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Estimating exports and imports demand for manufactured goods: The role of FDI.[1]

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Abstract

In this paper we examine the joint performance of FDI and trade under a full liberalization process consistent with New Trade Theory models. The testing framework consists of the estimation of demand for exports and imports of manufactured goods for a panel containing the majority of the EU countries as well as the US and Japan. The model includes as explanatory factors, not only the traditional determinants of trade, but also new ones, such as the stock of foreign direct investment (FDI). We apply a variety of panel unit root and cointegration tests to the cases of both homogeneous and heterogeneous panels. 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 complementarity relationship between trade and FDI.

J.E.L. codes: C23, F14, F21.

Key words: export and import demand, New trade theory, panel data, unit roots, cointegration, foreign direct investment, MNCs.

1 Introduction.

The demand for exports (or imports) has been traditionally specified as a function of the country's competitiveness and a foreign (domestic) activity variable. Although this approach has been predominant in the empirical literature, it has remained controversial. Problems such as parameter instability (see Hooper et al. 1998) or the non-stationarity of the data have revived the interest in the study of this relationship. 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 or the quality of the traded goods.

Consequently, recent empirical studies have introduced novelties both from a theoretical and a methodological point of view. In this paper, we will concentrate on the estimation of manufactured goods export and import demand, trying to find the main explanatory variables and use not only the traditional factors, but also foreign direct investment (FDI) stocks. We examine a quite wide sample of OECD countries using recent panel cointegration techniques that combine time-series and cross-section information and tackle the problems derived from the non-stationarity commonly found in economic variables.

The paper is organized hereafter as follows. In section 2, we review the theoretical issues relating trade and factor markets integration, and more specifically, trade and FDI. Section 3 is devoted to provide the testing formulation of trade equation emphasizing the role of foreign direct investment in the light of the New Trade Theory. In section 4 we discuss the empirical results for a panel formed by 11 European countries, the US and Japan. Finally, the last section is devoted to outline some concluding remarks and 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 sim-

ple) 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 a 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. Thus, normally it is assumed that the dominant relative price competition occurs among exporters. Consequently, the relative-price term that typically 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 domestic currency, and P is the price of the products that are domestic substitutes to this country's imports.

Goldstein and Kahn (1985) survey the empirical estimates of long-run income and price elasticities for imports and exports of major industrial countries. 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 vs. FDI?

The progressive 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 90s 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 hasn't 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 these crossed relations are heavily influenced by the activity of Multinational Corporations (MNCs). Consequently, any theoretical treatment that sees FDI similar to portfolio or physical factor allocation can be misleading and from the 70's there have been various attempts to shed some light on the relationship between trade and FDI.

The New Trade Theory has recently emphasized (see Krugman, 1989) that aggregate trade shares may depend on the variety and quality of goods produced in the economy. Thus, the amount of inward and outward FDI can be used as a proxy for the resources that a country devotes to innovation. The incorporation of the multinational firm into the New Trade Theory has been achieved only very recently focusing on the so-called proximity-concentration trade-off.

- *Classical view: the standard trade theory (50's-60's).*

Under the traditional Heckscher-Ohlin framework (H-O), provided 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,

[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.

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. According to this, Markusen (1983) claims that the substitution relationship between commodity and factor movements is the exception rather than the rule, whereas *complementarity* is likely to be the most frequent one.

- *Theory of Industrial Organization and the key concepts of economic integration of products and factors (70's).*

It is commonly acknowledged that Multinational Corporations (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, are considered direct investment.

A company that is setting up production abroad has to compare the disadvantages of it (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, that gave birth to the so-called OLI paradigm. According to it, a firms's choice between the three alternatives (exporting, licensing or investing abroad) depends on the combination of the three following advantages: *ownership-specific advantages, internalization advantages* and *locational advantages in the target market.*

An issue of interest when the analysis is focused on European countries is the effects that integration has on inward and outward FDI, both intra and inter-regions. The evolution of FDI and its expected complementary or substitute effect on trade would also depend on the reasons that justified the investment decision before the process of integration started.

According to Yannopoulos (1990) the key concepts of the theory of customs union can be combined together with the theory of the firm in order to depict a framework covering the different relationships between FDI and the creation of a customs union or a common market[2]. Hence, defensive import-substituting direct investments (meant to maintain existing markets) replace international trade (substitution relationship); offensive direct investments (investments based on the possibility of taking over new markets) do not limit existing trade but may limit potential trade (substitution relationship);

[2]See Bolmström and Kokko (1997) for an updated survey.

reorganization investments within the bloc in accordance with comparative advantages due to the existence of scale economies may boost trade (complementary relationship); finally, a rationalized investment (that is, the case in which market dynamics create a cost disadvantage that will worse off the export performance of the MNC) may foster intra-bloc trade (complementarity relationship) but decrease inter-bloc trade (substitution relationship).

- *New trade theory and new economic geography (80's)*

The early attempts to reconcile the theory of multinationals with trade theory appears in Markusen (1984) and Helpman (1984). The former focussed on horizontal investments in which a firm sets up abroad to produce the same product that it produces at home, while the latter focussed 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 this 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 *complementarity 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 and, thus it generates a market seeking FDI that will have a *substitutability 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 firms' level and tariffs are relatively 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 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*[3]).

- *Knowledge capital models (90's).*

A unified approach has been developed recently aiming at endogenizing multinational firms in general-equilibrium trade models and integrating separate contributions on multiplant horizontal MNCs with work on vertical ones (Markusen et al., 1996, Markusen, 2000 under the name of *knowledge-capital models (KK models).*

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 rising north-south (big-small size countries) trade and horizontal 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 volume of trade, that is, *FDI and trade are complements.*

The possibility to split the production process into different stages and/or the existence of multiproduct firms give rise to situations in which, regardless the aims of the firms, the most feasible outcome is a positive relation between the increase of MNCs activities and trade, either intra-firm or intra-industrial (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 complement or substitute nature of trade and FDI. Thus, the question remains open for the empirical analysis. Generally, we can distinguish two empirical approaches in the literature.

First, the empirical literature that analyzes the 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 from a proximity-concentration trade-off, where firms decide to serve a foreign market either as

[3]Helpman and Krugman (1989) 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.

an exporter (via trade) or as a multinational enterprise (via foreign affiliates sales). 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. First, the use of static panels has serious econometric flaws and, secondly, considers the integration effects in a static way, neglecting the fact that the phenomenon is rather dynamic. In order to overcome these pitfalls some other authors have proposed alternatively applying either computed general equilibrium analysis or dynamic panels. The empirical results in general, although they are not conclusive, point to a complementarity relationship[4].

In spite of its empirical success, reservations from a theoretical side cannot be eliminated as it has been claimed consistently that most of the tested equations were *ad hoc* (Leamer and Levinsohn, 1995). However, genuine efforts have been made to link empirical evidence with theory, as in Feenstra, Markusen and Rose (1999).

A second strand of the literature has been based on the estimation of *augmented* export and import equations. Recent empirical studies have introduced novelties 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 MNCs activities, an aspect that has so far had little impact on the empirical analysis of bilateral economic relationships. Lin (1995) finds a positive relationship between FDI and exports[5] while Barrel and Pain (1997) find a negative long-run relationship between exports and the stock of net FDI.

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. 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 cases. Secondly, 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 foreign direct investment (FDI).

[4] See for example, Brenton, Di Mauro and Lücke (1999) or Egger (2001). These results are also consistent with the ones in Carr et al. (2001) who found evidence for horizontal integration when testing for the KK model.

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

In line with recent theoretical work, the specifications presented here contain identical determining factors for both trade and multinational activities. We will concentrate on the manufactured goods export and import demand equations, trying to find the main explanatory variables and use not only the traditional factors, but also foreign investment stocks. Additionally, an assumption, basic to the model, that has been subject to criticism 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 admitted that exports do not immediately adjust to their long-run equilibrium level when there is a change in any of its determinants[6]. This kind of empirical or rather methodological drawback can be avoided using the cointegration techniques that account for the non-stationary nature of the data and explicitly consider the dynamic structure implicit in the model. This permits to obtain long-run relations without neglecting the short-run adjustment process and correcting for possible endogeneity problems. This is the case of the Dynamic OLS (DOLS) procedure. In addition, the combination of time series properties and estimation techniques with the information contained in a panel of data are possible using the recent tests for cointegration in panels. Hence, the use of panel cointegration tests allow us to gain power by exploiting cross-sectional information and taking into account the degree of heterogeneity in the cross-section dynamics.

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 foreign direct investment with innovation in industries and estimate a conventional panel of 11 OECD countries specified as an error correction mechanism. Finally, Bajo and Montero (1995, 2001) estimate, respectively, the demand for exports and imports using a measure of inward and outward FDI for the Spanish case and the causality relationship between FDI and trade distinguishing between short and long-run effects.

Our aim in this paper will be to analyze the empirical relationship between exports and imports and inbound and outbound FDI. This objective is achieved by extending the classical analysis of export and import functions to include outward and inward FDI from a macroeconomic point of view in a panel of 13 and 12 OECD countries, respectively. Our paper departs from

[6] 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.

other previous studies in several issues.

Firstly, in the use of *capital stock* rather than data on FDI flows. As these stock figures are usually lagging behind and the data on direct investment flows from national balances of payments are available at an earlier date, 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), high volatility of the data and absence of theoretical background[7]. Although the appropriate variable from a theoretical point of view would be the MNCs' sales in the host countries[8], these data are not reported for the set of countries and aggregation level we are working on. Thus, FDI stock can be considered a proxy (linear function) of MNC sales.

Secondly, we overcome the problem of sizeable data sets 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 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 empirical results relating trade in manufactures and foreign direct investment 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 disaggregate 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), disaggregation is preferred, as the

[7] As Bajo and Montero 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).

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

estimates obtained directly from the aggregate relationship are likely to be biased[9]. The estimates of price 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 manufactures exports will be of the form:

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

where rmx_{it} is the logarithm of real manufacturing exports, y^*_{it} is the variable representing 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 foreign investment respectively[10].

Similarly, the imports of manufacturing goods are specified relating the following variables:

$$rmmx_{it} = \alpha_i + \beta_{1i} yr_{it} + \beta_{2i} relpr_{it} + \beta_{3i} insfdi_{it} + \beta_{4i} outsfdi_{it} + u_{it} \qquad (6)$$

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 good 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 US and Japan[11]. The data are quarterly and the sample spans from 1981/Q1-1998/Q3, which is the longest period available for all the variables and countries.

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

[9] 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.

[10] See appendix A for more detailed information about the sources and data definitions.

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

than 2[12]. Concerning the signs of the *FDI* variables, they would depend on the substitutability or complementarity existing between trade and *FDI*. A positive 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 relation may be expected linking the real imports of manufactures and the stocks of foreign direct investment in equation (6): the two possibilities, complementarity and substitutability are supported by the theory. In addition, the theory predicts a positive link between real imports and the real income of the country (yr_{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. However, we also provide the results of the restricted specification or "traditional" model, where the FDI variables have been excluded.

Concerning the panel estimation, 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 heterogenous panel methodology specially interesting in this case, because we expect to find diversity of results for the foreign investment stocks. In fact, this diversity will allow us to characterize the foreign investment strategy followed by the countries in the sample or, at least, the MNCs involved.

The econometric methodology we use to analyze the panel described above is based on cointegration techniques. These tests, that originally were applied and developed for time series, have been successfully adapted to the case of panel data. The main advantage of this methodology is that it overcomes the problem of the non-stationarity 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.

In this paper we apply tests for cointegration both in the homogeneous and heterogeneous case. Specifically, in the long-run analysis we test for

[12]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).

the null of non-cointegration in homogeneous panels using the Kao (1999) tests, as well as for the null of cointegration implementing the McCoskey and Kao (1998) *LM* test. 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 both correct for possible problems of endogeneity and autocorrelation. They also show that the estimators are asymptotically normally distributed with zero means. The *DOLS* estimator is specially 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)[13], to the Im, Pesaran and Shin (1995) tests. However, in this section we have applied the *LM* test for the null of stationarity proposed by Hadri (2000) with heterogeneous and serially correlated errors due to its better power. These tests can be considered the panel version of the *KPSS* tests applied in the univariate context. The two statistics are called 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 time trend), so that all the panel variables can be considered non stationary.

3.2 Pooled analysis: the model specification.

3.3 Panel cointegration results.

Due to the large number of empirical results obtained in the long-run analysis, we have decided to present separately those of the exports from those of the

[13] Finally published as Levin, Lin and Chu (2002).

imports. However, later in this section, we will try to extract some general conclusions on the linkages between trade and foreign direct investment.

3.3.1 Exports of manufactures and FDI.

Panel cointegration test results: homogeneous panel.

Concerning the long-run analysis, we will first apply the panel cointegration tests and estimation procedures for homogeneous panels. In this framework, that means that we allow for fixed specific effects for each country but restrict the slope coefficients to be equal for all the members of the panel. Kao (1999) proposed DF-type panel cointegration tests based on the OLS residuals from the homogeneous panel regression.

The DF test from Kao (1999) follows the model:

$$y_{it} = \alpha_i + \beta x_{it} + e_{it}, \qquad i = 1, ..., N, \quad t = 1, ..., T \tag{7}$$

where both y_{it} and x_{it} are random walks. Thus, under the null hypothesis of no cointegration, the residual series e_{it} should be non-stationary.

The limiting distributions are asymptotically normally distributed at mean zero. However, they contain nuisance parameters because of possible long-run weak exogeneity and serial correlation in the errors. Thus, it would be necessary to have good estimates of the long-run parameters. Kao constructs new statistics whose limiting distributions are $N(0,1)$ and do not depend on the nuisance parameters, that are called DF_ρ^* and DF_t^*. Alternatively, he defines a bias-corrected serial correlation coefficient estimate and, consequently, the bias-corrected test statistics and calls them DF_ρ and DF_t. According to Baltagi and Kao (2000), the main difference between the two groups of tests is that whereas the DF_ρ and DF_t tests are based on the strong exogeneity of the regressors and errors, the DF_ρ^* and DF_t^* are more adequate for cointegration with endogenous relationships between regressors and errors. Finally, he also proposes an ADF version of the test.

In table 2 and in the first two columns, we present the results of the different versions of the DF test and the ADF tests described above. In the case of the exports of manufactured goods, all the tests agree: it is possible to reject the null hypothesis of non-cointegration at 1% significance levels.

Table 3 offers some more information related to the homogeneous estimation results: in the first column we present the OLS estimates, whereas the third one displays the bias corrected estimates. We should recall that the hypothesis imposed is that all the countries share the same coefficients for each of the explanatory variables. According to the OLS estimates, all the

variables are correctly signed and significant, with the exception of the inward stock of *FDI.* From the adjusted estimates, *insfdi* is also non-significant, whereas in the case of the outward stock of *FDI,* even if the sign is correct, the parameter is only significant at 7.7%.

A word of caution should be given before progressing: due to the heterogeneity of the countries involved in the analysis, the homogeneous analysis may introduce too strong restrictions in the parameters, not necessarily supported by the data, so that the heterogeneous analysis should be carried out. Non-significant parameters may be the consequence of large discrepancies between the different countries in the cross-sections.

Together with the information for the model that accounts for the role of *FDI* in exports, we also include both the tests and estimates of a restricted version of the model that excludes the two *FDI* variables. From tables 2 and 3, the tests results point to the existence of a long-run relation, whereas the parameters are significant and have the correct signs and magnitudes.

Panel cointegration test results: heterogeneous panel.

Tables 4 and 5 show the results of the panel cointegration tests for heterogeneous panels for the two specifications also described in the previous section.

The individual and panel *LM* test results for the null of cointegration are presented in table 4, second column. According to the individual *LM* tests, 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% (the critical value being 1.6449).

The *DOLS* parameter estimates for a model with one lead and three lags are shown in table 5 (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 and magnitude. In fact, the lowest value is the one of Denmark (1.17) and the highest corresponds to the US (4.34), all of them very close to those commonly found in the literature, where income elasticities, in general, are greater than one (see Goldstein and Khan (1985) and, for a recent study using cointegration techniques, Hooper et al. (1998)). 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 US to -0.979 in the Netherlands. In fact, the majority of them are between -0.5 and unity, as the theory predicts. It should be noted that, as in Hooper et al. (1998), the price elasticities are relatively small, and also smaller than in the case of 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 4 and 5, where the two FDI variables have been excluded. If compared with the homogeneous results, the picture changes when we allow for a less restricted testing approach in the heterogeneous analysis and use a more powerful test. In this case, although the estimates are highly significant, the *LM* tests indicate that the variables are not cointegrated. According to the tests results, the null hypothesis of cointegration is rejected for the majority of the countries, with the only exceptions of France, Sweden and the UK. In addition, cointegration is also rejected for the panel, with a test value of 23.10. The interpretation that we can give to this outcome is 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 an omitted variables bias in the analysis.

The estimates of the complete heterogeneous model presented in table 5 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 US an increase of the cumulated inward investment decreases the exports of manufactured goods. For outward FDI, there are four negative (Austria, Finland, France and Japan) and six positive signs (Belgium, Netherlands, Spain, Sweden, the UK and the US). 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 should also be emphasized that when the inward stocks turn out to be substitutes of trade, the outward stocks are complements (or insignificant) and conversely. The only exception is Sweden: for this country, the two types of *FDI* are complements to trade.

From the heterogeneous panel results we can now explain why the *FDI* variables were non significant in the homogeneous panel case. The reason can be that in only a part of the members of the heterogeneous panel these two variables were significant. In addition, the signs were not the same in all the significant cases. Consequently, it seems that the heterogeneous panel can better help us to identify the importance of *FDI* as variables explaining the evolution of real exports. For the *"traditional"* ones, the results are more similar in the group of countries studied, and thus, the homogeneous method gives us representative estimates. We have formally tested the restriction

of homogeneous slope parameters against the alternative of heterogeneous ones using a Wald-type test[14], that are distributed as $\chi^2(k)$, where k are the number of restrictions. In the case of the traditional specification, the result of the test is $\chi^2(24) = 15.15$, with a critical value $\chi^2_{0.05} = 36.41$. In the case of the model augmented with the foreign direct investment variables, the hypothesis of homogeneity is rejected.

3.3.2 Imports of manufactures and FDI.

Panel cointegration test results: homogeneous panel.

The *DF* and *ADF* homogeneous cointegration tests proposed by Kao (1999) have been also applied to the case of real imports of manufactures[15]. The results are presented in Table 6, where the null hypothesis of absence of cointegration can be rejected with all the tests. Moreover, the homogeneous estimates (see Table 7) are again consistent with the theory and are significant. There is only one non-significant parameter: the bias adjusted OLS coefficient for the variable outward stock of foreign investment. The same objections we gave above for the real exports of manufactures applies here: the existence of some degree of heterogeneity may be behind the lack of significance of the outward *FDI* stock.

Also in this case we include in tables 6 and 7 the homogeneous tests results and estimates for the restricted specification with no *FDI* variables considered. The homogeneous results are, as in the exports, favorable to cointegration (see the *DF* and *ADF* tests). In addition, the long-run parameter estimates exhibit the correct signs and magnitudes, although considerably larger than in the *FDI*-augmented specification.

Panel cointegration test results: heterogeneous panel.

The individual and panel *LM* tests for the null of cointegration are presented in Table 8. In general, the null cannot be rejected, with the exception of Denmark and France, for the individual countries in the model including the FDI variable. The panel test is also non-significant, that is, the existence of cointegration is accepted. The estimated *DOLS* coefficients for each country are shown in Table 9. The real income is significant in all cases, with the only exception of the UK, whereas the relative prices is also different from

[14] See Kao and Chiang (2000) for a description of hypotesis testing in the context of cointegration in panels.

[15] Belgium had to be excluded from the real imports analysis due to the inexistence of quarterly GDP data for the sample period. In the case of exports, this fact did not preclude the estimations, because the relevant variable was foreign income.

zero in eight out of twelve cases[16]. Again, the coefficients are in accordance with those postulated in the literature, with greater income elasticities in imports, as compared with those obtained for the exports.

In the case of the foreign direct investment 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 ten out of twelve of the cases, the inward stock is significant, with only two negative coefficients (those of Spain and the US). The rest are positive and large (from 1.53 in Denmark to 0.14 in Sweden). There are also ten significant outward stock coefficients, although in this case four of them are negative (Denmark, France, Netherlands and the US) and large (between -0.36 and -0.77). This explains that, in the homogeneous estimation, the outward stock was non significant in the bias adjusted OLS, as previously happened with the inward stocks in the manufactures exports. Similarly to the exports case, in four 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 US there is substitutability between any *FDI* activity and imports.

Once more, this analysis can be compared to what we have called the "traditional" specification, that provided acceptable empirical results in the homogeneous panel case. However, a closer and less restrictive examination performed thanks to the heterogeneous tests and estimates (tables 8 and 9) reveals that the null hypothesis of cointegration maintained in the *LM* test is rejected for the majority of the countries. The only exceptions are Austria, Germany, Italy, the Netherlands and the US. 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.

Finally, the same type of Wald test for the null hypothesis of homogeneity of the slope parameters were computed for the two alternative specifications in the case of real manufacturing imports, with a rejection of homogeneity.

[16] 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 experienced 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, the relative prices have also evolved in the opposite direction compared to the other OECD countries.

3.3.3 Summary of the trade-FDI results.

We present in table 10 a summary of the results obtained linking real exports and imports of manufactures and the *FDI* variables. In order to report the results in an easier way, we have split the countries into three different groups: the small EU countries, the large EU countries and the non-EU OECD countries (the US and Japan). It should be noted that the two first groups of countries form a trade bloc among them, where full liberalization of FDI and trade flows in manufactures has occurred during the sample period and, therefore, this process of economic integration may have created dynamic effects affecting the joint performance of the two variables. Cross-border mergers and acquisitions explain the majority of the FDI decisions. The leading sectors in manufactures have been the automobile industries and food. These investments, according to the UNCTAD World Investment Reports, have been directed towards restructuring or rationalizing the production process and can be considered of a horizontal nature. 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 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 to raise exports than outward investment. Our results are compatible with these hypotheses.

- The first group of countries is formed by *small open economies*, where FDI accounts for an important share of their GDP and external trade. With the exceptions of outward FDI in the case of Denmark and the inward variable in the Netherlands for exports of manufactures, foreign investment is always significant. 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 a platform to export and that the MNCs would 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 other microeconomic previous studies about FDI location in Spain like 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 if compared with their income. Therefore, only in the case of France for the two FDI variables and Italy and the UK for one of them, these variables are significant. The latter country is the largest EU investor abroad, specially in the US with a tradition of large MNCs, so that a complementarity relation may be capturing the intra-firm 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 expected due to some obstacles to investment like 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, due to the fact that market capitalization in Germany is comparatively small in relation to the country's economic size (Deutsche Bank, 1997).

- The rest of the *countries are outside the EU bloc* and, therefore, their strategies differ from the former. During the sample period, the Single Market was settled and EMU was launched. Thus, the US and Japanese outward investments are either defensive, in order to keep the markets where their affiliates were already located inside or, offensive in order to take advantage of the growing internal European market. However, the characteristics of Japan and the US in terms of size and location are very different. The US is an important host of market seeking FDI and, therefore, there is substitutability between trade and inward FDI. In contrast, Japan is a country whose domestic market has been traditionally 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 exports markets in order to avoid the trade barriers they normally faced. However, the inward cumulated flows do not present a significant relation with 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

In spite of the increasing interest in the impact of FDI on trade, the empirical evidence is rather scarce and far from being conclusive. The majority of the existing studies use cross-section data and the results can be different from those obtained with panel data. Static studies can be easily biased and therefore, it is a more useful tool an approach that can take account of 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.

Our paper sheds some light on the long-standing debate over the factors behind in trade performance of many OECD economies. The general approach adopted up to now by the econometric studies focused on aggregate trade has found structural changes linked to variations in income elasticities of demand over time but does not really explain the reason for those changes since they do not capture the impact of all relevant variables excluded (i. e. FDI stocks).

Our results, in general, would point to a complementary relationship between FDI and trade for the OECD area. These results agree with the predictions from capital-knowledge models, and therefore our findings are consistent with vertical FDI models, but also with models based on horizontal FDI under particular situations. 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, specially 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 non-negligeable 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, substantial theoretical results were confirmed by the estimations. The estimation results pointed, generally, at 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, inside a bloc, between relatively small open (and developed) economies, horizontal FDI is compatible with a tendency of increasing intra-industry trade (and to some extent intra-firm trade) due to product differentiation, that gives rise also to multi-plant firms and intra-industry two-way FDI. This last issue could be studied in the future along the lines proposed in Fukao, Ishido and Ito (2003).

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A Data sources.

The data in the paper is quarterly and covers 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 USA. The data has been obtained mainly from the magnetic data bases of the International Monetary Fund International Financial Statistics, the UNCTAD and the OECD.

$\boldsymbol{rmx}_t$: 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$, 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.

$\boldsymbol{ystar}_t$: real income of the OECD countries, base year 1990. Each country's income has been substracted from the total amount in order to avoid colinearity 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 decission.

$\boldsymbol{compe}_t$: 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, $pstar_t$, 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.

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

The competitors' price, $pstar_t$, 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 biggest exporters: the USA (15.54%), Canada (6.06%), Japan (14.22%), Belgium (5.1%), France (9.12%), Germany (18.1%), Italy (7.15%), Netherlands (5.7%), Spain (2.21%), Sweden (2.85%), Switzerland (2.8%), the UK (8.25%) and South Korea (2.9%). The data necessary to calculate the weights has 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.

$\boldsymbol{rmm}_t$: 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.

$\boldsymbol{yr}_t$: real income of the reporting country in dollars, calculated as the logarithm of each country's GDP in real terms (deflated using the GDP deflator).

$\boldsymbol{relpr}_t$: 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 $pstar_t$ as described above, because this variable was a proxy for world price of manufactures exports. For the domestic prices of competing goods we have chosen to use the wpi_t:

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

$\boldsymbol{insfdi}_t$: logarithm of the real stock of the inward foreign direct investment. The data on nominal stocks $(nsinfd_t)$ has been obtained from the UNCTAD FDI Statistics on Line (April 2002). Their sources are the IMF International Financial Statistics (IFS) and World Investment Report (UNCTAD), 2001. The real variables have been deflated using, for each country, the domestic prices of investment goods ($invp_t$):

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

Foreign direct investment 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 enterprsie 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% 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 among 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 non-resident direct investment in the reporting economy.

outsfdi$_t$: logarithm of the real stock of the outward direct investment. The nominal variable ($nsoutfdi_t$) has been also 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.

B Tables.

Table 1
Hadri (2000)
Panel Stationarity Tests
$l = 4$

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

Note: An asterisk denotes singificance at 5%. If this is the case, the null hypothesis of stationarity can be rejected.

Table 2
Homogeneous Panel Cointegration Tests
Kao (1999) DF and ADF Tests
Dependent variable: rmx_{it}

	With FDI		**Without FDI**	
	Test	**p-value**	**Test**	**p-value**
DF_ρ	-22.71**	0.000	-21.16**	0.000
DF_t	-6.35**	0.000	-5.69**	0.000
DF_ρ^*	-28.62**	0.000	-26.81**	0.000
DF_t^*	-6.65**	0.000	-6.02**	0.000
ADF	-2.37**	0.008	-2.66**	0.004

Note: the two asterisks denote rejection of the null hypothesis of non-cointegration at 5%. The tests statistics are distributed as $N(0,1)$.

Table 3
Homogeneous panel. Cointegration Results.
OLS and adjusted OLS estimates
Dependent variable: rmx_{it}

	OLS estimates		**Adjusted OLS estimates**	
Variables	**With FDI**	**Without FDI**	**With FDI**	**Without FDI**
$compe_{it}$	**-0.549**	**-0.545**	**-0.532**	**-0.524**
	(-9.15)	(-10.12)	(-8.13)	(-9.48)
y^*_{it}	**1.432**	**1.612**	**1.517**	**1.728**
	(4.86)	(15.88)	(4.06)	(6.47)
$insfdi_{it}$	-0.062	—	-0.068	—
	(-0.96)		(-1.02)	
$outsfdi_{it}$	**0.096**	—	0.099	—
	(1.90)		(1.42)	

Table 4
Individual and Panel
LM Cointegration tests 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: $rmx_{it} = \alpha_i + \beta_{1i} y^*_{it} + \beta_{2i} compe_{it}$

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

Notes:

(a) The tests and the models have been estimated using COINT 2.0. in GAUSS 3.2.4.

(b) The critical values at 1% (***), 5% (**) and 10% (*) 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
Panel Cointegration.
Individual DOLS parameters 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)
USA	**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:
(a) t-Students are reported in parentheses. Significant coefficients in bold. The intercepts have been excluded to gain in clarity.

Table 6
Homogeneous panel cointegration tests
Kao (1999) DF and ADF Tests
Dependent variable: rmm_{it}

	With FDI		**Without FDI**	
	Test	**p-value**	**Test**	**p-value**
DF_ρ	-9.53**	0.000	-13.10**	0.000
DF_t	-5.67**	0.000	-6.89**	0.000
DF_ρ^*	-20.85**	0.000	-27.11**	0.000
DF_t^*	-4.89**	0.000	-5.59**	0.000
ADF	-3.89**	0.000	-3.89**	0.000

Note: the two asterisks denote rejection of the null hypothesis of non-cointegration at 5%. The tests statistics are distributed as $N(0,1)$.

Table 7

Homogeneous panel. Cointegration results.
OLS and adjusted OLS Estimates
Dependent variable: rmm_{it}

	OLS estimates		**Adjusted OLS estimates**	
Variables	**With FDI**	**Without FDI**	**With FDI**	**Without FDI**
$relpr_{it}$	**-0.532**	**-1.105**	**-0.547**	**-1.174**
	(-20.59)	(-38.80)	(-9.31)	(-13.80)
yr_{it}	**0.904**	**1.870**	**0.910**	**1.9262**
	(27.65)	(84.76)	(21.29)	(37.97)
$insfdi_{it}$	**0.391**	—	**0.415**	—
	(21.83)		(12.61)	
$outsfdi_{it}$	**0.041**	—	0.026	—
	(3.11)		(0.90)	

Table 8
Individual and panel
LM Cointegration tests results.
1981:Q1-1998:Q3

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

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

Notes:

(a) The tests and the models have been estimated using COINT 2.0. in GAUSS 3.0.

(b) The critical values at 1% (***), 5% (**) and 10% (*) 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 9
Panel cointegration.
Individual DOLS parameter estimates
Dependent variable: rmm_{it}

	With FDI				**Without FDI**	
Country	*yr*	*relpr*	*insfdi*	*outsfdi*	*yr*	*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)
USA	**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:
(a) t-Students are reported in parentheses. Significant coefficients in bold. The intercepts have been excluded to gain in clarity.

Table 10
Summary table of the relationship between
real manufactures exports and imports and FDI

	Exports		**Imports**		
Countries	**In. FDI**	**Out. FDI**	**In. FDI**	**Out. FDI**	
Denmark	(+)	n.s.	(+)	(-)	
Finland	(+)	(-)	(+)	(+)	
Sweden	(+)	(+)	(+)	(+)	Small
Austria	(+)	(-)	(+)	(+)	EU
Netherlands	n.s.	(+)	(+)	(-)	Countries
Belgium	(-)	(+)	—	—	
Spain	(-)	(+)	(-)	(+)	
France	(+)	(-)	(+)	(-)	
Italy	n.s.	n.s.	(+)	n.s	Large
Germany	n.s.	n.s.	n.s.	n.s.	EU
UK	n.s.	(+)	n.s	(+)	Countries
USA	(-)	(+)	(-)	(-)	Third
Japan	n.s.	(-)	(+)	(+)	Countries

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 non-significant.