<br>(17.270)   | .183<br>(8.810)    |
| Foreign Sales Abroad       |                                       |                   |                    | .537<br>(13.990)  |                    |                    |
| Adjusted $R^2$             | .681                                  | .783              | .844               | .859              | .899               | .919               |
| Observations               | 663                                   | 663               | 663                | 507               | 299                | 299                |

Notes: The t-statistics are in parentheses and are constructed using standard errors that are autocorrelation and heteroskedastic consistent. The 5 percent critical value for the t-statistic is 1.96. Column A includes only standard gravity variables for trade; column B adds adjacency and regional dummies; column C adds outward FDI stocks; column D adds foreign sales abroad; column E adds inward FDI stocks; and column F adds both outward and inward FDI stocks.

These results indicate that once patterns of FDI are taken into account as an additional determinant of international trade, U.S. exports to Europe and Latin America fall short of what is predicted by the gravity model, whereas U.S. exports to its adjacent partners and East Asia exceed what is predicted by the gravity model. In contrast, U.S. exports to Japan are consistent with what is predicted by the gravity model. Distance remains a negative determinant of trade. Both the exchange rate and language dummy now have incorrect signs. Nevertheless, the results indicate that both outward and inward stocks of FDI stimulate U.S. exports. Furthermore, outward FDI is predicted to have a larger impact on exports than is inward FDI.

*Testing the Link Between FDI and Imports*

The next hypothesis tested is whether FDI has a significant impact on imports. Column A of Table 3 estimates the standard gravity model, showing expected signs, except for exchange rates. U.S. imports are positively related to the product of GDPs and GDPs per capita and to language similarities. They are negatively related to distance between countries and the exchange rate, but the latter relation is statistically insignificant.

**TABLE 3**  
**Gravity Model Regressions for U.S. Imports and FDI: 1982-94**

| Independent Variables         | Dependent Variable: Bilateral Exports |                    |                    |                    |                   |                   |
|-------------------------------|---------------------------------------|--------------------|--------------------|--------------------|-------------------|-------------------|
|                               | A                                     | B                  | C                  | D                  | E                 | F                 |
| Product of Per<br>Capita GDPs | .269<br>(3.990)                       | .316<br>(4.950)    | .190<br>(2.900)    | .061<br>(.820)     | .170<br>(1.550)   | .159<br>(1.470)   |
| Product of GDPs               | .746<br>(33.940)                      | .733<br>(37.770)   | .620<br>(22.280)   | .476<br>(12.670)   | .608<br>(26.650)  | .566<br>(21.800)  |
| Distance                      | -.627<br>(-9.870)                     | -.924<br>(-13.490) | -.960<br>(-14.890) | -.874<br>(-13.550) | -.942<br>(-9.430) | -.980<br>(-9.700) |
| Language                      | .317<br>(4.380)                       | .254<br>(4.350)    | .034<br>(.550)     | .006<br>(.100)     | -.136<br>(-1.930) | -.221<br>(-2.990) |
| Exchange Rates                | -.110<br>(-1.060)                     | -.634<br>(-6.540)  | -.493<br>(-4.490)  | -.334<br>(3.000)   | .061<br>(.560)    | .094<br>(.850)    |
| Adjacency                     |                                       | .372<br>(3.110)    | .211<br>(1.680)    | .203<br>(1.880)    | .076<br>(.610)    | .019<br>(.140)    |
| Europe                        |                                       | -.593<br>(-6.590)  | -.701<br>(-8.070)  | -.576<br>(-6.360)  | -.803<br>(-8.970) | -.837<br>(-9.360) |
| East Asia                     |                                       | 1.391<br>(13.490)  | 1.224<br>(10.710)  | 1.265<br>(10.680)  | 1.332<br>(9.100)  | 1.287<br>(8.750)  |

TABLE 3 (CONT.)

| Independent Variables | Dependent Variable: Bilateral Exports |                  |                  |                  |                   |                   |
|-----------------------|---------------------------------------|------------------|------------------|------------------|-------------------|-------------------|
|                       | A                                     | B                | C                | D                | E                 | F                 |
| Latin America         |                                       | .095<br>(.880)   | -.204<br>(1.630) | -.033<br>(-.280) | -.343<br>(-2.790) | -.453<br>(-3.560) |
| Japan                 |                                       | 1.036<br>(8.820) | 1.005<br>(8.910) | 1.023<br>(8.930) | .661<br>(4.720)   | .716<br>(5.010)   |
| Outward FDI           |                                       |                  | .163<br>(6.260)  |                  |                   | .081<br>(2.700)   |
| Inward FDI            |                                       |                  |                  |                  | .168<br>(9.890)   | .139<br>(6.690)   |
| Foreign Sales Abroad  |                                       |                  |                  | .359<br>(9.980)  |                   |                   |
| Adjusted $R^2$        | .657                                  | .811             | .822             | .858             | .923              | .924              |
| Observations          | 663                                   | 663              | 663              | 507              | 299               | 299               |

Notes: See notes in Table 2.

Column B adds the dummy variables. The signs on the initial variables are now unchanged, but the exchange rate is statistically significant and still incorrectly signed. The results indicate that the U.S. imports more from its adjacent trading partners, Japan, and East Asia than is predicted by the gravity model but less from Europe, while imports from Latin America conform to predictions.

Column C adds U.S. outward FDI as a determinant of U.S. imports. As with exports, language now becomes statistically insignificant. FDI has eliminated the statistical significance of one of the transactions costs. The FDI variable itself is positive and significant, indicating that increased FDI to a country increases U.S. imports from that country. The adjacency dummy becomes statistically insignificant (that is, there are no unexplained imports), indicating that MNEs play a major role in facilitating U.S. imports from Canada and Mexico. The addition of FDI has also left the Latin America dummy statistically insignificant, whereas the Europe dummy becomes more negative and the Japan and East Asia dummies become marginally smaller.

Column D shows the results are little affected by the use of foreign sales rather than FDI.<sup>11</sup> Column E turns to inward FDI, which is positively and strongly associated with imports into the U.S. Column F adds inward and outward FDI simultaneously. Both are positive and strongly significant, although inward FDI is a more important determinant of imports than is outward FDI.

Once inward and outward FDI are taken into account, the Europe and Latin America dummies are negative, indicating that the U.S. imports too little from these regions, given

comparative advantage and patterns of FDI. In contrast, the Japan and East Asia dummies are positive and significant, indicating the U.S. imports too much from these regions, given comparative advantage and patterns of FDI. The adjacency dummy is insignificant, indicating that accounting for patterns of FDI explains all excess imports between the U.S. and its adjacent trading partners. Although the exchange rate is statistically insignificant, the language dummy is incorrectly signed and significant, a result also found in the export regressions reported in Table 2.

#### *Possible Explanations*

The first result that needs to be explained is the relationship between the coefficients on inward and outward FDI in column F of Tables 2 and 3. These show that U.S. outward FDI stimulates more exports than does inward FDI. By contrast, inward FDI stimulates more imports than does outward FDI. This paper's hypothesis is that FDI should stimulate trade because of the resulting increase in information flows. Ultimately, it is an empirical question whether exports or imports should increase more.

Data on patterns of intrafirm trade shed more light on the empirical estimates.<sup>12</sup> Table 4 shows the percentage of U.S. exports and imports, which are intrafirm, and the role played by U.S. parents and their foreign affiliates (U.S. outward FDI) against the role played by U.S. affiliates and their foreign-owned parent (U.S. inward FDI).

In 1992, 33.4 percent of all U.S. exports were intrafirm, with 22.5 percent between U.S. parents and their foreign affiliates and only 10.9 percent between U.S. affiliates and their foreign-owned parents. As for imports, 41.5 percent were intrafirm, with 15.6 percent involving U.S. MNEs and 25.9 percent involving foreign MNEs. These numbers suggest not only that FDI contributes to the explanation of trade flows, but also that U.S. MNEs play a larger role in explaining U.S. exports than do foreign MNEs (Table 2) and that foreign MNEs play a larger role in U.S. imports than do U.S. MNEs.

The data in Table 4 also sheds light on why adding FDI improves the gravity model's ability to explain U.S. trade with its adjacent trading partners and Japan but is less successful with other areas. Japan is clearly the outlier: 70.1 percent of U.S. exports to Japan and 71.3 percent of U.S. imports from Japan are intrafirm, with a majority of this trade occurring between foreign affiliates in the U.S. and their Japanese parents. Only 15.9 percent of U.S. exports to Japan are intermediated between U.S. parents and their foreign affiliates and 2 percent of imports from Japan. In contrast, 54.2 percent of U.S. exports to Japan and 69.2 percent of imports are intermediated between foreign affiliates and their Japanese parents.

The gravity results in Tables 2 and 3 confirm what would be expected from this material. In Table 2, adding patterns of outward FDI does little to explain the excess amounts of exports between the U.S. and Japan, whereas adding patterns of inward FDI makes the Japan dummy statistically insignificant, thus explaining all excess exports from the U.S. to Japan. A similar story occurs on the import side. Adding outward FDI to the gravity model does little to explain excess imports into the U.S. from Japan. On the other hand, adding inward FDI significantly reduces the Japan dummy, helping the gravity model to explain this excess trade.

**TABLE 4**  
**The Role of MNEs in U.S. Exports and Imports by Industry: 1992**

|  | All Countries | Canada | Mexico | Europe | Latin America | Japan | East Asia |
|--|---------------|--------|--------|--------|---------------|-------|-----------|
| <b>U.S. Exports that are Intrafirm</b>                           |               |        |        |        |               |       |           |
| Percentage of all exports  | 33.4          | 41.4   | 26.3   | 35.5   | 70.1          | 20.8  | 38.5      |
| Between U.S. parents and their majority-owned foreign affiliates | 22.5          | 37.4   | 24.9   | 26.8   | 15.9          | 18.6  | 14.7      |
| Between U.S. affiliates and their foreign-owned parents          | 10.9          | 4.0    | 1.5    | 8.7    | 54.2          | 2.2   | 23.8      |
| <b>U.S. Imports that are Intrafirm</b>                           |               |        |        |        |               |       |           |
| Percentage of all imports  | 41.5          | 46.7   | 34.7   | 46.3   | 71.3          | 29.1  | 42.6      |
| Between U.S. parents and their majority-owned foreign affiliates | 15.6          | 37.1   | 30.5   | 11.5   | 2.0           | 20.3  | 7.7       |
| Between U.S. affiliates and their foreign-owned parents          | 25.9          | 9.6    | 4.2    | 34.8   | 69.2          | 8.8   | 34.9      |

Source: Zeile [1997].

A similar story can be told to explain why adding outward FDI helps to significantly reduce the adjacency dummy in the export regressions, whereas adding inward FDI adds very little. In contrast, both inward and outward FDI help to significantly reduce the adjacency dummy in the import regressions. These results can be explained by the large role U.S. MNEs play in both exports and imports to its adjacent trading partners, while adjacent country MNEs play a very small role in facilitating U.S. exports but play a larger role in facilitating U.S. imports.

The results presented in Tables 2 and 3 also lend support to the view that increased amounts of U.S. FDI, both outward and inward, increase the trade surplus between the U.S. and its trading partners. A comparison of column F in Tables 2 and 3 indicates that the predicted impact of outward FDI on exports is much larger than its predicted impact on imports (.278 versus .081). The implication is that outward U.S. FDI increases the U.S. trade surplus (all else constant). At the same time, increases in inward FDI also increase both U.S. exports and U.S. imports, but again, the predicted impact is larger on exports than on imports (.183 versus .139).

One notable result is the consistently negative dummy variable for Europe, whether for exports or imports or, as noted shortly, sectorally. Europe trades significantly less with the U.S. than is predicted by the model. There are important institutional and other variables not captured in this model that reduce U.S.-Europe trade.

*A Sectoral Analysis for U.S. FDI*

The links between trade and FDI at the sectoral level may reflect different motivations for FDI. It is often hypothesized that firms undertake outward FDI to take advantage of factor price differences, including low-cost natural resources, with at least part of the foreign production being exported back to the home country. FDI undertaken to secure market access and access to technological skills can outweigh this motive especially in developed countries and some sectors of industry. Each of these motivations for FDI give ambiguous predictions as to whether exports would increase by more than imports. Access to service industries usually requires FDI given that services are largely nontradeables. However, this motivation would predict an increase in exports from the home country, especially in retail and wholesale trade, with little or no predicted impact on imports back to the home country.

Tables 5, 6, and 7 show that about half of all U.S. outward and inward stocks of FDI in 1994 was in services and just over one-third in manufacturing. Mexico and Canada receive the largest percentage of U.S. outward manufacturing FDI, whereas Europe and Latin America receive the large percentages of services FDI. On the U.S. inward side, Canada, Mexico, and Europe have the largest concentrations of manufacturing FDI while Japan, Latin America, and East Asia have the largest concentration of services FDI.

Table 7 brings out the asymmetry between U.S. MNEs and foreign MNEs with regard to intrafirm trade.<sup>13</sup> For U.S. parents and their foreign affiliates, two-thirds to three-quarters of such trade occur in manufacturing, as compared to only 20 percent for foreign MNEs and their U.S. affiliates. By contrast, wholesale trade accounts for almost three-quarters of all trade between U.S. affiliates and their foreign parents, as compared to less than 30 percent for U.S. parents and their foreign affiliates.

**TABLE 5**  
**Distribution of U.S. Outward FDI Stock by Industry: 1994**

|               | All Industries | Petroleum | Manufacturing | Services | Other |
|---------------|----------------|-----------|---------------|----------|-------|
| All Countries | 100.0          | 10.67     | 35.01         | 49.18    | 5.14  |
| Canada        | 100.0          | 11.22     | 48.82         | 32.18    | 7.78  |
| Mexico        | 100.0          | NA        | 63.64         | NA       | 14.19 |
| Europe        | 100.0          | 8.31      | 34.60         | 54.44    | 2.66  |
| Japan         | 100.0          | 16.69     | 41.51         | 39.45    | 2.35  |
| Latin America | 100.0          | 5.64      | 27.82         | 59.30    | 7.24  |
| East Asia     | 100.0          | 17.71     | 36.32         | 39.53    | 6.45  |

Notes: NA denotes not available. Figures are in percentages.

**TABLE 6**  
**Distribution of U.S. Inward FDI Stock by Industry: 1994**

|               | All Industries | Petroleum | Manufacturing | Services | Other |
|---------------|----------------|-----------|---------------|----------|-------|
| All Countries | 100.0          | 6.6       | 36.9          | 51.7     | 4.7   |
| Canada        | 100.0          | 6.7       | 40.8          | 42.3     | 10.2  |
| Mexico        | 100.0          | NA        | 46.8          | 40.5     | NA    |
| Europe        | 100.0          | 8.1       | 43.9          | 42.4     | 5.6   |
| Japan         | 100.0          | 1.0       | 19.8          | 7.2      | 1.0   |
| Latin America | 100.0          | 4.7       | 26.3          | 66.9     | 2.2   |
| East Asia     | 100.0          | 2.0       | 19.5          | 76.1     | 2.4   |

Notes: NA denotes not available. Figures are in percentages.

**TABLE 7**  
**The Role of MNEs in U.S. Exports and Imports by Industry Averages: 1982-94**

|   | All Industries | Manufacturing | Wholesale | Petroleum and Other |
|---|----------------|---------------|-----------|---------------------|
| <b>Intrafirm Trade Between U.S. Parents and Their Majority-Owned Foreign Affiliates</b> |                |               |           |                     |
| Exports   | 100.0          | 66.7          | 29.3      | 4.0                 |
| Imports   | 100.0          | 75.4          | 8.3       | 16.3                |
| <b>Intrafirm Trade Between U.S. Affiliates and Their Majority-Owned Foreign Parents</b> |                |               |           |                     |
| Exports   | 100.0          | 20.6          | 73.8      | 5.6                 |
| Imports   | 100.0          | 20.3          | 73.8      | 5.8                 |

These data explain the results presented in Tables 2 and 3. Most U.S. FDI located in Canada and Mexico is in manufacturing, and most U.S. MNE intrafirm trade takes place in manufacturing. Hence, outward FDI significantly reduces the adjacency dummy in the export and import regressions. Similarly, most Japanese FDI in the U.S. is in services, and three-quarters of foreign MNE intrafirm trade is wholesale trade. Hence, inward FDI significantly reduces the Japan dummy in the export and import regressions.

Table 8 shows the predicted impact on exports and imports when outward U.S. FDI in services, manufacturing, and petroleum is added to the gravity model. Outward U.S. FDI in petroleum has a small positive but statistically insignificant impact on U.S. exports and imports. By contrast, U.S. outward FDI in manufacturing predicts a large positive and highly significant impact on exports and imports, with the impact larger on exports. U.S. outward FDI in services predicts a positive and statistically significant impact on exports and imports, with the impact on exports quite large but that on imports small.<sup>14</sup> When taken together, these results are consistent with those on aggregate outward FDI that increases in outward FDI stimulate exports more than imports. Data limitations prevent a detailed analysis of inward FDI stock by industry.

**TABLE 8**  
**Gravity Model Regressions for U.S. Exports and Imports**  
**with Sectoral Outward FDI: 1982-94**

| Independent Variables      | Exports           |                    |                    | Imports            |                    |                    |
|----------------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                            | Petroleum         | Services           |                    | Petroleum          | Services           |                    |
|                            | Manufacturing     |                    |                    | Manufacturing      |                    |                    |
| Product of Per Capita GDPs | .366<br>(5.800)   | .277<br>(7.140)    | .216<br>(4.690)    | .430<br>(4.930)    | .211<br>(3.310)    | .229<br>(3.670)    |
| Product of GDPs            | .626<br>(30.380)  | .313<br>(13.780)   | .459<br>(23.120)   | .726<br>(32.890)   | .515<br>(21.020)   | .700<br>(29.500)   |
| Distance                   | -.443<br>(-5.840) | -.524<br>(-6.930)  | -.738<br>(-11.040) | -.806<br>(-10.740) | -.866<br>(-14.330) | -.990<br>(-14.350) |
| Language                   | .402<br>(6.580)   | .016<br>(.340)     | .003<br>(.060)     | .294<br>(4.440)    | -.006<br>(-.100)   | .131<br>(2.210)    |
| Exchange Rates             | -.567<br>(-5.690) | -.174<br>(-2.440)  | -.145<br>(-1.760)  | -.452<br>(4.190)   | -.425<br>(-4.150)  | -.584<br>(5.670)   |
| Adjacency                  | .990<br>(7.500)   | .431<br>(3.260)    | .419<br>(3.030)    | .556<br>(4.750)    | .179<br>(1.620)    | .256<br>(2.030)    |
| Europe                     | -.346<br>(-3.610) | -.832<br>(-11.810) | -.837<br>(-10.220) | -.302<br>(-2.790)  | -.785<br>(-9.610)  | -.681<br>(-7.320)  |
| East Asia                  | .785<br>(9.350)   | .429<br>(6.200)    | .508<br>(6.320)    | 1.516<br>(12.510)  | 1.136<br>(12.140)  | 1.382<br>(13.270)  |
| Latin America              | .133<br>(1.330)   | -.511<br>(-5.350)  | -.524<br>(-5.990)  | .282<br>(2.280)    | -.307<br>(-2.970)  | -.069<br>(-.580)   |
| Japan                      | .501<br>(4.640)   | .449<br>(5.260)    | .428<br>(4.690)    | 1.236<br>(8.920)   | .992<br>(8.810)    | .974<br>(8.420)    |

TABLE 8 (CONT.)

| Independent Variables | Exports         |                  |                  | Imports         |                  |                 |
|-----------------------|-----------------|------------------|------------------|-----------------|------------------|-----------------|
|                       | Petroleum       | Services         |                  | Petroleum       | Services         |                 |
|                       | Manufacturing   |                  |                  | Manufacturing   |                  |                 |
| Outward FDI           | .028<br>(1.710) | .299<br>(19.870) | .218<br>(12.910) | .019<br>(1.190) | .209<br>(11.900) | .058<br>(3.430) |
| Adjusted $R^2$        | .817            | .857             | .833             | .825            | .840             | .824            |
| Observations          | 551             | 657              | 648              | 551             | 657              | 648             |

Notes: The t-statistics are in parentheses and are constructed using standard errors that are autocorrelation and heteroskedastic consistent. The 5 percent critical value for the t-statistic is 1.96. Each column adds outward FDI in petroleum, manufacturing, and services, respectively, to the gravity model.

### Conclusions and Qualifications

This study has established that international trade and FDI are complements. Using a gravity model for 51 countries from 1982 to 1994 shows that U.S. FDI, both outward and inward, stimulates U.S. trade. The overall impact of FDI on exports exceeds that on imports. In this sense, FDI can be said to increase the trade surplus, other things equal. The impact of FDI on trade is a matter of some policy concern, and it addresses a point of theoretical interest. Note that the trade surplus in itself is a limited aspect of the welfare impact of FDI.

The sectoral results indicate that U.S. outward FDI in petroleum does not lead to statistically significant increases in international trade. In sharp contrast, U.S. outward FDI in manufacturing stimulates large increases in both exports and imports, with the former being larger. U.S. outward FDI in services stimulates significant increases in U.S. exports, with little or no increase in imports. These sectoral results are consistent with the aggregate results which show that increases in outward FDI stimulate relatively more exports than imports.

Closer examination indicates that the U.S. trades more with its adjacent trading partners, East Asia, and Japan than is predicted by the gravity model but less with Europe. Adding patterns of U.S. FDI to the gravity model helps to significantly improve its ability to explain these excess amounts of trade with adjacent partners and Japan but is less successful with other regions. These results were linked to the role of U.S. parents and their foreign affiliates in intermediating trade. Where U.S. trade involves U.S. parents, adding patterns of U.S. outward FDI to the gravity model should significantly improve its ability to explain bilateral trade. This hypothesis is confirmed. Where U.S. trade involves foreign parents, adding patterns of U.S. inward FDI to the gravity model should significantly improve its ability to explain bilateral trade. This hypothesis is also confirmed.

The findings of this paper confirm other research which finds that trade and FDI are complementary. Although the gravity model is often used, the motivation in this paper for including FDI stocks is unique. The gravity model has been linked here to the transactions cost-based theory of MNEs. It is argued that the presence of FDI stocks facilitates the flow of information between home and host economies, thereby increasing international trade. The relationship between FDI stocks and trade is measured and the estimated relationships are shown to be sensitive to both intrafirm trade and the sectoral distribution of FDI. It is evident that any results that come from aggregate regressions of trade and FDI must be significantly qualified.

### Footnotes

1. For studies on the outward side, see Globerman [1994], Lipsey and Weiss [1981, 1984], and Blömstrom and Kokko [1994].
2. Similar concerns have been raised in Japan in terms of a hollowing out of its manufacturing sector [Bayoumi and Lipworth, 1997]. The academic debate in the U.S. has focused on the effects of globalization, driven especially by trade and FDI, on domestic income inequality [*Journal of Economic Perspectives*, 1995, 1998; *NBER Reporter*, 1997, 1998].
3. The absolute value of U.S. outward FDI stock in 1990 was \$435 billion, whereas the inward stock was \$394 billion.
4. A partial review of the theoretical literature is contained in the *World Investment Report* [United Nations Conference on Trade and Development, 1996, pp. 123-5]. Globerman [1994] has a number of articles of interest.
5. For references to internalization and alliances, see the *Journal of International Business Studies* [1994, pp. 806-8].
6. Entering GDPs in product form is empirically well established in bilateral trade regressions. It can be justified by the modern theory of trade under imperfect competition. Furthermore, GDP per capita has a positive effect on trade: as countries become more developed, they tend to specialize and trade more [Frankel et al., 1995].
7. Grosse and Trevino [1996] estimate the gravity model with inward FDI flows and foreign sales in the U.S. as dependent variables. In contrast, this paper uses trade (exports and imports) as the dependent variable and adds outward FDI stocks and foreign sales abroad as independent variables.
8. It is a complex task to convert stock data to real values, which are reported at historical costs. For such attempts, see the U.S. Department of Commerce [1995], Gray and Rugman [1994], and Bellak and Cantwell [1996], though none of these have succeeded in the detail needed for the present purposes.
9. All t-statistics reported in this paper use estimated standard errors which are autocorrelation and heteroskedastic consistent. The constant is not reported. Note that a fixed effects model cannot be estimated because such effects would be collinear with the distance measures.
10. One important qualification should be noted regarding column F. Columns A to C have 663 observations because the U.S. has FDI stock in most countries over the entire sample. In columns E and F, the number of observations falls to 299 because many countries (especially developing ones) do not have significant FDI in the U.S. or data are suppressed to protect confidentiality.
11. It could be argued that outward FDI could impact exports and imports only with a lag. To test this hypothesis, the gravity model for exports and imports was reestimated, but lagged FDI stocks were included one year, two years, and three years earlier. The results reported here are

- qualitatively unchanged from such analysis.
12. Note that outward U.S. FDI data capture the relationship between U.S. parents and their majority-owned foreign affiliates abroad but not the relationship between foreign affiliates in the U.S. and their foreign parents. On the other hand, inward FDI data capture the relationship between foreign affiliates operating in the U.S. and their foreign parents.
  13. Note that the industries in Table 7 do not line up exactly with those in Tables 5 and 6. In particular, wholesale trade in Table 7 makes up only a part of services in Tables 5 and 6 but nevertheless comprises most of the trade in the service industries.
  14. When outward FDI in petroleum, manufacturing, and services is put into the gravity model simultaneously, petroleum FDI has no statistically significant impact on exports or imports, FDI in manufacturing has a strong and almost equal impact on exports and imports (although the impact on U.S. exports is slightly larger), and U.S. outward FDI in services stimulates significant increases in exports but has no statistically significant impact on imports.

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