Foreign Investment and the Mediation of Trade Flows

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Abstract:
How does foreign direct investment affect the trade between nations? While many theories of the multinational firm are based on the premise that foreign production and trade are substitutes, most empirical studies of foreign investment and trade uncover a complementary relationship. This paper shows that the mismatch between theoretical work and empirical findings is a byproduct of data aggregation. When I analyze the unique country-industry patterns of mostly OECD foreign investment in the U.S. I find that predicted substitution patterns are revealed at the data level that roughly corresponds to broad products. The complementary effects of foreign investment on trade emerge at higher levels of aggregation.

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1. Introduction

How does foreign direct investment affect the trade between nations? Most theories of the multinational firm assume that imports and foreign affiliate production are substitutes. In this framework multinational firms possess firm-specific assets or advantages, and a primary question they face is how they may best exploit their unique assets. The multinational has to evaluate whether it maximizes its worldwide profits by producing at home and exporting, or by investing abroad and shifting production to its foreign affiliates.\(^1\) This tradeoff underpins the substitution hypothesis of foreign investment, as foreign affiliate production is expected to displace imports of similar items from the home country.

In confirmation of the substitution hypothesis, Blonigen (2001) studies a set of products, and finds that U.S. imports from Japan decline when Japanese foreign investment creates a U.S. manufacturing presence. In related work, Brainard (1997) studies the 1989 cross-section of U.S. foreign investment activities and shows that multinationals are most likely to serve target markets via foreign affiliate sales, as opposed to exports, if the industry is characterized by high transportation costs, minimal plant scale economies, high tariffs, and openness to foreign investment.

In contrast, most empirical examinations have uncovered a complementary relationship between foreign investment and trade.\(^2\) To begin, potential complementary linkages between trade and foreign investment arise if multinational production affiliates purchase imported inputs from their

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\(^1\) Markusen (1995) reviews this body of research, and outlines his approach to the question.

\(^2\) This work includes Lipsey and Weiss (1981), and Blomstrom, Lipsey and Kulchycky (1988), Grubert and Mutti (1991), and Svensson (1996), Clausing (1997) and Barrell and Pain (1999).

In most papers, cross-country variation in trade and FDI are used to identify substitution or complementarity. In contrast, Pfaffermayr (1996) and Pain and Wakelin (1998) use time series variation to
The goal of this paper is to provide empirical evidence regarding the magnitude of these competing effects of foreign investment on trade, and in so doing, to reconcile the contrary empirical findings that arise from aggregate versus to micro trade analyses of this question. Similar to macro studies, my data analysis examines the broad spectrum of U.S. imports over the long time interval of twenty years. As a result, my conclusions are not limited to a subset of firms, countries or product industries. However, as is demonstrated by micro-based studies of trade and foreign investment, I discover that the identification of the multiple effects of foreign investment on trade requires finer disaggregation of the foreign investment data. Other authors, including Pfaffermayr (1996) and Pain and Wakelin (1998) have demonstrated the benefits of disaggregating data along its cross section and time series dimensions. In this paper, the disaggregation is taken further through an expansion of industry detail, and through the classification of foreign investments categorized at the product, industry and overall manufacturing levels. The results show that the traditional finding of complementarity is resoundingly echoed when foreign investment aggregation is left at the high level of overall manufacturing. In contrast, opposing substitution forces only become visible when U.S. imports are matched to foreign investments that have been disaggregated to the product level. In other words, empirically identifying the substitution and complementary effects of foreign investment identify these effects.

3 Empirical estimates from Blonigen (2001) and Head and Ries (1997) suggest the importance of this channel.

4 Firm level investigations are likely to provide a lower bound estimate of complementary production effects. This is because firms may purchase a number of inputs from independent suppliers that are located in their home country. Because I am matching trade and investment at a country level, my analysis captures these effects. Ideally, I would also like to measure the effects of firm sourcing arrangements that entail the
requires additional disaggregation of the trade and investment data.

The paper is structured as follows. In section two I develop a basic model that incorporates the multiple effects of foreign investment on trade. The model guides the subsequent estimation by demonstrating that one expects to find substitution at the product level, while complementarity is more likely to emerge at higher levels of aggregation. Section three discusses the data and is followed by estimation results in section four. After providing a baseline regression that can be compared with aggregate studies of foreign investment and trade, I show how disaggregation of foreign investment data provides meaningful evidence for the differing substitution and complementary connections created by foreign investment. Implications of my findings and conclusions are discussed in section five.
2. A Model of FDI and Imports

I develop a simple model to highlight the channels that link foreign investment to subsequent product trade flows. Consumer and producer demands for foreign products provide the foundation of the model. Since foreign direct investment (FDI) enables foreign firms to provide foreign product varieties via their U.S. facilities, import demand arises as the difference between the demand for foreign types, and the production of foreign products in foreign firm’s U.S. affiliates. If demand for foreign varieties is static, foreign affiliate production displaces trade at a rate of one for one. However, foreign investment creates further effects on trade if it stimulates product demand through informational spillovers, and through the creation of production channels.

I begin with consumer utility which is based the consumption of products from a number of product groups $D_j$, and the consumption of a non-traded good $N$. The utility function is Cobb-Douglas:

$$U = \left[ \prod_{j=1}^{n} \left( D_j^{\alpha_j} \right) \right] N^{\alpha_n}.$$ 

Within the utility function, the $\alpha_j$ coefficients apply to the composite consumption from each of the product groups, while the coefficient on the non-traded good is $\alpha_n = 1 - \sum \alpha_j$. Each of the product groups $D_j$ contains many varieties of the differentiated goods, each of which is distinguished by country of origin. Letting $c$ denote country of origin:

$$D_j = \sum_c \delta_c^j \left[ \frac{1}{\sigma_j} \right] \left[ \frac{1}{\frac{1}{\delta_j} + \frac{1}{\sigma_j}} \right]^j.$$ 

The $\sigma$’s represent the elasticity of substitution, while the $\delta$’s are demand distribution parameters for the national good types in each group $j$.

National origin is defined by the nationality of the firm’s ownership. I assume that consumer
product preferences are unaffected by production location. This means, for example, that imported British products are viewed as perfect substitutes with similar products produced by British foreign affiliates in the U.S. As long as the product price is the same, consumers choose the quantity of each foreign type that maximizes their utility, and the quantity they choose is independent of production location.

While consumers regard foreign products as indistinguishable by production location, accumulated foreign investment may affect demand if the presence of foreign factories generates goodwill, facilitates information spillovers, or creates positive demand externalities. Demand spillovers affect the demand distribution parameters, and are represented by the demand shift term: \[ \delta_j = \delta_j(K_j, K_m). \]

A nation’s distribution parameter for any product \( j \) depends first on that country’s accumulated foreign investment in product \( j \), \( K_j \). Although the characteristics of the foreign goods are not changed by U.S. production, the foreign firm’s U.S. presence may stimulate demand for the foreign goods as U.S. customers gain awareness of their existence. This effect causes consumers to switch away from U.S. and other countries’ types of product \( j \). The second foreign investment effect operates through the potential information flows created by foreign investment in all other industries that generate FDI stock \( K_m \). This effect is expected to be positive as well, reflecting information externalities associated with foreign direct investment production. In particular, as customers learn more about German or Japanese products generally, due to U.S. foreign investments by German or

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5 For generality, the shift parameter, and other later variables are subscripted \( f \), to indicate that they are the value for the foreign type. However, there are unique values for each country (ie: United Kingdom, France, Germany, Japan, etc.) each of which depend on intrinsic customer product preferences and the country’s accumulated stock of foreign investment.
Japanese firms, their taste for German and Japanese products may change.

U.S.-based production creates the second source of demand for foreign imports. All firms producing in the U.S. market combine U.S. and foreign inputs \((X_{us} \text{ and } X_{f})\) to create final goods \(Q_{us}\) and \(Q_{FDI}\), respectively. The production function for U.S. firms is

\[
Q_{us} = X_{us}^\gamma X_{f}^{1-\gamma},
\]

while the production function for foreign firms producing in the U.S is,

\[
Q_{FDI} = X_{us}^\beta X_{f}^{1-\beta}.
\]

I assume that the production of foreign and U.S. firms differs in two ways. First, U.S. firms use U.S.-produced inputs more intensively than do foreign firms, or \(\gamma > \beta\). Second, I assume that the foreign firm’s production techniques change as they accumulate investments in the U.S. In particular, I assume that foreign investment activities enable foreign firms to increase their use of U.S.-produced inputs. To begin, these effects arise as the foreign firm’s knowledge of the U.S. market grows, and as U.S. suppliers locate near the foreign firm’s U.S. operations. In addition, foreign input suppliers to the investors may choose to join the producer in the U.S. As foreign input supplier follow the MNC, the fraction of U.S.-produced inputs will rise, even if the nationality of the production is foreign. To represent how foreign firms change their relative reliance on foreign sourced inputs, the coefficients in the foreign production function are based foreign capital stock. Now \(\beta = \beta(K)\), and the value of \(\beta\) rises with accumulated foreign investment, though it does so at a

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6 Although I expect the demand spillovers to be positive, demand externalities could be negative.
declining rate, and it never exceeds the U.S. firm parameter value of $\gamma$ in magnitude. To reduce the complexity of the model, I assume that the cost of foreign and domestic inputs is identical, regardless of location. By doing so, I can eliminate changes in product price that arise when foreign firms replace exports with foreign affiliate production.

U.S. import demand is determined by the difference between total demand for the foreign product and the volume of foreign production in the U.S. As explained, the total demand for the foreign product depends on consumer and producer demands. To simplify the analysis, I assume that products $j$ are used as inputs to other industries but not as inputs in their own production. As a result, the import demand for each product $j$ takes the form:

$$\text{IMP}_j = (D_{f,j} - Q_{FDI,j}) + \sum_{k \neq j} [\psi_{as}Q_{assk} + \psi_fQ_{FDIk}]$$

The equation represents the import demand for products produced by foreign firms. Time and country subscripts are suppressed for simplicity. The first term in brackets represents consumer import demand for product $j$ that arises when final demand for the foreign variety of $j$ is not satisfied by foreign FDI production in the U.S., $Q_{FDIj}$. The second set of bracketed terms represents intermediate input demand for product $j$ that is generated by the use of product $j$ as an input in the production of other industries $k$. Since I assume products aren't used as inputs in their own production, this implies that production demand for any product $j$ is related solely to the

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8 $\beta_k > 0$, $\beta_{kk} < 0$, $\beta(\infty) \leq \gamma$. It might be argued that the preference for U.S.-produced inputs is more closely related to age than capital stock. We use capital stock as our proxy for the effects on input demand since the size of foreign investment stocks should be correlated with age, and because data constraints preclude the use of age. The effects of age could be examined with a data set that included firm age, and firm trade flows and sourcing choices. In contrast, all trade flow data in this analysis are at the country level.

9 This assumption is used to simplify the model results by preventing demand feedback effects that accompany product price changes. In recent decades the bulk of FDI has occurred between highly developed countries (Markusen (1995)), and in my sample, almost all investment transactions involve other rich OECD nations and the U.S.
downstream production of other final products of U.S. and foreign origin, which are denoted $Q_{\text{us},k}$ and $Q_{\text{di},k}$ respectively. Since the production functions imply that the demand for imported intermediate inputs is different for foreign and U.S. producers, the input-intensity parameters $\psi_{\text{us}}$ and $\psi_{\text{For}}$ represent this fact.

Overall, changes in imports can now be decomposed into changes that are related to three categories of foreign investment: Product, Industry, and Overall Manufacturing. The Product effect of FDI describes how product $j$ FDI affects imports of product $j$. The two components of this effect include the potential expansion of demand, or proximity effect of foreign investment, and the substitution effect in which foreign affiliate production displaces imports. The overall effect may be positive or negative, though it will be negative if substitution effects dominate.

A number of effects contribute to the relationship between import changes and Industry foreign investment. The first is a production effect that reflects the changes in product composition. To begin, when foreign affiliate sales displace domestic sales, the aggregate use of intermediate inputs moves away from the U.S. style - lower foreign content production - to the foreign mode that relies more heavily on imported intermediate inputs. In other words, the effect of input composition is interacted with changes in demand, because consumer switches from the U.S. to the foreign variety of a final good, imply that production will shift from the U.S. input mix towards

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10 I assume that all U.S. types are only produced in the U.S. This implies that $D_{\text{us},k} = Q_{\text{us},k}$. This assumption still holds if U.S. multinationals use the same input mix when they produce offshore. However, when there is offshore production, $Q_{\text{us},k}$ must be replaced by $D_{\text{us},k}$ in the import equation.

11 $\psi_{\text{us}}$ and $\psi_{\text{For}}$ describe how intensively U.S. and foreign firms producing in industry $k$, use inputs of product $j$.

12 Changes in accumulated foreign investment stocks ($K$) correspond to new foreign investment (FDI), or $\partial K_j = \text{FDI}_j$.

13 Market expansion effects are related to $\partial D_{f,j} / \partial K_j$, and should be positive since the own derivative of the demand shift parameter is positive, $\delta_{K_j} > 0$. Again, since $\partial K_j = \text{FDI}_j$, an expansion of $K_j$ represents growth of FDI activity. The substitution effect is created by $\partial Q_{\text{FDI},j} / \partial K_j$. In other words, if demand does not
the foreign mix. Next, accumulations of foreign investment will alter production techniques over time, as is explained in the discussion of the coefficient $\beta$. As foreign firms become familiar with the U.S. market, their need to import intermediate inputs declines. Finally, if foreign investment facilities that produce $k$ as their primary product also produce other related products including product $j$, FDI at the Industry level creates substitution effects that will reduce imports of product $j$. It is obvious that the effects at the industry level are many and competing. Whether industry FDI effects are positive or negative is a question to be resolved through empirical analysis.

The last foreign investment effect is the Overall Manufacturing effect. Here too, we expect to find that FDI in overall manufacturing is likely to stimulate imports of product $j$, if product $j$ is used as an intermediate input. Second, this effect captures any network effects or information externalities. It recognizes that demand for product $j$, may be affected when foreign firms develop networks as they invest in other products, $m$. The last effect should be positive as long as foreign investment intensifies international linkages, and creates positive informational or demand spillovers. Overall these two effects are expected to reinforce each other.
3. Data and Investment Patterns

The substantial, and relatively recent inflows of foreign investment into the U.S. provide an excellent opportunity for observing how investment inflows transform trade patterns. Over the twenty-year interval from 1977 to 1997, for example, the gross product of foreign investors' U.S. affiliates grew more than ten-fold from 35.2 billion dollars to 384.9 billion dollars.  

Ranked by the size of their contributions to gross affiliate product in 1997, United Kingdom firms were out front, followed in turn by Japan, Germany, France and Canada. Such expansion of foreign investment suggests that we can utilize the time series variation in country-industry investment patterns to learn more about the linkages between trade and foreign investment.

Two primary data sources provide the data for this study. I begin with foreign investment data compiled by the International Trade Administration (ITA) of the U.S. Department of Commerce and published in “Foreign Direct Investment in the United States: Transactions.” My study contains the entire 1974 to 1994 ITA data set. The foreign investment transaction data include information on investor nationality and identity, the 4-digit industry in which the investment was placed, and transaction value. My primary estimation technique relates the value of trade to value foreign investment. To study the effect of investment on imports, I match the investment data with U.S. Department of Census data on U.S. imports for the same 1974 to 1994 time period.

14 In percentage terms, the gross product of these foreign affiliates rose from 2.3 to 6.3 percent of total U.S. gross product. Zeile (1999) Survey of Current Business, p21-25.
15 The ITA ceased this collection effort after 1994.
16 The ITA data measure the value of investments in the U.S. These values represent the value of the new firm established, or the new plant or expansion, regardless of the form of financing and its location (US versus abroad). Since the ITA data do not create a census of foreign firms in the U.S., they do not track the subsequent decisions made by the FDI firms in the U.S. Therefore, the data set misses smaller investments (i.e. the purchases of a few new machines) though the ITA data collection attempts to capture larger subsequent investments including new plants or plant expansions.
interval. I provide further details regarding the construction of the data set in the data appendix.

The ITA investment sample exhibits a few notable characteristics. To begin, foreign investment flows into the U.S. originated from 67 countries. However, the investments were not evenly divided across countries. The primary investors were the United Kingdom and Japan, though Germany, Canada and France were also substantial investors followed by a handful of other, mostly rich countries of the OECD. Second, foreign investment was unevenly distributed across industries. The three industries which experienced the highest frequency of foreign investment were chemicals (SIC 28), non-Electrical Machinery (SIC 35) and Electrical Machinery (SIC 36), each of which captured roughly one-seventh of all the foreign investments as measured by investment counts. To convey an impression of the diversity of foreign investment flows across industries, Figures 1 through 3 display the time series evolution of foreign investments in the chemical, machinery and electrical machinery industries, disaggregated to the country level. At the fine industry level a number of the series have large jumps that represent years in which activities, or even a single transaction, boosted foreign investment substantially.

Empirical identification in this project relies, in part, on the cross-country differences in the time paths of investment. Additional identification is based on the differences in the time-paths of investment for each of the individual sub-industries. Although most countries

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17 The import data are taken from the NBER Trade Database which contains Bureau of Census, Department of Commerce data on TSUSA level product trade. See Feenstra (1996) for details.
18 The graphs were created by converting FDI flows to 1992-dollar values and then summing the annual FDI flows (by country and industry) over the years 1974 to 1994. This method of creating stocks implicitly assumes that initial FDI investments neither appreciate nor depreciate over time. Since this assumption is impossible to verify, the empirical analysis works with FDI flows and import changes rather than accumulated FDI stocks and import levels.
generally invested more heavily in the 1980's than they did in the 1970's, the figures show that individual countries nonetheless accumulated U.S. foreign investments at different rates. For example, Figure 1 illustrates that the rapid accumulation of German chemical investments began in the early 1970’s. In contrast, British chemical investment accelerated only after 1985, while Japanese and Swiss chemical investments began their rapid ascent at later dates yet.

To identify the various channels of foreign investment effects, I created measures that correspond to Product, Industry, and Overall Manufacturing foreign investment. I define Product foreign investment as all foreign investment in the same 3-digit SIC industry as the import. To measure industry linkages I connected 3-digit trade flows with all foreign investments by the country that occurred in the two-digit industry containing the 3-digit product flow. To prevent double counting, the value of the original product investment is subtracted from the aggregated Industry FDI measure. For example, the Industry variable I create for imports of product SIC 351 includes all of a country’s investment in the broad 2-digit industry SIC 35, with the exception of investments in SIC 351 that have already been counted in the product variable. I call this variable Industry foreign investment. This aggregation makes a stylized assumption about the relationship between products within a given 2-digit SIC industry; namely, that the production process generally utilizes same industry inputs more intensively than inputs from other industries. While this system of

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19 Since my study concerns all trade flows, I choose a broad 3-digit SIC definition of Product. While it is possible to use the finer 4-digit SIC foreign investment observations, use of the 4-digit data results in many observations with zero investment. The data are far less thin at the 3-digit level. Work that focuses on finer TSUSA product data, such as Blonigen (2001) necessarily limits itself to a much smaller subset of industries that received significant foreign investment.

20 In ideal conditions I would match imports to 3-digit industry investments which use the product as input. Unfortunately, it is not feasible to match foreign investors to upstream producers of inputs.
matching does not replicate production relationships exactly, the results found here can be interpreted as a rough estimate of industry linkages. In addition, since foreign investors often produce multiple products in their U.S. facilities the Industry variable also captures the possibility that foreign production will displace imports in other products that are similar to the primary product for which the investment is classified. Under these circumstances the Industry variable reflects the substitution effects associated with related operations. The net effect of input demand and multiproduct production determines the sign of the regression coefficient on the industry foreign investment variable.

The final investment variable is the Overall Manufacturing investment variable. I created the Manufacturing term by summing the universe of each country’s manufacturing investments for each year. Here too, I avoid double counting by subtracting those investments counted at the lower levels of aggregation. I expect to find a positive relationship between manufacturing foreign investment and subsequent U.S. imports. First, the manufacturing term will capture positive spillover effects generated by proximity benefits, as detailed in Brainard (1997), or the value for trade of networks of information and

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21 While foreign investors may produce many items, the ITA data classification system only lists the 4-digit SIC industry that comprises the foreign investor’s primary activity. If the firm produces other related products in the same industry, the effects of their production would be captured by the industry variable.

22 One data decision was how to aggregate the data at the most encompassing manufacturing or economy levels; whether to include all foreign investment across all industries, or to limit the inquiry to manufacturing investments alone. The ITA reports investment transactions in all areas - including non-manufacturing. The drawback of the non-manufacturing data is that transaction values are very frequently absent. If I impute the missing values for the non-manufacturing transactions, and replace the Overall Manufacturing FDI measure with an Overall Economy FDI variable, the qualitative results are not changed. For this reason, this project relies on the more precisely reported manufacturing transactions.
trading connections created by foreign investment as suggested by Lipsey (1995). Overall manufacturing imports may also rise if the foreign workers in the industry prefer their native home varieties, and their demand changes US imports when US industries fail to meet their needs. Finally, manufacturing imports will rise if the products are used as intermediate inputs in the production by foreign affiliates.

4. Estimation Framework and Results

The model of foreign investment and imports in section two demonstrates that foreign investment exerts a number of complex, and sometimes countervailing, effects on imports. In this section I apply the insights from the basic model to see whether the disaggregation of FDI data into product, industry, and overall manufacturing categories provides meaningful insights into international trade connections.

While the basic model relates import levels to foreign investment stocks, the estimating equation examines how changes in U.S. country-industry imports are related to changes in foreign investment stocks. A levels specification requires the necessarily problematic task of imputing foreign investment stocks from the time series evolution of foreign investment flows. To avoid measurement error introduced through the use of inaccurate depreciation rates or by the use assumptions regarding the sources of revaluation.

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23 A core data argument in Brainard (1997) is that study of substitution by multinationals should examine the tradeoff between trade and foreign affiliate sales, rather than the tradeoff between trade and foreign direct investment stocks. However, foreign direct investment stocks may allow the multinational firm to expand its foreign market over time, for example as the firm gains better information on foreign customers. In this case, it is appropriate to perform a time series analysis that examines the effect of foreign investment stocks, rather than foreign affiliate sales, on trade. Since Brainard studies a single year cross section, this issue could not be addressed in her work.
The magnitude of consumption demand is likely to be small, as most of the workforce hired by foreign investors, with the exception of a few expatriate managers, are local workers in the host country.
of foreign investment stocks, I choose to work with foreign investment flows. Consequently, my estimating equation examines how import changes are affected by new foreign investments completed in previous years at the product (PROD), industry (IND), and overall manufacturing (MFG). The regression specification is:

\[
\ln(\Delta import_{cj}) = \beta_1 \ln(PROD_{FDI}_{cj}) + \beta_2 \ln(IND_{FDI}_{cj}) + \beta_3 \ln(MFG_{FDI}_{cj}) + \psi_{cj} + \varepsilon_{cj}
\]

Changes in U.S. imports of product \( j \) from country \( c \) are related to the appropriately constructed FDI variables that pertain to country \( c \) activity. Time subscripts have been dropped for simplicity. However, it should be noted that changes in imports are related to prior year FDI flows.\(^25\) Because I am estimating a changes specification, any fixed effects, such as those for nation, industry, or nation-industry, drop out of the estimating equation. The only variables that vary at the product level are the measures of \textit{product FDI}. If there are time varying product level variables that belong in the regression the estimates may suffer from omitted variable bias. However, the actual direction of this omitted variable bias would depend on the correlation between the product-level time-varying variables that have been excluded from the regression, and the \textit{product FDI} variables that are included.

The remaining independent variables \( X \) include macroeconomic determinants that influence changes in imports; namely the real exchange rate, and the GDP of the country.

\(^{25}\) The FDI regressors measure the three-year changes in investment prior to the change in import levels. I choose this time convention to allow the effects of foreign investment to come on line. I experimented with different time frames. I find that the basic results are unaltered, as long as I lag the foreign investment at least 2 years compared with the import dependent variable. The estimated investment effects are smaller if lags are reduced to a single year."
exporting to the U.S. 26 Since I am analyzing import changes, the GDP and Real Exchange Rates I use in my specification measure the changes in these variables rather than their levels.

To provide a comparison with other studies of foreign investment and imports, and to illustrate the importance of decomposing FDI to a finer level of detail, I begin with a regression specification that evaluates the effect of aggregate foreign investment on imports. I present my baseline regression in the first column of Table 1. As the results indicate, there is a positive association between previous foreign investment, and subsequent import changes. The point estimate suggests that a 10% increase in foreign investment is followed by a 1.5 percent increase in imports from the investing country. While the economic magnitude of this effect is relatively small, my results mirror the predominant finding in the literature, which suggests that trade and foreign investment are complements. The remaining regression coefficients enter as expected. U.S. imports decline when the dollar depreciates versus the exporting country’s currency. In addition, U.S. imports are higher when the GDP of the exporter rises, as is predicted by gravity model specifications of trade.

I next disaggregate foreign investment into its Product, Industry and Overall Manufacturing components. As displayed in column 2 of table 1, I find that Product and Industry foreign investment have a negative correlation with import changes - or that Product and Industry FDI are net substitutes for U.S. imports. At the same time a positive,

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26 My choice of macroeconomic controls follows the general specification of Goldberg and Klein (1997). Their study of U.S. and Japanese investment in Latin America and Southeast Asia includes both the U.S. and Japanese exchange rates as explanatory variables, since these two countries are the primary competing investors in the markets they study. While it is undoubtedly true that many countries vie for investment opportunities in the U.S., this study focuses on the direct effect of bilateral real exchange rates on investment. Because there are a large number of potential investors in the U.S., it is not practical to include each potential investor’s real exchange rate in a single specification.
or complementary, relationship emerges between Overall Manufacturing foreign investment and imports. While an overall measure of FDI produces a single coefficient that suggests the dominance of complementary effects, the more disaggregated specification shows that latent substitution effects are present at the Product and Industry levels.

To investigate the sensitivity of my findings to the measurement of FDI, I re-estimate the regression using investment counts instead of reported investment values. Column 3 of Table 1 displays the estimation results based on investment counts. These results are consistent with the regression based on investment values, though the estimated elasticities for investment counts are somewhat higher.

While the initial estimates hint that disaggregation of foreign investment data is informative, the initial estimates do not deal with the issue of simultaneity. In particular, a correlation will arise if a foreign country’s ongoing proficiency contributes not only its continued success in exporting to the U.S., but also to its repeated investments in the U.S. While the initial regressions seek to mitigate the simultaneity problem by lagging the foreign investment variables, ensuring that the investment regressors are predetermined relative to the imports dependent variable, we may still expect correlation between these variables. To account for this possibility I turn to instrumental variables estimation. I instrument for country ability with prior year investment stocks at the product,

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27 I turn to counts since investment values are not reported for all transactions in my data set. As a further check, I also ran regressions that used predicted investment values for the transactions that had no reported value. Predicted values were generated through a first stage regression that included U.S. state, transaction type, investor nationality, and year as explanatory variables. I do not include the results based on predicted investment values, since the regression coefficients are very similar to the reported coefficients displayed in the tables.

28 The importance of ongoing excellence is suggested by Lipsey’s (1999) finding that residuals from earlier year FDI equations provide explanatory power for current FDI. This persistence is consistent with country excellence that continues over the years.
industry, and manufacturing levels. In addition, it is possible that the U.S. becomes attractive for certain types of activity, and that this U.S. attractiveness will stimulate both imports and foreign investment. To control for this possibility, I instrument for the attractiveness of foreign investment by using the value of foreign investment undertaken by other countries. My remaining instruments include a set of country dummies, year dummies, population change as an instrument for GDP change, and lagged values of the exchange rate as an instrument for the current exchange rate.

As I show in the fourth and fifth columns in Table 1, I find that instrumenting for investment ability substantially magnifies my estimated foreign investment coefficients and highlights the importance of foreign direct investment distinctions. This is especially true for the product and industry coefficients. These coefficients grow five-fold and four-fold, respectively. Even the overall manufacturing coefficient more than doubles. The new coefficients from the fourth column of Table 1 now imply that a ten-percent rise in Product foreign investment is associated with a 12.7 percent decline in imports of the same product. In contrast, it is worth noting that the coefficients on the real exchange rate and GDP are little changed, though they shrink a bit, when I move to instrumental variables estimation. The big changes emerge only for the foreign investment variables whose endogeneity was of concern.

Compared with Blonigen (2001) who analyzes more finely detailed 7-digit TSUSA data, it is likely that the magnitude of my product level substitution estimates represent a lower bound

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29 As with Head and Ries’s (1998b) creation of employee investment stocks, I create investment value stocks by converting FDI values to constant 1992 dollars and assuming that investments, on average, neither grow nor shrink over time.
30 The inclusion of this variable is meant to control for factors that stimulate investment that are distinct from factors which make the U.S. economy attractive for all economic activities generally. For example, consider a Swiss investment in the food industry (SIC 201) in 1988. To account for factors that made the U.S. food industry attractive to all investors in that year, I include investment in industry SIC 201
estimate of the true substitution effects. Because data limitations preclude my ability to work with more finely disaggregated product level data, I am matching trade flows that span a number of products, with investment that potentially creates only a handful of those products encompassed by the 3-digit product classification. In addition, if FDI creates demand spillovers, this also causes empirical estimates of product the FDI coefficient to be a lower bound estimate of substitution effects, since demand expansion effects work to offset the substitution effects brought about by FDI production.

A likely interpretation for the negative Industry coefficient is that the production by typical FDI facilities will generate numerous products, each of which may substitute for former import flows. While import displacement is likely to be most pronounced in the investor’s primary product area of activity - the one for which they receive their SIC industry classification - the production activities will also generate substitution effects at the more encompassing industry level if they use their new foreign investment facility to produce other closely related products in the same industry. The last coefficients describe the effect of Overall Manufacturing foreign investment on trade. It is here that complementary effects of foreign investment dominate.

To investigate the robustness of the results across industries, separate regressions were estimated for each 2-digit industry and the results are reported in Table 2. Due to the endogeneity issues identified in the baseline regressions, I only present my instrumental variables estimates here, and in the remainder of the paper. I find that the effect of Product foreign investment on same 3-digit trade is negative in all but five of the industry segments (Primary Metals, Non-Electrical Machinery, Electrical Machinery, Measuring, Analyzing and Controlling Products, and by all other investors in 1988 as an instrument for similar Swiss investments.
Miscellaneous Manufacturing). However, in four of the five industry segments where the \textit{product} coefficient is positive, the \textit{industry} coefficient is significantly negative, suggesting that this finding may relate to data aggregation.\footnote{As mentioned earlier, the foreign investment data are only recorded by the primary 4-digit code of activity. However, if the foreign investment produces a number of goods in a related industry segment, the} Another factor that may influence the results in these five sectors is the nature of their products. The products in these five industries are often used as inputs for production and investment (machinery, electrical machinery). For example, the foreign investor may build a plant to produce power driven hand tools (SIC 3546) in the U.S. However, the creation and operation of the plant may cause the foreign investor to import machine tools - metal cutting (SIC 3541) and machine tools - metal forming (SIC 3542). Each of these products originates from a distinct 4-digit SIC industry. Since the data analysis is conducted at the 3-digit level instead, however, the investment and the trade flows will all show up under 3-digit SIC 354 even though the final product - power driven hand tools - is distinct from the new imports.

When I examine trade data at the industry level I find that Overall Manufacturing foreign investment exerts a positive and statistically significant effect on subsequent U.S. imports in all 2-digit industry segments. This is the complementary effect that is overwhelmingly found in studies of trade and investment. However, a substitution effect is found at the Product or Industry level for almost all industries, illustrating that the disaggregation of foreign investment types provides meaningful information for the analysis of trade flow changes in virtually all industries.

I also examine the scope of my results across countries by turning next to country regressions for investing countries that invested most heavily in the U.S. The results are reported in Table 3. A few interesting findings emerge. First, the expected \textit{product} substitution effect is
exhibited by all but two of the countries - both Germany and Switzerland- and these substitution
effects are most pronounced for the United Kingdom, Canada, and Japan. In addition, the
complementary effect of investment on imports at the higher manufacturing level emerges for all
countries aside from the Netherlands, and is again most pronounced for the United Kingdom,
Canada, and Japan.

My finding of heterogeneity across countries echoes the heterogeneity in Pain and Wakelin's
(1998) findings for 11 OECD countries since 1971. While their data are somewhat more
aggregated, and hence find a general complementarity between FDI and trade, the magnitude of the
effect differs across countries. Such complementarity is also found for Austrian trade and foreign
investment in Pfaffermayr (1996), whose results also suggest that the strength of the effects differ
substantially across countries.

What is unique in my paper is its finding of substitution at the country level using Product
level FDI. However, other work on a number of other countries has found substitution when
working with firm level data. Svensson (1996) finds that production by foreign affiliates replaces
parent firm exports of finished goods from Sweden. Similar findings emerge in U.S. firm data and
Japanese firm data examined by Lipsey and Weiss (1984) and Head and Ries (1997) respectively,
as well as in very specific product categories examined by Blonigen (2001).

In my results, the displacement of trade by product FDI is greatest in the case of Canada.
The especially high Canadian coefficient makes sense if Canadian firms generally build one plant to
serve all of North America. Due to physical proximity to customers, it may be especially common
for Canadian firms to locate some of their production in the U.S. (for sales to U.S. and Canada, as

substitution may be more noticeable at the industry than product level.
well as Mexico). In contrast, European or Japanese firms are much more likely to use their FDI in the U.S. to serve the U.S. market, while retaining production facilities in Europe or Asia to serve their respective home markets.

6. Conclusion

This paper uses the unique variation in country-industry foreign investment patterns to identify the effect of foreign investment on subsequent trade flows. A key message of the study is that the identification of the substitution and complementary effects of FDI requires finer disaggregation of foreign investment variables. The results show that foreign investment substitutes for trade at the product and industry levels while it stimulates imports at the gross manufacturing level. In estimating the magnitude of these effects, I also find that instrumenting for potential investment endogeneity is critical.

These findings reconcile the conflicting empirical results that have emerged from other studies of foreign investment and trade. The Product level results echo Blonigen’s (2001) finding that product FDI and product trade are substitutes, and show that Blonigen's findings extend universally across the broad spectrum of products. At the same time, my finding that overall manufacturing investments stimulate trade in distantly related products matches the conclusions of numerous aggregate studies that have argued that trade has a complementarity relationship with investment.

One interesting question for future research involves the origins of the complementary effect of Overall Manufacturing FDI. Do the complementary effects of investment on imports originate
from production channels that stimulate the demand for imported intermediate inputs, or are the effects generated by demand augmenting effects of informational spillovers and network ties? The possibility that foreign investment fosters network ties, is especially intriguing, as it implies that foreign investment may generate an infrastructure of linkages that change subsequent levels of trade. It is plausible that foreign investment may provide such linkages, since foreign investment disseminates information between country pairs and provides a new conduit for personal and managerial information flows, and may reduce the transactions costs that characterize a target country and its investors. However, more detailed work is needed to conclusively disentangle and measure the economic magnitudes of these sources of complementarity.

In future work, it would also be interesting to focus on a more limited subset of industries for whom the input-output structure is well known, to see whether trade patterns appear to follow the sourcing needs of new foreign investors. Such a study could be used to determine whether U.S. production by foreign firms is supplied primarily by imports of foreign inputs, or whether the sourcing of U.S. inputs becomes more common over time as foreign offshore production takes on the character and operational style of domestic firms.

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32 Other network ties have been found to exert their effects on foreign trade. Rauch (1999) shows that highly differentiated products that are not traded with a reference price or on an organized exchange are traded most intensively among countries that have links such as similar language or membership in a trading block. In addition, the trade volume of these products is more inhibited by distance than other products. Recent work on ethnic ties by Cassella and Rauch (1997) provides theoretical justification for how these ties may work. In a similar vein, evidence for the relationship between immigration and trade is reported in Gould (1994) and Head and Ries (1998a).
Table 1: The effect of FDI on Import Changes.

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>OLS (2)</th>
<th>OLS (3)</th>
<th>IV (4)</th>
<th>IV (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Value</td>
<td>Counts</td>
<td>Value</td>
<td>Counts</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.153(^a)</td>
<td>(.006)</td>
<td>-0.140(^a)</td>
<td>-0.596(^a)</td>
<td>-0.750(^a)</td>
</tr>
<tr>
<td>FDI</td>
<td>(.011)</td>
<td>(.032)</td>
<td>(.143)</td>
<td>(.520)</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>-0.130(^a)</td>
<td>-0.637(^a)</td>
<td>-0.577(^a)</td>
<td>-1.218(^b)</td>
<td></td>
</tr>
<tr>
<td>FDI</td>
<td>(.008)</td>
<td>(.022)</td>
<td>(.069)</td>
<td>(.279)</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>0.216(^a)</td>
<td>0.740(^a)</td>
<td>0.471(^a)</td>
<td>1.631(^a)</td>
<td></td>
</tr>
<tr>
<td>FDI</td>
<td>(.007)</td>
<td>(.018)</td>
<td>(.016)</td>
<td>(.059)</td>
<td></td>
</tr>
<tr>
<td>Manuf.</td>
<td>-2.238(^a)</td>
<td>-2.120(^a)</td>
<td>-1.747(^a)</td>
<td>-1.661(^a)</td>
<td>-0.980(^a)</td>
</tr>
<tr>
<td>FDI</td>
<td>(.038)</td>
<td>(.036)</td>
<td>(.036)</td>
<td>(.056)</td>
<td>(.069)</td>
</tr>
<tr>
<td>Exch</td>
<td>1.807(^a)</td>
<td>1.804(^a)</td>
<td>1.563(^a)</td>
<td>1.780(^a)</td>
<td>1.216(^a)</td>
</tr>
<tr>
<td>Rate Δ</td>
<td>(.013)</td>
<td>(.013)</td>
<td>(.017)</td>
<td>(.020)</td>
<td>(.038)</td>
</tr>
<tr>
<td>GDP Change</td>
<td>9196</td>
<td>9196</td>
<td>9196</td>
<td>9196</td>
<td>9196</td>
</tr>
<tr>
<td>R(^2)</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes: Standard errors in ( ). All variables are measured in logs. The dependent variable is the change in imports. The FDI variables are lagged relative to the dependent variable. Columns labeled "Value" use Product, Industry and Manuf FDI variables that are based on FDI value. The columns labeled "Counts" present the results for regressions in which Product, Industry and Manuf FDI variables are based on counts of foreign direct investments in each category. \(^a\) denotes statistical significance at the 1% level. \(^b\) denotes statistical significance at the 5% level. \(^c\) denotes statistical significance at the 10% level.
Table 2: The effect of Foreign Direct Investment on US Imports by 2-digit SIC Industry.

<table>
<thead>
<tr>
<th>SIC 20</th>
<th>SIC 22</th>
<th>SIC 23</th>
<th>SIC 24</th>
<th>SIC 25</th>
<th>SIC 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food &amp; Kindred</td>
<td>Textile Apparel</td>
<td>Apparel &amp; Finished</td>
<td>Lumber &amp; Wood</td>
<td>Furniture &amp; Fixtures</td>
<td>Paper &amp; Allied</td>
</tr>
<tr>
<td>Products</td>
<td>Products</td>
<td>Products</td>
<td>Products</td>
<td>Products</td>
<td>Products</td>
</tr>
<tr>
<td>Product -1.069&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.756&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.347&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-0.697&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.890&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.087</td>
</tr>
<tr>
<td>FDI (.241)</td>
<td>(.476)</td>
<td>(.214)</td>
<td>(.224)</td>
<td>(.210)</td>
<td>(.258)</td>
</tr>
<tr>
<td>Industry -0.032</td>
<td>-0.369&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-0.651&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.380&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.329&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.660&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>FDI (.149)</td>
<td>(.201)</td>
<td>(.110)</td>
<td>(.165)</td>
<td>(.117)</td>
<td>(.211)</td>
</tr>
<tr>
<td>Manuf. 0.281&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.548&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.449&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.410&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.371&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.393&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>FDI (.055)</td>
<td>(.082)</td>
<td>(.053)</td>
<td>(.071)</td>
<td>(.067)</td>
<td>(.070)</td>
</tr>
<tr>
<td>Exch -1.877&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.394&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.767&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.785&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.847&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.110&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Rate Δ (.203)</td>
<td>(.306)</td>
<td>(.196)</td>
<td>(.255)</td>
<td>(.251)</td>
<td>(.298)</td>
</tr>
<tr>
<td>GDP 1.848&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.782&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.782&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.763&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.843&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.731&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Change (.072)</td>
<td>(.106)</td>
<td>(.070)</td>
<td>(.088)</td>
<td>(.092)</td>
<td>(.103)</td>
</tr>
<tr>
<td>Obs 610</td>
<td>620</td>
<td>621</td>
<td>382</td>
<td>345</td>
<td>340</td>
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</table>

Notes: Standard errors in ( ). All variables measured in logs. The dependent variable is the change in imports. The FDI variables are lagged relative to the dependent variable. All regressions are estimated by instrumental variables. <sup>a</sup> denotes statistical significance at the 1% level. <sup>b</sup> denotes statistical significance at the 5% level. <sup>c</sup> denotes statistical significance at the 10% level.
Table 2: The effect of Foreign Direct Investment on US Imports by 2-digit SIC Industry.

(continued)

<table>
<thead>
<tr>
<th></th>
<th>SIC 27</th>
<th>SIC 28</th>
<th>SIC 29</th>
<th>SIC 30</th>
<th>SIC 31</th>
<th>SIC 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing,</td>
<td>-0.072</td>
<td>-1.080^a</td>
<td>-0.571^b</td>
<td>-0.350</td>
<td>-0.258</td>
<td>-0.705^a</td>
</tr>
<tr>
<td>Publishing &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Allied Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDI</td>
<td>(.300)</td>
<td>(.274)</td>
<td>(.261)</td>
<td>(.315)</td>
<td>(.200)</td>
<td>(.240)</td>
</tr>
<tr>
<td>Industry</td>
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<td>-0.059</td>
<td>-0.378^a</td>
<td>-0.566^a</td>
<td>-0.517^a</td>
<td>-0.436^a</td>
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<tr>
<td>FDI</td>
<td>(.178)</td>
<td>(.152)</td>
<td>(.128)</td>
<td>(.171)</td>
<td>(.098)</td>
<td>(.126)</td>
</tr>
<tr>
<td>Manuf.</td>
<td>0.535^a</td>
<td>0.292^a</td>
<td>0.356^a</td>
<td>0.370^a</td>
<td>0.408^a</td>
<td>0.397^a</td>
</tr>
<tr>
<td>FDI</td>
<td>(.069)</td>
<td>(.062)</td>
<td>(.072)</td>
<td>(.068)</td>
<td>(.056)</td>
<td>(.053)</td>
</tr>
<tr>
<td>Exch Rate Δ</td>
<td>-1.708^a</td>
<td>-1.935^a</td>
<td>-1.878^a</td>
<td>-1.863^a</td>
<td>-1.852^a</td>
<td>-1.923^a</td>
</tr>
<tr>
<td></td>
<td>(.243)</td>
<td>(.212)</td>
<td>(.306)</td>
<td>(.248)</td>
<td>(.210)</td>
<td>(.204)</td>
</tr>
<tr>
<td>GDP Change</td>
<td>1.689^a</td>
<td>1.829^a</td>
<td>1.816^a</td>
<td>1.833^a</td>
<td>1.745^a</td>
<td>1.766^a</td>
</tr>
<tr>
<td></td>
<td>(.087)</td>
<td>(.082)</td>
<td>(.306)</td>
<td>(.089)</td>
<td>(.073)</td>
<td>(.077)</td>
</tr>
<tr>
<td>Obs</td>
<td>583</td>
<td>534</td>
<td>203</td>
<td>360</td>
<td>463</td>
<td>590</td>
</tr>
</tbody>
</table>

Notes: Standard errors in ( ). All variables measured in logs. The dependent variable is the change in imports. The FDI variables are lagged relative to the dependent variable. All regressions are estimated via instrumental variables. ^a denotes statistical significance at the 1% level. ^b denotes statistical significance at the 5% level. ^c denotes statistical significance at the 10% level.
Table 2: The effect of Foreign Direct Investment on US Imports by 2-digit SIC Industry.

<table>
<thead>
<tr>
<th>SIC 33</th>
<th>SIC 34</th>
<th>SIC 35</th>
<th>SIC 36</th>
<th>SIC 37</th>
<th>SIC 38</th>
<th>SIC 39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Metal Industries</td>
<td>Fabricated Metal Products</td>
<td>Non-Electrical Machinery</td>
<td>Electrical Machinery</td>
<td>Transport Equipment</td>
<td>Measuring, Analyzing, Controlling Equipment</td>
<td>Misc. MFG</td>
</tr>
<tr>
<td>FDI</td>
<td>0.274</td>
<td>-2.191&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.148</td>
<td>0.189</td>
<td>-0.451&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.233</td>
</tr>
<tr>
<td>(0.214)</td>
<td>(0.411)</td>
<td>(0.231)</td>
<td>(0.229)</td>
<td>(0.244)</td>
<td>(0.409)</td>
<td>(0.228)</td>
</tr>
<tr>
<td>Industry FDI</td>
<td>-0.777&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.258</td>
<td>-1.118&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.787&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.632&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.744</td>
</tr>
<tr>
<td>(0.117)</td>
<td>(0.210)</td>
<td>(0.135)</td>
<td>(0.120)</td>
<td>(0.109)</td>
<td>(0.178)</td>
<td>(0.139)</td>
</tr>
<tr>
<td>Manuf. FDI</td>
<td>0.3577&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.327&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.518&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.425&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.440&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.370&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>(0.061)</td>
<td>(0.089)</td>
<td>(0.068)</td>
<td>(0.060)</td>
<td>(0.062)</td>
<td>(0.066)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>Exch Rate Δ</td>
<td>-1.622&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.558&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.286&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.797&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-1.765&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-2.014&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>(0.242)</td>
<td>(0.359)</td>
<td>(0.268)</td>
<td>(0.221)</td>
<td>(0.228)</td>
<td>(0.240)</td>
<td>(0.289)</td>
</tr>
<tr>
<td>GDP Change</td>
<td>1.909&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.891&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.879&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.804&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.793&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.796&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>(0.087)</td>
<td>(0.125)</td>
<td>(0.087)</td>
<td>(0.077)</td>
<td>(0.079)</td>
<td>(0.089)</td>
<td>(0.101)</td>
</tr>
<tr>
<td>Obs</td>
<td>474</td>
<td>548</td>
<td>615</td>
<td>552</td>
<td>472</td>
<td>473</td>
</tr>
</tbody>
</table>

Notes: Standard errors in ( ). All variables measured in logs. The dependent variable is the change in imports. The FDI variables are lagged relative to the dependent variable. All regressions are estimated via instrumental variables. <sup>a</sup> denotes statistical significance at the 1% level. <sup>b</sup> denotes statistical significance at the 5% level. <sup>c</sup> denotes statistical significance at the 10% level.
Table 3: The Effect of Foreign Direct Investment on US Imports by Nation of Origin.

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>France</th>
<th>Germany</th>
<th>Japan</th>
<th>Netherlands</th>
<th>Sweden</th>
<th>Switzerland</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>-2.6506</td>
<td>-.5295</td>
<td>.8460</td>
<td>-1.2582</td>
<td>-.1883</td>
<td>.4532</td>
<td>-1.8753</td>
<td></td>
</tr>
<tr>
<td>FDI</td>
<td>(.7315)</td>
<td>(.2233)</td>
<td>(.5762)</td>
<td>(.2845)</td>
<td>(.3830)</td>
<td>(.4264)</td>
<td>(.4758)</td>
<td>(.3091)</td>
</tr>
<tr>
<td>Industry</td>
<td>-.5466</td>
<td>-.0419</td>
<td>.5249</td>
<td>-.2005</td>
<td>.6243</td>
<td>-.6468</td>
<td>-.1292</td>
<td>.3475</td>
</tr>
<tr>
<td>FDI</td>
<td>(.3808)</td>
<td>(.0959)</td>
<td>(.2072)</td>
<td>(.3167)</td>
<td>(.0710)</td>
<td>(.1327)</td>
<td>(.0457)</td>
<td>(.2210)</td>
</tr>
<tr>
<td>Manuf.</td>
<td>1.2302</td>
<td>0.3300</td>
<td>0.3114</td>
<td>1.0600</td>
<td>-.2695</td>
<td>0.2722</td>
<td>0.2491</td>
<td>1.3506</td>
</tr>
<tr>
<td>FDI</td>
<td>(.2148)</td>
<td>(.0309)</td>
<td>(.2009)</td>
<td>(.1757)</td>
<td>(.0736)</td>
<td>(.0277)</td>
<td>(.0357)</td>
<td>(.1657)</td>
</tr>
<tr>
<td>Exch</td>
<td>-.17340</td>
<td>-1.0071</td>
<td>-2.2913</td>
<td>-.4724</td>
<td>-.9212</td>
<td>-.5922</td>
<td>-.4346</td>
<td>.9174</td>
</tr>
<tr>
<td>Rate Δ</td>
<td>(.8585)</td>
<td>(.1422)</td>
<td>(.2341)</td>
<td>(.2973)</td>
<td>(.1064)</td>
<td>(.1245)</td>
<td>(.0350)</td>
<td>(.7009)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.5993</td>
<td>1.5826</td>
<td>0.7983</td>
<td>0.6574</td>
<td>2.9980</td>
<td>2.4970</td>
<td>2.2236</td>
<td>-.1138</td>
</tr>
<tr>
<td>Change</td>
<td>(.3767)</td>
<td>(.0686)</td>
<td>(.2662)</td>
<td>(.1285)</td>
<td>(.1363)</td>
<td>(.0724)</td>
<td>(.0582)</td>
<td>(.2263)</td>
</tr>
<tr>
<td>Obs</td>
<td>817</td>
<td>816</td>
<td>687</td>
<td>811</td>
<td>813</td>
<td>803</td>
<td>790</td>
<td>820</td>
</tr>
</tbody>
</table>

Notes: Standard errors in (). All variables measured in logs. The dependent variable is the change in imports. The FDI variables are lagged relative to the dependent variable. All regressions are estimated via instrumental variables. a denotes statistical significance at the 1% level. b denotes statistical significance at the 5% level. c denotes statistical significance at the 10% level.
Data Appendix

Foreign Investment Data

The foreign direct investment data are collected from the annual Department of Commerce publications "Foreign Direct Investment in the United States: Transactions" for the years 1974 to 1994. The International Trade Administration (ITA) of the Department of Commerce draws on a number of sources to assemble a comprehensive listing of foreign investment activities in the U.S. The ITA reports provide the compiled list of transactions. For each transaction, the data set lists the industry classification (4-digit SIC level), the nationality and name of the foreign firm, the location in the U.S., the mode of entry, and the value of the transaction (when reported). Each of the transaction values represents the value of the transaction upon entry to the U.S. (E.g. the initial value of a new plant placed in the U.S). Since the ITA data do not create a census of foreign firms in the U.S., they do not track the subsequent decisions made by the FDI firms in the U.S. Therefore, the data set misses smaller investments made in later years (i.e. the purchases of a few new machines) though the ITA data collection attempts to capture larger subsequent investments including new plants or plant expansions. Transaction financing does not affect the values recorded by the ITA. Since the ITA data record the value of transactions, rather than the source of funds, the values may include reinvested earnings.

As the text discusses, the foreign investment data are attached to the trade flows to account for product, industry, and economy effects. Before I work with the data, all foreign investment transaction and trade values are converted to 1992 dollars. Product effects are described as the effect of 3-digit SIC foreign investment on the imports of the same 3-digit products from the investing nation. Industry foreign investment is measured by aggregating all foreign investment in the same 2-digit industry as the foreign investment. The 3-digit investment that has already been measured at the product level is subtracted to avoid double counting. Finally, overall manufacturing investment is measured by aggregating the remaining investment of the country in a given year. Here too, FDI accounted for at lower levels of aggregation are subtracted, to prevent double counting of the investments. One is added to each of the foreign investment variables before I take logs, to prevent undefined observations for the cases where no new foreign investment occurred.

Since a handful of countries perform the bulk of all investments, individual country investment is computed only for the twelve largest investors - Belgium, Canada, Finland, France, Germany, Italy, Japan, Korea, the Netherlands, Sweden, Switzerland and the UK. The remaining investments are aggregated on a regional basis for Africa, Australia with New Zealand and surrounding island nations, the Middle East, South America, Other Asia, and Other Europe. For comparability, the trade data are aggregated along the same lines. The final form of the data set contains investment and trade series for the twelve large investor nations and six regions for the years 1974 to 1994.

Since a number of the investment transactions do not include reported transaction values, I experimented with three methods for dealing with the missing values. First, I created investment aggregations that treated missing values as zeros. Second, I tried replacing the
missing values with values predicted by a simple prediction equation that used nation, year, U.S. state, transaction type and 2-digit SIC industry dummy variables. Since the use of this variable doesn’t alter my fundamental results, these regressions are not reported. Finally, for a concrete and different view, I also formed investment variables that were based on the universe of investment counts.

The foreign investment transactions data are also used to construct instruments for foreign investment. To gauge the attractiveness of the U.S. as an investment location, I created a variable that measured foreign investment by other countries. Second, to capture unobserved country abilities that cause repeated investments over time, I formed lagged investment variables for each of the countries or regions.

There are some important differences between the International Trade Administration data series, and the investment data collected by the BEA, as reported in the Survey of Current Business and benchmark surveys. While the BEA surveys report details taken from mandatory reports completed by firms, the transactions data are not subject to the same reporting requirements, though the Commerce Department claims that the two sources are highly correlated. A benefit of the transactions data are that they contain information on plant expansions and other transactions that are not included in the BEA surveys. This is important, since the value of plant expansions is comparable to the value of new plant activities included in BEA surveys, and failure to account for plant expansions will result in an omission of an important source of foreign investment.

Trade Data

The Trade data are based on U.S. Department of Census, Department of Commerce data on U.S. imports, as compiled by Feenstra (1996). The import observations are reported at the 7-digit TSUSA product level. I used the SIC identifiers provided by Feenstra to form composite imports at the 3-digit SIC level that were then linked to the 3-digit Product FDI data and other relevant variables. As with foreign investment data, I converted the data to constant 1992 dollars using the GDP deflator before I performed any of the aggregations. For this project the GDP was taken from the 1997 Economic Report of the President, which sets 1992 as the benchmark 100. Since I am examining changes in imports, some modifications were needed. First, some industry-country combinations have no exports to the U.S. Rather than classifying these observations as zero change, I dropped these observations from the sample, since trade in those fields did not emerge as a relevant activity. Second, though most changes in imports are positive, some were negative. Since I use a log dependent variable, I added 17,000 to all import observations to prevent undefined observations.

Macroeconomic Variables

The real exchange rates and gross domestic product variables are taken from International Monetary Fund annual series data contained in the International Financial
Statistics.
References


Bruce A. Blonigen, In search of substitution between foreign production and exports, Journal of International Economics (53)1 (2001):81-104


