Estimating the Export and Import Demand for Manufactured Goods: The Role of FDI

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Abstract: In this paper we estimate the demand for exports and imports of manufactured goods for a panel containing the majority of the EU countries as well as the United States and Japan. The model includes as explanatory factors both the traditional determinants of trade and also the stock of foreign direct investment (FDI). We apply panel unit root and cointegration tests allowing for heterogeneity. Whereas there is no evidence of cointegration when using just the traditional formulation, the results are favorable to the existence of long-run relationships linking the variables of the augmented model. Moreover, the results point mainly to a complementary relationship between trade and FDI. JEL no. C23, F14, F21
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1 Introduction

The demand for exports (or imports) has been traditionally specified as a function of a country's competitiveness and a foreign (domestic) activity variable. Although this approach has been predominant in the empirical literature, it has remained controversial. Econometric work with data for different countries spanning a number of years faces some daunting challenges: country- and time-specific effects, endogeneity of the explanatory

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variables, omission of relevant variables, parameter instability or the non-stationarity of the data (see Hooper et al. 1998). At the same time, the so-called New Trade Theory, influenced by the theory of industrial organization, has added a new insight into the possible factors affecting the demand for exports and imports, such as foreign direct investment (FDI) or the quality of the traded goods.

Consequently, recent empirical studies have introduced new features both from a theoretical and a methodological point of view. In this paper, we aim to make a contribution to the empirical discussion of long-run relationships for export and import demand. For this purpose, we first estimate the traditional specification to reproduce some of the existing results in the literature, but using a new econometric framework for the analysis. In particular, we apply recent panel cointegration techniques that combine time-series and cross-section information and tackle the problems derived from the nonstationarity and endogeneity commonly found in economic variables. Furthermore, and using the same econometric methodology, we check for robustness by introducing in the analysis an enlarged specification in line with recent theoretical work. In particular, we will concentrate on the estimation of export and import demand for manufactured goods for a group of OECD countries, using both the traditional explanatory variables and also FDI stocks. In this way, a relevant outcome of the paper is to add some insight into the study of the long-run relationships between trade and FDI.

The paper is organized hereafter as follows. In Section 2, we review the theoretical issues relating trade to its determinants, and more specifically, the role of FDI. In Section 3, we discuss the empirical results for a panel formed by 11 European countries, the United States, and Japan. Section 4 makes some concluding remarks and outlines possible directions for future research.

2 Theoretical Issues

2.1 The Traditional Formulation

Conventionally, the empirical analysis of trade flows has been carried out through partial-equilibrium models based on the hypothesis of imperfect substitution between foreign and domestic goods. The main assumption of the model is that, in a simple two-country world, each country produces

a single tradable good that is an imperfect substitute for the good produced in the other country (Goldstein and Khan 1985). The most widely used (and simple) procedure for estimating aggregate export and import demand functions in this context is based on the Marshallian demand function.

The model can be extended to an n-country world, in which the symmetry between the import demand and the export demand equations disappears. The country's total imports face competition only from domestic producers, whereas the country's exports will face competition not only from domestic producers in the importing region, but also from third-country exporters to that region. It is generally assumed that the dominant relative price competition occurs between exporters. Consequently, the relative-price term that frequently appears is the ratio of the export price to competitor's export prices adjusted for the exchange rate. Therefore, a typical function for aggregate exports can be written as follows:

$$X_d = F(\underset{(+)}{Y^*}, \underset{(-)}{P_x/S \times P^*}), \tag{1}$$

where X_d is the volume of exports demanded by foreigners, Y^* is the world economic activity in constant prices, P_x is the price of exports, P^* are the foreign competitor's prices in the country's export markets, and S is the nominal exchange rate in units of foreign currency per unit of home currency. Therefore, the relative price term ($P_x/S \times P^*$) can be viewed as the terms of trade or the real exchange rate.

In a similar way, the demand for imports can be specified as follows:

$$M_d = f(\underset{(+)}{Y}, \underset{(-)}{P_M/P}), \tag{2}$$

where M_d is the volume of imports demanded by the domestic residents, Y is the domestic economic activity in constant prices, P_M is the price of imports in the domestic currency, and P is the price of the products that are domestic substitutes for this country's imports.

These specifications have been widely used in applied research. A survey of the empirical estimates of long-run income and price elasticities for imports and exports of major industrial countries can be found in Goldstein and Kahn (1985). More recently, Hooper and Márquez (1995) also survey price elasticities for trade in the United States, Japan, and Germany.

2.2 Beyond the 'Traditional Formulation': The Role of Foreign Direct Investment

2.2.1 Theoretical Considerations: Trade versus FDI?

The increasing openness of the capital markets in Europe as a result of the Single Market initiative, as well as the process of globalization at the world level, has renewed the interest of both the theoretical and the applied literature in the study of the effects of international mobility of production factors on trade. Similarly, many developing countries have embarked themselves on a process of liberalization during the 1990s giving rise to many uncertainties concerning macroeconomic and monetary issues as well as trade and long-term direct investment. Unfortunately, as Markusen (1997) points out, this latter topic has not been tackled properly or extensively enough by trade economists and the trade theory paradigm continues to be heavily influenced by the seminal paper of Mundell (1957), according to which trade in goods and factors are substitutes.

However, the accumulation of evidence from at least the last twenty years suggests that it is important to examine in depth the sign of the relationship linking trade and FDI, since the relationship is heavily influenced by the activity of multinational corporations (MNCs). Consequently, any theoretical treatment that sees FDI as similar to portfolio or physical factor allocation can be misleading and from the 1970s there have been various attempts to shed light on the relationship between trade and FDI.

Classical View: The Standard Trade Theory (1950s–1960s)

Under the traditional Heckscher–Ohlin framework (H–O), provided that a certain set of restrictive assumptions holds,[1] either international trade or international mobility of factors of production could equalize factor prices across countries. The conventional view of the relationship between factor movements and commodity trade maintains that the two are *substitutes* (Mundell 1957). However, the assumptions of the factor price equalization theorem can never be fully met in reality, so that factor movements cannot ensure equalization of commodity prices or factor prices. Indeed, Markusen (1983) claims that the substitution relationship between com-

[1] These assumptions include perfect competition in all industries, no transport costs between countries, and also identical patterns of demand and production functions with constant returns to scale.

modity and factor movements is the exception rather than the rule, whereas *complementarity* is likely to be the more frequent one.

Theory of Industrial Organization and the Key Concepts of Economic Integration of Products and Factors (1970s–1980s)

It is commonly acknowledged that MNCs are involved in a substantial part of international trade and capital movements. MNCs are characterized by setting up businesses and producing commodities outside their home country. The movement of capital which takes place in this context, and which consists of establishing foreign affiliates or acquiring majority share positions in existing foreign companies, is considered direct investment.

A company that is setting up production abroad has to compare its disadvantages (communication costs, differences in culture, language, legislation, exchange and sovereign risks) to the alternatives like exporting or licensing.

Dunning (1972, 1977) formulated an eclectic view of the different approaches made by the theory of industrial organization, which gave birth to the so-called OLI paradigm. According to it, a firm's choice between the three alternatives (exporting, licensing, or investing abroad) depends on the combination of the three following advantages: *ownership-specific advantages, locational advantages*, and *internalization advantages in the target market.*

An issue of interest when the analysis is focused on European countries is the effect that integration has on inward and outward FDI, both within and between blocs. The evolution of FDI and its expected complementary or substitute effects on trade would also depend on the reasons that justified the investment decision before the process of integration started and also on the changes in the market structure as well as the trade policy measures boosted by the integration process.[2] Due to the complexity of these relationships, a general equilibrium framework would be the most adequate to capture all these interactions. However, an alternative view has been formulated during the 1980s based on Brander and Spencer type of reciprocal dumping models in the form of oligopoly partial equilibrium models.[3]

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[2] See Blomström and Kokko (1997) for an updated survey and discussion of the channels through which regional integration agreements could affect FDI.

[3] See the seminal paper by Smith (1987) and Martin (1993).

New Trade Theory and New Economic Geography (1980s–1990s)

The early attempts to reconcile the theory of multinationals with trade theory appears in Markusen (1984) and Helpman (1984). The former focused on horizontal investments in which a firm sets up abroad to produce the same product that it produces at home, while the latter focused on vertical investments in which the production process is decomposed by stages according to factor intensities in different countries. In both cases, multinationals export services produced from physical factors, rather than (or in addition to) those factors themselves. The exploitation of ownership assets (intangibles) gives rise to MNCs with a segmented structure either horizontal or vertical, justifying both complementarity and substitutability relationships between FDI and trade:

- Vertical integration (à la Helpman) is based on different factor endowments and, therefore is an efficiency-seeking FDI that may have mainly a *complementary relationship* with trade.
- Horizontal integration (à la Markusen or à la Brainard) is mainly based on the improvement of market access or market growth prospects, thus generating a market-seeking FDI that will have a *substitutional relationship* with trade.

The literature on MNCs normally distinguishes between vertical and horizontal firms, and suggests that the latter's location decisions are determined mainly by market access rather than by cost considerations. However, Neary (2002) shows that even when multinational activity is purely horizontal, yet costs are crucial in determining *where* in the union a new plant will locate.

When the sum of the fixed costs at the firm level and the tariffs are higher than the fixed costs at the plant level, the multiplant production is more appropriate than a centralized one. In these models of horizontal multiplant production, the decision to engage in multinational production reflects a trade-off between the firm's desire to be close to foreign markets (because of trade costs) and the desire to concentrate production at home and exploit economies of scale (*home market effect*[4]).

A unified approach has been developed recently aiming at endogenizing multinational firms in general-equilibrium trade models and integrating

[4] Helpman and Krugman (1985) claimed that there is a "home market effect" when a tariff imposed by one country causes firms to enter that country and exit the other.

separate contributions on multiplant horizontal MNCs with work on vertical ones.[5]

The results show that vertical multinationals dominate when countries are very different in relative factor endowments and, conversely, horizontal multinationals dominate when the countries are similar in size and in relative endowments, and trade costs are moderate to high. Although, generally, vertical direct investment could be thought of as expanding north-south (big-small countries) trade and horizontal as associated with decreasing trade in north-north (or equal size) relationships between countries, the empirical evidence shows that in general investment liberalization leads to an increase in the volume of trade: that is, *FDI and trade are complements.*

The possibility of splitting the production process into different stages and/or the existence of multiproduct firms gives rise to situations in which, regardless of the aims of the firms, the most feasible outcome is a positive relationship between an increase in MNCs activities and trade, either intrafirm and/or intraindustrial (Baldwin and Ottaviano 2001 and Markusen and Maskus 2001).

2.2.2 Testing Strategies in Previous Empirical Studies

The theoretical review undertaken in subsection 2.2.1 cannot give clear-cut conclusions about the complementary or substitute nature of trade and FDI. Thus, the question remains open for empirical analysis. Generally, we can identify two empirical approaches in the literature.

First, the empirical literature that analyzes the bilateral export/import behavior of affiliates of multinational firms towards host-country markets based on the theoretical background provided by the *theory of industrial organization.* This part of the literature using mainly data at industry and individual firm level has built on the so-called gravity models, estimating the effects of economic integration in large cross-sections of countries. These gravity equations estimate the class of theoretical models derived mostly from the KK models[6] and, to some extent, from a proximity-concentration trade-off, where firms decide to serve a foreign market either as an exporter (via trade) or as a multinational enterprise (via foreign affiliates sales).

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[5] See Markusen et al. (1996), Carr et al. (2001), and Markusen (2002) under the name of *knowledge-capital models (KK models).*

[6] See for instance Carr et al. (2001), Markusen and Maskus (2002), and Blonigen et al. (2003).

Because of data availability problems, the latter can be proxied by stocks of FDI rather than the foreign affiliates sales itself.

However, this approach has been criticized both from an econometric and a theoretical point of view. On the one hand, the use of static panels has serious econometric flaws and, on the other hand, it considers the integration effects in a static way, neglecting the fact that the phenomenon is intrinsically dynamic. In order to overcome these pitfalls some authors have proposed alternatively applying either computable general equilibrium analysis (Helpman et al. 2003) or dynamic panels (Egger 2001). The empirical results in general, although they are not conclusive, point to a complementarity relationship.

Second, a strand of the literature has been based on the estimation of *augmented* export and import equations. Recent empirical studies have introduced new features both from the theoretical and the methodological point of view. Former empirical research was concerned almost solely with trade relations but more recent theoretical studies on MNCs and trade have found that the same exogenous factors are at work in determining trade and MNC activities. Lin (1995) finds a positive relationship between FDI and exports[7] while Barrell and Pain (1997) find a negative long-run relationship between exports and the stock of net FDI. Using aggregate data Driver and Wren-Lewis (1999) derive a specification for exports that allows for traditional relative-price effects as well as effects from innovation in variety and quality. They estimate this model for the panel of the G-7 countries using time series and panel cointegration techniques.

In addition, Pain and Wakelin (1998) analyze the export performance and also relate FDI to innovation in industries. They estimate a conventional panel of 11 OECD countries specified as an error correction mechanism. Finally, Bajo and Montero (1995, 2001) estimate Spanish demand for exports and imports using a measure of inward and outward FDI and examine the causality relationship between FDI and trade.

As Egger (2001) points out, two caveats can be raised from an econometric point of view with respect to the results of most empirical analyses included in the two above-mentioned approaches. First, only a few of these studies made use of the information in every available dimension of variation (i.e., cross-section and time) at the aggregate level. Country-specific effects could have been a major influence, but were not tested for in many

[7] Blonigen (2001) argues that the lack of substitutability can be due to an aggregation bias.

cases. Second, only static specifications have been estimated so far under panel data models, yet a dynamic treatment would be useful to distinguish between short-run and lon-run relationships.

In this paper, we aim to make a contribution to the empirical discussion of long-run relationships between trade and FDI. In line with recent theoretical work, the specifications presented here contain identical determining factors for both trade and multinational activities. We will concentrate on equations for export and import demand of manufactured goods, trying to use not only the traditional factors (price/cost and external/internal demand), but also foreign investment stocks. Additionally, a basic assumption of the model is that exporters are always on their demand schedules so that demand always equals the actual level of trade flows. However, it has been widely acknowledged that exports do not immediately adjust to their long-run equilibrium level when there is a change in any of its determinants.[8] This kind of empirical or rather methodological flaw can be avoided using cointegration techniques that account for the nonstationary nature of the data and explicitly consider the dynamic structure implicit in the model. Using the dynamic OLS (DOLS) procedure we can obtain long-run relations without neglecting the short-run adjustment process correcting for possible endogeneity problems. In addition, time series properties and estimation techniques can be combined with the information contained in a panel of data by using the recent tests for cointegration in panels. Hence, the use of panel cointegration tests allows us to gain power by exploiting cross-sectional information and taking into account the degree of heterogeneity in the cross-section dynamics.

This objective is achieved by extending the classical analysis of export and import functions to include aggregate outward and inward FDI using a panel of 13 and 12 OECD countries, respectively, for the period 1981–1998. Our paper departs from other previous studies in several issues.

First, we make use of *capital stock* rather than flow data on FDI. Data on direct investment flows from national balances of payments are usually available earlier than the corresponding stock data; hence, they are frequently used when the authors are interested in country comparisons. However, such comparisons may lead to misinterpretations in an econometric analysis due to lack of harmonization (Deutsche Bundesbank 1997),

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[8] Goldstein and Khan (1985) discuss in detail the problems of modelling trade. Note that important econometric issues are the stability of the trade functions and the omitted variables problem.

high volatility of the data and the absence of a solid theoretical underpinning.[9] The most appropriate variable from a theoretical point of view would be the MNCs' sales in the host countries.[10] However, as these data are not reported for the required set of countries and aggregation level, FDI stocks are used as a linear proxy of MNC sales.

Second, we overcome the problem of sizeable data sets by combining into meaningful estimations the information given by time series and cross-country analysis through the so-called *panel cointegration* technique.

Let us denote *IFDI* and *OFDI* the inward and outward FDI, respectively. Thus:

$$X_d = F(\underset{(+)}{Y^*}, \underset{(-)}{P_x/S \times P^*}, \underset{(+/-)}{IFDI}, \underset{(-/+)}{OFDI}) \tag{3}$$

$$M_d = F(\underset{(+)}{Y}, \underset{(+/-)}{P_M/P}, \underset{(+/-)}{IFDI}, \underset{(-/+)}{OFDI}) \tag{4}$$

From these equations, it is easy to see that the sign for the traditional variables are the same as before and that the theory leaves open different channels compatible with a positive or negative sign between trade and FDI.

3 Empirical Results

In this section we present the results of our empirical analysis of trade in manufactures and FDI following the theoretical approach described in Section 2. We estimate a model for the demand of exports and another one for the demand of imports. We should note that the approach we are adopting here is a rather aggregate one, that is, we concentrate on the group 6, manufactures, as reported in the standard one-digit SITC classification. According to Goldstein and Khan (1985), some degree of disaggregation would be preferred, as the estimates obtained directly from the aggregate relationship are likely to be biased.[11] The estimates of price

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[9] As Bajo and Montero (1995) pointed out, FDI strategies should be treated as a long-run phenomenon that might be blurred when looking at the year-to-year evolution of FDI flows. Moreover, stocks are the key variable since they are employed in the production process (Egger 2001).

[10] See Brainard (1997) for an example of this type of analysis.

[11] In aggregate trade equations, goods with relatively low price elasticities can display the largest variation in prices and exert a dominant effect on the estimated aggregate price elasticity, biasing the estimate downwards.

and income elasticities normally differ in the two cases, depending on the commodity group, with price elasticities higher for manufactures than for nonmanufactures. These results are in accordance with previous studies reported extensively in the empirical literature. Also the activity (income) elasticity is higher than those of other groups, but less markedly.

The equation for exports of manufactures will be of the form:

$$rmx_{it} = \alpha_i + \beta_{1i} y^*_{it} + \beta_{2i} compe_{it} + \beta_{3i} insfdi_{it} + \beta_{4i} outsfdi_{it} + u_{it}, \tag{5}$$

where rmx_{it} is the logarithm of real manufacturing exports, y^*_{it} is the variable representing real foreign income, adjusted by substracting the income of country i in equation i, $compe_{it}$ are the relative prices, $insfdi_{it}$ and $outsfdi_{it}$ are the real stocks of inward and outward FDI, respectively.[12]

Similarly, the equation for imports of manufacturing goods is specified as follows:

$$rmm_{it} = \alpha_i + \beta_{1i} y_{it} + \beta_{2i} relpr_{it} + \beta_{3i} insfdi_{it} + \beta_{4i} outsfdi_{it} + u_{it}, \tag{6}$$

where rmm_{it} is the logarithm of real manufacturing imports, y_{it} is the logarithm of real income, $relpr_{it}$ are the relative prices of the import goods as compared to their internal equivalents. The FDI variables are defined as above.

The panel consists of 13 countries, 11 members of the European Union, plus the United States and Japan.[13] The data are quarterly and the sample spans from 1981:Q1–1998:Q3.

According to the theory, the sign of y^*_{it} in (5) should be positive and the one for relative prices ($compe_{it}$) should be negative. Thus, $\beta_{1i} > 0$ and $\beta_{2i} < 0$. In addition, the value of β_{2i} should be in the proximity of unity, whereas β_{1i} would normally exceed that value and be even larger than 2.[14] Concerning the signs of the FDI variables, they would depend on the substitutability or complementarity existing between trade and FDI. A positive

[12] See the Appendix for more detailed information about the sources and data definitions.

[13] In the case of the imports, Belgium had to be excluded due to unavailability of quarterly GDP data for the whole sample.

[14] The expected values suggested for the estimated coefficients are those mentioned in the wide survey of empirical evidence by Goldstein and Khan (1985) and later by Hooper et al. (1998).

sign would be expected in inward or outward stocks when the complementarity hypothesis is the one maintained, whereas a negative sign would appear when substitutability prevails.

The same type of relationship may be expected linking the real imports of manufactures and the stocks of FDI in equation (6): the two possibilities, complementarity and substitutability, are supported by theory. In addition, the theory predicts a positive link between real imports and the real income of the country (y_{it}) with a coefficient exceeding one, whereas the parameter β_{2i} that relates imports and relative prices should be negative and, as in the exports, also around unity.

The evidence we are presenting in this paper concentrates on the two specifications described above, (5) for manufactured goods exports and (6) for imports. In addition, for the sake of comparison we also provide the results of the restricted specification or "traditional" model, where the FDI variables have been excluded.

The econometric methodology we use to analyze the panel described above is based on cointegration techniques. These tests were originally applied and developed for time series but have been successfully adapted to the case of panel data. The main advantage of this methodology is that it overcomes the problem of the nonstationarity usually found in economic variables. The most common way to deal with this problem has been to take first differences. However, this filter removes from the variables an important part of the long-run information. Consequently, an alternative and more efficient way to estimate economic long-run relationships in panels is to use the recent tests for panel unit roots and cointegration.

Two approaches can be adopted to estimate the parameters in the panel. In the homogeneous case, we restrict the β parameters to be the same for all the countries in the panel, that is, $\beta_{11} = \beta_{12} = ... = \beta_{1N}$, $\beta_{21} = \beta_{22} = ... = \beta_{2N}$, etc. In the heterogeneous panel case, this restriction is lifted and the slope coefficients may differ between countries. This possibility makes the use of the heterogeneous panel methodology especially interesting in this case, because we expect to find diversity of results for the foreign investment stocks.

We have applied tests for cointegration both in the homogeneous and heterogeneous case. Specifically, in the long-run analysis we have tested for the null of noncointegration in homogeneous panels using the Kao (1999) tests and, in the heterogeneous estimation we have tested for the null of cointegration implementing the McCoskey and Kao (1998) LM test. However, the results reported in this paper are restricted to the heterogeneous

case because of the nonacceptance of the homogeneity restriction imposed on the long-run parameters.[15]

The application of the LM test makes it necessary to use an efficient estimation technique of cointegrated variables. Kao and Chiang (2000) recommend the fully modified (FM) estimator of Phillips and Hansen (1990) and the dynamic ordinary least squares (DOLS) estimator as proposed by Saikkonen (1991) and Stock and Watson (1993). The latter has better properties and corrects for possible problems of both endogeneity and autocorrelation; the estimators are asymptotically normally distributed with zero means. The DOLS estimator is especially suited for this case: the relation linking trade and FDI should allow for the presence of adjustment costs, since neither exports (imports) nor FDI react immediately to changes in foreign demand because of the presence of investment plans, capacity constraints, etc; moreover, linkage effects between exports (imports) and FDI can be accounted for by the inclusion of lagged variables.

3.1 Stationarity Analysis: Panel Unit Root Results

Bearing all these considerations in mind, we should start the analysis by the study of the order of integration of the variables. Several procedures to test for unit roots in panels are already available in the literature, from the early works of Levin and Lin (1992, 1993),[16] to the Im, Pesaran and Shin (1995) tests. However, as proposed by Hadri (2000), we here apply the LM test for the null of stationarity in the presence of heterogeneous and serially correlated errors, owing to its better power. These tests can be considered the panel version of the KPSS tests (Kwiatkowski et al. 1992) applied in the univariate context. The two statistics are η_μ for the null of stationarity around a constant and η_τ when the null is stationarity around a deterministic trend.

The results of the tests applied to the variables involved, both in the cases of imports and exports, are presented in Table 1. The null hypothesis of stationarity can be easily rejected in the two cases (with and without a time trend), so that all the panel variables can be considered nonstationary.

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[15] These results are available in an extended version of this paper at the address <http://www.ucm.es/info/econeuro/documentos/documentos/dt222003.pdf>.

[16] Finally published as Levin et al. (2002).

Table 1: *Panel Stationarity Tests ($l = 4$)*

Variables	η_μ	η_τ	Variables	η_μ	η_τ
rmx_{it}	21.13*	421.74*	rmm_{it}	28.63*	142.65*
$compe_{it}$	18.55*	232.94*	$relpr_{it}$	23.30*	160.37*
y^*_{it}	31.54*	740.86*	y_{it}	19.67*	354.88*
$insfdi_{it}$	30.19*	205.25*			
$outsfdi_{it}$	30.95*	383.08*			

Note: An asterisk denotes singificance at 5 percent. If this is the case, the null hypothesis of stationarity can be rejected. For the method, see Hadri (2000).

3.2 Panel Cointegration Results

Due to the large number of empirical results obtained in the long-run analysis, the results for exports are presented separately from those for imports. However, later in this section, we draw some general conclusions on the linkages between trade and FDI.

3.2.1 Exports of Manufactures and FDI

Tables 2 and 3 show the results of the panel cointegration tests for heterogeneous panels for the two specifications described in the introduction to this section: model 1, the extended specification including FDI stocks, and model 2, the "traditional" specification.

In the case of model 1, the individual LM tests results given in Table 2 show that the null hypothesis of cointegration cannot be rejected for the majority of the countries (the only exception being the Netherlands). In addition, the LM panel test (1.38) does not allow us to reject the null of cointegration at 5 percent (the critical value being 1.6449).

The DOLS parameter estimates for a model with one lead and three lags are shown in Table 3 (columns 2 to 5), together with the t-values in parentheses. It should be emphasized that this estimation method corrects for endogeneity and autocorrelation and, according to McCoskey and Kao (1998), has better asymptotic properties than the fully modified and OLS estimators. From the results, it should be stressed, first, that the variable representing foreign income is significant in the majority of the equations (8 cases), the coefficients being of the correct sign

Table 2: *Exports of Manufactures: Individual and Panel LM Cointegration Test Results (1981:Q1–1998:Q3)*

Model 1: $rmx_{it} = \alpha_i + \beta_{1i}y^*_{it} + \beta_{2i}compe_{it} + \beta_{3i}insfdi_{it} + \beta_{4i}outsfdi_{it}$

Model 2: $rmx_{it} = \alpha_i + \beta_{1i}y^*_{it} + \beta_{2i}compe_{it}$

Countries	Model 1	Model 2	Countries	Model 1	Model 2
Austria	0.03849	0.22145*	Japan	0.02682	0.42871***
Belgium	0.08207	0.26620**	Netherlands	0.25463***	0.25939**
Denmark	0.06047	0.19177*	Spain	0.06322	0.64343***
Finland	0.03672	0.31676**	Sweden	0.02359	0.13610
France	0.03759	0.07641	UK	0.02362	0.11835
Germany	0.09760	0.33730**	US	0.08257	0.82799***
Italy	0.06541	0.20167*			
Panel tests	1.38	23.10***			

Note: The tests and the models have been estimated using COINT 2.0. in GAUSS 3.2.4. The critical values at 1 percent (***), 5 percent (**) and 10 percent (*) for the LM test are 0.1983, 0.1204, and 0.0929, respectively, for the case of four regressors (Harris and Inder 1994) whereas the critical values are 0.372, 0.217, and 0.167 for the model with two variables.

and magnitude. In fact, the lowest value is that for Denmark (1.170) and the highest one is for the United States (4.343). All of the values are very close to those commonly found in the literature, where income elasticities, in general, are greater than one.[17] The estimates of relative prices are even more promising: all the parameters are (highly) significant, and their values go from −0.318 in the case of the United States to −0.979 in the Netherlands. In fact, the majority of them are between −0.5 and −1, as the theory predicts. It should be noted that, as in Hooper et al. (1998), these export price elasticities are relatively small, and are below those for imports.

The variables representing the cumulated inward and outward FDI deserve special attention. In fact, before analyzing them we should look at the results presented in the last columns of Tables 2 and 3, where the two FDI variables have been excluded. For model 2 the LM tests reported in Table 2 indicate that the variables are not cointegrated. According to the test

[17] See Goldstein and Khan (1985) and, for a recent study using cointegration techniques, Hooper et al. (1998).

Table 3: *Exports of Manufactures: Panel Cointegration Individual DOLS Parameter Estimates, Dependent Variable:* rmx_{it}

	With FDI				Without FDI	
Country	y^*	*compe*	*insfdi*	*outsfdi*	y^*	*compe*
Austria	**1.519**	**−0.639**	**0.292**	**−0.132**	**1.431**	**−0.844**
	(2.37)	(−5.66)	(2.49)	(−2.33)	(11.87)	(−13.41)
Belgium	0.456	**−0.546**	**−0.699**	**0.857**	**1.606**	**−0.777**
	(0.28)	(−2.44)	(−2.51)	(2.35)	(11.83)	(−11.03)
Denmark	**1.170**	**−0.729**	**0.311**	−0.119	**1.692**	**−0.855**
	(2.57)	(−5.43)	(2.03)	(−1.07)	(16.54)	(−10.16)
Finland	**2.604**	**−0.802**	**0.139**	**−0.140**	**2.097**	**−0.684**
	(2.73)	(−5.05)	(1.90)	(−1.74)	(26.01)	(−10.48)
France	**1.625**	**−0.717**	**0.352**	**−0.373**	**1.484**	**−0.737**
	(3.95)	(−7.52)	(1.69)	(−1.67)	(14.59)	(−9.17)
Germany	**2.143**	**−0.848**	−0.300	0.097	**1.048**	**−0.804**
	(2.87)	(−6.37)	(−1.46)	(−0.32)	(7.34)	(−10.08)
Italy	**2.909**	**−0.501**	−0.086	−0.060	**2.239**	**−0.515**
	(2.81)	(−2.03)	(−0.43)	(−0.26)	(14.05)	(−5.71)
Japan	0.230	**−0.540**	0.044	**−0.100**	0.209	**−0.482**
	(0.57)	(−3.30)	(0.53)	(−1.78)	(1.13)	(−16.71)
Netherlands	**2.124**	**−0.979**	−0.622	**0.658**	**1.404**	**−0.838**
	(2.22)	(−5.39)	(−1.39)	(1.72)	(8.85)	(−8.43)
Spain	0.284	**−0.884**	**−0.499**	**0.883**	**2.368**	**−0.490**
	(0.25)	(−7.36)	(−4.91)	(5.24)	(10.92)	(−3.83)
Sweden	−0.534	**−0.522**	**0.330**	**0.161**	**1.936**	**−0.776**
	(−0.55)	(−3.19)	(3.51)	(1.66)	(15.57)	(−8.27)
UK	0.142	**−0.500**	−0.182	**0.883**	**2.268**	**−0.944**
	(0.150)	(−2.08)	(−1.28)	(3.07)	(19.42)	(−9.00)
US	**4.343**	**−0.318**	**−0.889**	**1.085**	**3.339**	−0.456
	(5.74)	(−2.71)	(−5.51)	(10.16)	(6.50)	(−1.42)

Note: t-Student statistics are reported in parentheses. Significant coefficients at 10 percent in bold. The intercepts have been excluded to gain in clarity.

results, the null hypothesis of cointegration is rejected for the majority of the countries, with the exceptions only of France, Sweden, and the United Kingdom. In addition, cointegration is also rejected for the panel, with a test value of 23.10. Table 3 however indicates that the coefficient estimates for model 2 are highly significant. This suggests that although foreign income and the country's competitiveness are fundamental explanatory variables of the behavior of real exports, there are other factors that, if not accounted for, provoke a severe misspecification problem.

The estimates of the complete heterogeneous model presented in Table 3 point to *complementarity* between FDI and trade. In fact, five out of the eight significant coefficients of $insfdi_{it}$ are positive (from 0.139 in Finland to 0.352 in France) and only in the cases of Belgium, Spain, and the United States does an increase in cumulated inward investment appear to decrease the exports of manufactured goods. For outward FDI, there are four negative (Austria, Finland, France, and Japan) and six positive signs (Belgium, the Netherlands, Spain, Sweden, the United Kingdom, and the United States). There is also less similarity in the magnitude of the coefficients than in the case of $insfdi_{it}$ (from -0.100 to -0.373, and 1.085). It is also notable that, when the inward stocks turn out to be substitutes for trade, the outward stocks are complements (or insignificant) and conversely. The only exception is Sweden: for this country, both types of FDI are complements to trade.

3.2.2 *Imports of Manufactures and FDI*

The contrast in Table 4 of the results for models 1 and 2 is striking. For model 1, the individual and panel LM tests for the null of cointegration

Table 4: *Imports of Manufactures: Individual and Panel LM Cointegration Tests Results (1981:Q1–1998:Q3)*

Model 1: $rmm_{it} = \alpha_i + \beta_{1i} y_{it} + \beta_{2i} relpr_{it} + \beta_{3i} insfdi_{it} + \beta_{4i} outsfdi_{it}$

Model 2: $rmm_{it} = \alpha_i + \beta_{1i} y_{it} + \beta_{2i} relpr_{it}$

Countries	Model 1	Model 2	Countries	Model 1	Model 2
Austria	0.06917	0.1494	Japan	0.03386	0.3200**
Denmark	0.14739**	0.7177***	Netherlands	0.08373	0.1578
Finland	0.01460	0.3953***	Spain	0.08570	0.1762*
France	0.13814**	0.8452***	Sweden	0.02362	0.1963*
Germany	0.08119	0.1358	UK	0.09039	0.1775*
Italy	0.05939	0.1270	US	0.03841	0.1389
Panel tests	1.63	20.91***			

Note: The tests and the models have been estimated using COINT 2.0. in GAUSS 3.0. The critical values at 1 percent (***), 5 percent (**), and 10 percent (*) for the LM test are 0.1983, 0.1204, and 0.0929, respectively, for the case of four regressors (Harris and Inder 1994), whereas the critical values are 0.372, 0.217, and 0.167 for the model with two variables.

Table 5: *Imports of Manufactures: Panel Cointegration Individual DOLS Parameter Estimates, Dependent Variable:* rmm_{it}

	With FDI				Without FDI	
Country	*y*	*relpr*	*insfdi*	*outsfdi*	*y*	*relpr*
Austria	**0.979**	0.144	**0.172**	**0.106**	**1.198**	**1.503**
	(6.54)	(0.43)	(2.15)	(3.64)	(12.77)	(4.10)
Denmark	**1.182**	**−2.906**	**1.538**	**−0.779**	**1.652**	**−0.681**
	(9.46)	(−6.49)	(7.46)	(−5.89)	(23.88)	(−2.00)
Finland	**0.433**	0.448	**0.347**	**0.182**	**1.703**	**−1.483**
	(2.49)	(1.52)	(5.61)	(3.69)	(20.93)	(−11.22)
France	**1.150**	**−1.507**	**1.083**	**−0.758**	**1.690**	**−0.710**
	(27.51)	(−15.62)	(8.46)	(−5.83)	(29.35)	(−4.45)
Germany	**1.029**	−0.143	0.076	0.205	**1.232**	**0.564**
	(3.29)	(−0.24)	(0.26)	(0.67)	(15.40)	(1.92)
Italy	**0.489**	**−0.581**	**0.476**	−0.008	**1.493**	**−1.211**
	(1.73)	(−1.70)	(2.50)	(−0.03)	(22.78)	(−34.69)
Japan	**−1.053**	**0.449**	**0.646**	**0.646**	**1.473**	−0.244
	(−3.47)	(2.11)	(9.30)	(8.56)	(6.82)	(−0.91)
Netherlands	**1.161**	−0.670	**0.502**	**−0.487**	**1.380**	−0.132
	(5.07)	(−1.36)	(2.09)	(−1.91)	(16.78)	(−0.34)
Spain	**1.917**	**−0.758**	**−0.232**	**0.594**	**2.207**	**−1.940**
	(9.36)	(−2.90)	(−1.92)	(3.95)	(38.09)	(−35.24)
Sweden	**0.791**	**−0.587**	**0.142**	**0.180**	**1.353**	**−1.134**
	(4.94)	(−3.36)	(4.01)	(3.21)	(21.10)	(−29.15)
UK	−0.133	**−0.328**	0.163	**0.979**	**1.218**	**−1.115**
	(−0.72)	(−2.96)	(1.54)	(5.92)	(12.16)	(−16.83)
US	**6.346**	**−0.370**	**−0.757**	**−0.360**	**3.457**	−0.036
	(11.25)	(−4.00)	(−5.63)	(−3.46)	(42.29)	(−0.61)

Note: t-Student statistics are reported in parentheses. Significant coefficients at 10 percent in bold. The intercepts have been excluded to gain in clarity.

show that, in general, the null cannot be rejected, with the exception of Denmark and France. The panel test is also nonsignificant, that is, the existence of cointegration is accepted. The estimated DOLS coefficients for each country are shown in Table 5. Real income is significant, with the sole exception of the United Kingdom, whereas the relative prices are also different from zero in eight out of twelve cases.[18] Again, the coefficients are

[18] The two "traditional" variables are significant in the case of Japan, although the signs are the opposite to those predicted by the theory. The visual inspection of the variables and the comparison with the other countries in the sample shows that Japan has experi-

in accordance with those postulated in the literature, with greater income elasticities for imports, as compared with those obtained for exports.

In the case of the FDI variables, the results are also mixed, as for the exports, although the positive signs prevail, with an overall assessment of *complementarity* between trade and FDI. In 10 out of 12 of the cases, the inward stock is significant, with only two negative coefficients (those of Spain and the United States). The rest are positive and large (from 1.538 in Denmark to 0.142 in Sweden). There are also 10 significant outward stock coefficients, although in this case 4 of them are negative (Denmark, France, the Netherlands, and the United States) and large (between −0.36 and −0.77). Similarly to the export case, in 4 of the countries when one of the stocks is a complement to imports the other one is a substitute. However, in Austria, Finland, Japan, and Sweden both the inward and the outward stocks are complements to imports of manufactures, whereas in the United States there is substitutability between any FDI activity and imports.

For model 2—the traditional version—the results of the heterogeneous tests and estimates (Tables 4 and 5) reveal that the null hypothesis of cointegration maintained in the LM test is rejected for the majority of the countries. The exceptions are Austria, Germany, Italy, the Netherlands, and the United States. In addition, the panel equivalent test result is 20.91, far above the critical value of 1.64, so that no evidence of cointegration can be extracted from the heterogeneous analysis.

3.2.3 Summary of the Trade-FDI Results

We present in Table 6 a summary of the results obtained linking real exports and imports of manufactures to the FDI variables. For ease of reporting, the countries are split into three different groups: the small EU countries, the large EU countries and the non-EU OECD countries (the United States and Japan). It should be noted that the two first groups of countries form a trade bloc, where full liberalization of FDI and trade flows in manufactures has occurred during the sample period. This process of economic integration may have created dynamic effects influencing the joint performance of the two variables. Cross-border mergers and acquisitions account for the majority of the FDI decisions. The leading sectors in FDI have been the automobile

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enced a long period of stagnation in real activity. However, the real imports have maintained their trend independently of this fact, due to the importance of other factors in their behavior. At the same time, relative prices have also evolved differently from those in the other OECD countries.

Table 6: *Summary Table of the Relationship between Real Manufactures Exports and Imports and FDI*

		Exports		Imports	
	Countries	Inward FDI	Outward FDI	Inward FDI	Outward FDI
Small EU countries	Denmark	(+)	n.s.	(+)	(−)
	Finland	(+)	(−)	(+)	(+)
	Sweden	(+)	(+)	(+)	(+)
	Austria	(+)	(−)	(+)	(+)
	Netherlands	n.s.	(+)	(+)	(−)
	Belgium	(−)	(+)	—	—
	Spain	(−)	(+)	(−)	(+)
Large EU countries	France	(+)	(−)	(+)	(−)
	Italy	n.s.	n.s.	(+)	n.s.
	Germany	n.s.	n.s.	n.s.	n.s.
	UK	n.s.	(+)	n.s	(+)
Third countries	US	(−)	(+)	(−)	(−)
	Japan	n.s.	(−)	(+)	(+)

Note: The signs in parentheses indicate a positive (+) or negative (−) relationship between real manufactures exports or imports and inward or outward FDI stocks. "n.s." stands for nonsignificant.

and food industries. According to the UNCTAD *World Investment Reports*, investments have been directed toward restructuring or rationalizing the production process and can be considered as horizontal FDI. As Pain and Wakelin (1998) stress, the impact of production relocation can differ according to whether it is to exploit natural resources, to improve access to local markets or simply as part of the international division of labor within the firm. Thus significant differences might be observed across countries or industries, although, on balance, the available evidence suggests that inward investment is more likely than outward investment to raise exports. Our results are compatible with these hypotheses.

In the first group, *small open economies*, FDI accounts for an important share of GDP and external trade. With the exceptions of outward FDI in the case of Denmark and the inward variable in the Netherlands, foreign investment is always significant for exports of manufactures. In addition, the relationship found is one of complementarity for the majority of them. In fact, when looking at the relation between imports and FDI inside the small

EU countries, only Spain shows a negative sign. It would appear that given its peripheral location and the size of its market, Spain is not used as an export platform and MNCs attach a higher importance to the domestic market, that is, these investments would be more *market-seeking* than *efficiency-seeking*. This evidence is consistent with previous microeconomic studies about FDI location in Spain including Martínez-Serrano and Myro (1992) and Bajo and López-Pueyo (2002). As pointed out in Barry et al. (1997), the enforcement of a liberalization process is a prior for a country to become attractive as a platform for external trade. However, although in small economies (such as Ireland or Portugal) the efficiency-seeking motive to boost trade has been specially relevant, in the Spanish case, supplying the domestic market seems to be the main reason for FDI.

In contrast, the economic weight of FDI in the *large EU countries* is relatively small when compared with their income. Therefore, only in the case of France for the two FDI variables and Italy and the United Kingdom for one of them, are these variables significant. The latter country is the largest EU foreign investor, specially in the United States. It has a tradition of large MNCs, so that a complementarity relation may be capturing intrafirm transactions both in exports and imports. For France, inward FDI promotes trade whereas the outward French investment substitutes it. Germany should be carefully considered because, with the exception of the late nineties, it has received less inward flows than might be expected due to obstacles to investment such as a high degree of regulation, strict environmental protection, and rigid labor markets. In addition, another negative factor can be found in the specific structure of German enterprises and their financing: market capitalization in Germany is comparatively small in relation to the country's economic size (Deutsche Bundesbank 1997b).

The remaining two *countries are outside the EU bloc* and, therefore, their strategies may differ. During the sample period, the Single Market was established and EMU was launched. Thus, the U.S. and Japanese outward investments are either defensive, in order to retain European markets in which their affiliates were already located or, offensive in order to take advantage of the growing internal European market. However, the characteristics of Japan and the United States in terms of size and location are very different. The United States is an important host of market-seeking FDI and, therefore, trade and inward FDI may be substitutes. In contrast, Japan is a country whose domestic market has traditionally been very protected and, as a consequence, has dealt with important barriers to its exports. Thus, a negative relation is found between manufactured goods exports

and outward FDI: the Japanese firms have established in their export markets in order to avoid the trade barriers they normally faced. However, inward FDI stocks are not significantly related to Japanese exports, whereas imports and inward FDI turn out to be complements. Our results are compatible with the results of the study undertaken by Eaton and Tamura (1996).

4 Conclusions and Directions for Further Research

The present paper sheds some light on the long-standing debate over the factors behind trade performance in OECD economies. The general approach adopted up to now in econometric studies has focused mainly on aggregate trade and in the "traditional" specification has neglected the impact of some relevant variables such as FDI stocks. Additionally, in spite of the increasing interest in the impact of FDI on trade, the empirical evidence is rather scarce and far from conclusive. The majority of the existing studies use cross-section data and the results can be different from those obtained with panel data. In general, it is preferable to use methods that take into account the evolution of the variables over time. An increase in either inward or outward FDI raises or lowers trade compared with the level they would otherwise have achieved given the level of foreign demand and the other characteristics of domestically produced goods. Therefore, with increasing globalization, it is important to take account of the effect of FDI on trade, as well as the impact of traditionally included variables such as the level of foreign demand.

The main conclusions that can be derived from the empirical findings discussed above are the following:

(1) Income and relative prices, the so-called "traditional" variables commonly considered the main determinants of exports and imports demand, turned out to be insufficient to explain the behavior of trade in OECD countries. A specification excluding FDI omitted part of the fundamental determinants of these trade flows, so that no evidence of cointegration was found when heterogeneity was allowed within the countries in the sample.
(2) In the majority of the cases analyzed, the stock of inward and outward foreign investment is positively related to trade, so that the *complementarity* hypothesis is the one supported by the evidence.

(3) However, depending on the countries, and, especially in the cases of exports/inward stock and imports/outward stock, an important number of negative coefficients, that is, *substitutability* has been found.
(4) Finally, also in a nonnegligible number of cases, a positive sign of one of the FDI variables was associated with a negative sign of the other for the same country.

In summary, the estimation results pointed generally to a complementary relationship between FDI and trade (*efficiency-seeking*). This is consistent with the findings of the very recent empirical literature which confirms the existence of a major process of horizontal FDI under an eclectic theoretical framework. Substitutability relationships would be more frequent between blocs unless the aim of FDI is vertical integration. However, it can be hypothesized that, inside a bloc, between relatively small, open (and developed) economies, horizontal FDI is compatible with a tendency of increasing intraindustry trade (and to some extent intrafirm trade) due to product differentiation, which gives also rise to multiplant firms and intraindustry two-way FDI. Obviously, these issues are beyond the scope of the present study but should be considered in future research.

Appendix: Data Sources

The data in the paper are quarterly and cover the period 1981:Q1–1998:Q3. The panel consists of 13 to 12 countries, depending on the availability of data. It includes all the EU members with the exceptions of Ireland, Luxembourg, Portugal and Greece due to data availability problems, plus Japan and the United States. The data have been obtained mainly from the magnetic data bases of the International Monetary Fund *International Financial Statistics* (*IFS*), the UNCTAD, and the OECD.

rmx_t: logarithm of real exports of manufactured goods.

$$rmx_t = \log\left(\frac{nexmanu_t}{pexmanu_t} \times 100\right),$$

where $nexmanu_t$ are the exports of manufactured goods, Section 6, in millions US dollars, from the OECD *Monthly Foreign Trade Statistics-Series A*; $pexmanu_t$ are the export prices of manufactured goods from the OECD *International Trade and Competitiveness Indicators*, with the exceptions of Austria, Belgium and the Netherlands, that are wholesale price indexes, from the IMF *IFS*.

y_t^*: real income of the OECD countries, base year 1990. Each country's income has been substracted from the total amount in order to avoid collinearity in the estimation, with the exceptions of Austria, Belgium, and Denmark, due to lack of data availability for the whole period. However, the relatively small size of these countries in the OECD supports this decision.

$compe_t$: logarithm of the competitive position of the country, as the ratio of each country's prices of exports of manufactured goods (as defined above) to the competitors' prices, p_t^*, in domestic currency. To transform the prices to common currency we have used the bilateral exchange rate of the dollar from the IMF *IFS* (defined as units of foreign currency in a unit of domestic currency), $eus\$_t$, with the exception of the United States where we used the nominal effective exchange rate, also obtained from the IMF.

$$compe_t = \log\left(\frac{pexmanu_t}{p_t^* \times eus\$_t} \times 100\right)$$

The competitors' price, p_t^*, has been calculated as a weighted average of the export prices of manufactured goods (or wholesale price indexes, depending on data availability. The weights are proportional to each country's share on world exports. The selected countries are the 13 world's biggest exporters (percentages): the United States (15.54), Canada (6.06), Japan (14.22), Belgium (5.1), France (9.12), Germany (18.1), Italy (7.15), the Netherlands (5.7), Spain (2.21), Sweden (2.85), Switzerland (2.8), the United Kingdom (8.25), and South Korea (2.9). The data necessary to calculate the weights have been obtained from the OECD *Direction of Trade Yearbook*, 1992. The benchmark year is 1987, due to its placement in the middle of the sample.

rmm_t: logarithm of real imports of manufactured goods.

$$rmm_t = \log\left(\frac{immanu_t}{eus\$_t}\right),$$

where $immanu_t$ are the imports of manufactured goods, Section 6, in millions of national currency from the OECD *Monthly Foreign Trade Statistics-Series A*; the variables have been transformed in US dollars using the bilateral exchange rates.

y_t: real income of the reporting country in US dollars, calculated as the logarithm of each country's GDP in real terms (deflated using the GDP deflator).

$relpr_t$: relative prices, computed as the logarithm of the ratio of import prices relative to domestic prices of competing goods. As import prices we have used the variable p_t^* as described above, because this variable was a proxy for world price of manufactured exports. For the domestic prices of competing goods we have chosen to use the wpi_t:

$$relp_t = \log\left(\frac{p_t^* \times eus\$_t}{wpi_t} \times 100\right)$$

$insfdi_t$: logarithm of the real stock of the inward FDI. The data on nominal stocks ($nsinfd_t$) have been obtained from the UNCTAD *FDI Statistics on Line* (April 2002). Their sources are the IMF *IFS* and UNCTAD *World Investment Report*, 2001. The real variables have been deflated using, for each country, the domestic prices of investment goods ($invp_t$):

$$infdi_t = \log\left(\frac{nsinfdi_t}{invp_t}\right)$$

FDI is defined as an investment involving a long-term relationship and reflecting a lasting interest and control of a resident entity in one economy (foreign direct investor or parent enterprise) in an enterprise resident of a different economy (FDI enterprise or affiliate enterprise or foreign affiliate). This definition is based on the FDI concept as presented in the IMF *Balance of Payments Manual* and is also a basis for that adopted in the second edition of the OECD *Detailed Benchmark Definition of FDI*. In addition, FDI implies that the investor exerts a significant degree of influence on the management of the enterprise resident in the other economy (that is, owns 10 percent or more of the ordinary sales or voting power). Such investment involves both the initial transaction between the two entities and all subsequent transactions between them and between foreign affiliates. Direct investors (in contrast to portfolio investors) are in a position to obtain benefits in addition to investment income, such as management fees opportunities.

Finally, inward FDI is a nonresident direct investment in the reporting economy.

$outsfdi_t$: logarithm of the real stock of the outward FDI. The nominal variable ($nsoutfdi_t$) has also been obtained from the UNCTAD *FDI Statistics on Line*. The real variables have been deflated using the G-7 GDP deflator, from the OECD *Main Economic Indicators Database* ($deflg7_t$). The use of this particular price index relies on the fact that the G-7 countries are the largest investors and hosts of FDI in the world.

$$outfdi_t = \log\left(\frac{nsoutfdi_t}{deflg7_t}\right)$$

Outward FDI is the investment abroad made by a resident of the reporting country.

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