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The Spanish case**

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A multivariate cointegrated model testing for temporal causality between exports and outward FDI: The Spanish case

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Abstract: Historically, outward foreign direct investment has been contemplated as an alternative way of firms' internationalisation. In this line, a relational substitution between exports and foreign direct investment would be expected. However, this seems to contrast with recent developments in the "new trade theory" which show that the volume of trade and the emergence of multinational firms may be positively related one to the other. In this paper, we try to investigate if some empirical evidence exists either supporting a substitution or a complementary relationship between both forms of internationalisation. With this aim, we adopted an aggregate time series approach using quarterly aggregate data (seasonal adjusted) from the Spanish economy covering the period 1970(I)-1992(III). We employed a vector autoregressive model for both multivariate cointegration analysis and Granger temporal causality testing. The strength and direction of causal relationships are shown through the dynamic variance decomposition and the impulse response technique. Once controlling for relative market size and prices, our results provide evidence of a positive long-run Granger causality going from foreign direct investment to exports, although not in the opposite direction.

Key words: outward foreign direct investment, exports, multivariate cointegration, Granger causality.

JEL Classification: F10, F20, F21.

I INTRODUCTION

Over the past two decades, foreign direct investment (FDI) has been steadily gaining ground as a way of firms' internationalisation in most of the developed economies.¹ This growth has been particularly pronounced since the 1980's within the countries that belong to the European Common Market (ECM), coinciding with their complete liberalisation of trade and factor mobility. In this process, Spain has not been an exception.

Historically, Spain has mainly been considered a recipient country of FDI inflows, and only nearly the 1970's, FDI became an increasing form of the Spanish firms' internationalisation,² this rise being especially sharp since its inclusion in the ECM. In this sense, membership of the Common Market has meant not only a rise of the Spanish outward FDI but also a change in the aim sought by these investment flows. While cheap-factor seeking FDI has fallen its importance in relative terms, distribution foreign investment has become increasingly popular during this period.

Investing in other countries has important implications not only at a firm level but also at a macroeconomics level over both host and home economies. From an aggregate perspective, the effects of FDI have long been focused on activity level and employment. But a full assessment of the impact of FDI on the home country will critically depend on the nature of these investment projects, and more concretely on their connection with trade.³

In this line, exports and outward FDI have usually been treated as alternative modes of supplying foreign markets. From this point of view, FDI will represent a substitute for the home country's exports. Conversely, outward FDI by international firms that look

for better access to the final market will lead to a complementary relationship with exports in goods and services. These mixed assessments reflect the theoretical complexity of this issue, and suggest that the question of the relationship between outward foreign direct investment and exports is both a controversial point and an empirical problem.

In this paper, we focus on this relationship in respect to the Spanish economy. We will try to determine whether these foreign investment flows represent a substitution or a complement for exports in goods and services from the source country. The knowledge of this association will allow us to establish to some degree, the impact of foreign direct investment flows over domestic activity and employment level. In this sense, when both exports and FDI act as complements, foreign investment will probably constitute an improvement in the production capacity and some form of generation of employment in the domestic country. Conversely, when substituted, it will be difficult to believe that foreign direct investments had beneficial effects on domestic production and employment.⁴

Looking at the impact of FDI on goods trade will enable us to shed some light on the nature and the character of these investment flows too. So that, if FDI entails moving production capacity and employment toward other countries (motivated by lower transportation costs, avoidance of trade barriers, etc.), outward foreign direct investment will probably be accompanied by a lower export level from the home to the host country. This is in fact the traditional point of view about foreign investment that considers FDI in terms of capital factor mobility, and trade as perfect substitutes. Although in these perfect competition models there is no specific place for either intangible assets, multi-plant or multi-product production, whether horizontal or vertical.

Nevertheless foreign direct investment mainly represents the international activity of multinational firms that, in addition to the location advantages stressed in the traditional approach, possess some ownership advantages (such as, intangible assets, or “knowledge” capital), and tend to be important in industries characterised by some degree of scale economies and imperfect competition. From this perspective, the international investment flows might also be contemplated as a way to expand the domestic firm’s control over other markets, improving their access and sales facilities to them. Accordingly, outward FDI may eventually contribute to a greater level of exports from the home to the host country.

From an empirical point of view, and even though the issue of whether outward foreign direct investment and exports are substitutes or complements has been extensively analysed, the results are mixed. For instance, Lipsey and Weiss (1981, 1984) and Blomström et al. (1988) using disaggregating data by industry and countries show a positive relationship between foreign production by United States firms and US exports from the same industry to the area in which the production takes place. Similarly, complementary behaviour is displayed by Yamawaki (1991) for Japanese firms investing in the United States, or by Blomström et al. (1988) and Pfaffermayr (1996) for the Swedish and Austrian industries, respectively. However more recently, Svensson (1996) also taking into consideration the parent’s exports to countries other than where the affiliates are situated finds that the negative relationship between Swedish firms’ foreign production and home country’s exports is dominant⁵.

The differences in data and methodology make it difficult to directly compare these results and, even at a more aggregate level, the differences still remain.⁶ Thus, by using a causality analysis between the ratios of aggregate FDI and exports to the domestic GDP, Pfaffermayr (1994) reports a positive association for the Austrian economy,⁷

while Alguacil and Orts (1998) show a negative relationship for the Spanish case⁸. However, Bajo and Montero (1995) from the estimation of the Spanish export demand show a positive long-run relationship between the accumulated FDI flows (as a proxy of the aggregate foreign capital stock) and exports. Barrel and Pain (1997) find evidence of the opposite relationship for the German, British, French and Swedish cases. Although these findings are not truly contradictory, they suggest to go beyond in this study.

With this aim, in this paper we analyse the dynamic relationship between the Spanish outward foreign direct investment and exports, expressing both in real terms. To address this issue we use a time series approach covering the period 1970(I)-1992(III)⁹. We employ a multivariate cointegrated model to test for both the existence of long-run and short-run Granger causality between outward FDI and exports. Our results indicate that in addition to the negative short-run relationship previously found, there also exists a positive long-run causality going from foreign direct investment to exports.

The remaining paper is organised as follows. In Section II, we discuss the different theoretical arguments supporting either a relational substitution or complementarity between exports and foreign direct investment. Section III is concerned with econometric issues. The statistical results of the Granger causality analysis are shown here. A brief account of methodology is also provided in this section. Finally, in Section IV, we present some concluding remarks and further comments. Descriptions of the data and diagnostic tests are given in separate appendices.

II. WHAT DOES COMPLEMENTARITY OR SUBSTITUTABILITY BETWEEN OUTWARD FDI AND EXPORTS IMPLY?

In conventional neo-classical models, the pattern of trade is determined by factor prices divergence between countries, and the international goods exchange represents an indirect way of factor mobility.¹⁰ Strictly, within the Heckscher-Ohlin-Samuelson model framework, capital mobility only makes sense with the presence of obstacles to trade (such as tariff or NTB and/or transport costs). In this context, an increase in capital movements will discourage trade flows across countries. Furthermore, as mentioned by Mundell (1957), under certain assumptions, the substitution of goods trade for capital mobility will be complete.

But the above results critically rely on the presumptions made upon the sources of comparative advantages, and on the factor-price-equalisation result of the free trade in goods. Concretely, Markusen (1983) examines different situations with a non-factor-proportion basis for trade, in which capital movements and goods trade are complements.¹¹

In all these general equilibrium models, the capital mobility is conceived as a physical movement of resources, and there is no place for multinational enterprises. However, FDI mainly refers to the international expansion of multinational corporations. Actually, more than 95 per cent of the world-wide capital flows classified as foreign direct investment involve transactions between multinational firms.¹²

Moreover, in these traditional works, international transactions need not be undertaken by the multinational company in question, and hence it makes little sense to talk about internalisation advantages. Despite that, as stressed in the Dunning's OLI framework, they constitute a necessary condition for firms to engage in international activities.¹³

After all, multinational firms exist as long as it is more profitable to carry out this type of transactions within a firm rather than between firms.

In addition to the internalisation advantages, two further advantages are needed for foreign direct investment to occur: ownership and location. The ownership of certain knowledge-based, firm-specific inputs confers firms some monopolistic profits that provide compensation toward the extra cost of foreign investing, albeit the possession of these specific-inputs do not by itself lead to FDI. Some particular characteristics of the host country or, simply, the desire of reducing risks or uncertainty about local demand requirements make it preferable to place sale or production facilities in foreign locations rather than in domestic ones. In this sense, the avoidance of tariff or shipping costs, the presence of cheaper factor prices, or the possibility of obtaining information, and other location advantages provide the necessary incentives for firms to locate abroad.

The modern theory of multinational enterprise and FDI combines different approaches of ownership advantages and several types of location advantages. It also includes elements from the industrial organisation literature, recognising multi-plant, multi-product and multi-stage production, with either horizontally or vertically integrated firms, depending on cases.

In fact, when the firm involves several production plants situated in different locations but producing identical goods (horizontal direct investment), it seems reasonable to think of FDI supplanting exports in the country of origin. However, when the production process is carved up into separate stages in different countries (vertical foreign direct investment), the most likely relationship we expect to find is the complementary one, i.e. both FDI and exports rising simultaneously.

The increased degree of “multinationality” experienced recently in most developed countries seems to be closely related to the continuous development of new or

technically complex goods and production processes, as well as the rise of advertising or marketing activities.¹⁴ Actually, the multinational activity is carried out by firms with high levels of human capital resources and R&D activities, and consequently it is mainly concentrated in industries with high levels of “intangible” and knowledge-based assets.¹⁵

These firm-specific inputs confer the firm’s ownership advantages that have been treated within the theoretical models of trade and FDI from different, although not excluding, perspectives. Each of them provides not only a different explanation for the surge of the multinational enterprise but also, and what is more important to us, a different relationship between exports and FDI.

Many of these works, for instance, rely on the “public-good” nature of the firm-specific inputs to justify the emergence of the multinational, multi-plant firm. Insofar as these knowledge-base, firm-specific assets can be used in several plants, in different countries, with no productivity losses, the multi-plant production will arise as the optimal choice for the multinational enterprise. The horizontal expansion of the firms, in this case, rules out the duplication of the firm-specific costs, and it represents a technological gain in their production process.¹⁶

Particularly, if the firm-specific costs are large relative to plant-specific costs, the multi-plant production dominates, and a negative relationship between exports and FDI arises. Moreover, locational considerations based on the tariff-jumping approach (transport costs, tariffs or NTB’s barriers) reinforce this negative relationship. The “public-good” aspect of the firm-specific inputs plays a crucial role in explaining the dominance of the two-plant multinational firms, against one-plant national firms in the works of Ethier and Horn (1990), Horstmann and Markusen (1992), Brainard (1993a, 1997), Markusen (1995) and Markusen and Venables (1996, 1998).

The services of firm-specific assets have also been considered as an essential stage in the production process that need not be situated within the production plant. Concretely, these corporate inputs may be used in a country different to the country where they are produced and placed. The possibility of geographically separating the corporate and the production activities, as well as their different factor intensities, provide arguments in favour of the vertical disintegration of the multinational corporation in Markusen (1984), Helpman (1984) and Helpman and Krugman (1985).

From this point of view, the multinational enterprise will optimally decide to internationally spread its production process in different stages attending production factor requirements. By doing this, firms attend to internalise the location advantages that stem from the presence of factor rewards divergences among countries. Usually, those activities that provide ownership advantages, and that are subject to increasing returns (such as, management, marketing and R&D activities) will be concentrated in the parent firm's country, whilst those concerned with production activities will be located in third countries (concretely, in those countries relatively well endowed with the factor used intensively in these production stages).

Consequently, the location advantages, in terms of factor proportions, plus the possibility of employing domestic "intangible" inputs in foreign production plants, and the prevalence of the plant-specific costs, will lead to a world economy dominated by vertically integrated multinationals, with parent firms importing final goods from their foreign affiliates while exporting headquarters services to them, giving rise to the possibility of a complementary relationship between FDI and exports. Additional stages in the production and distribution processes strengthen the feasibility of intra-firm or intra-industry trade in intermediate or final goods, and thus reinforce the complementary relationship aforementioned [Helpman (1984), Helpman and Krugman (1985),

Grossman and Helpman (1989), Ethier and Horn (1990), Brainard (1993b)].

Obviously, when the multinational activity of the firm mainly consists in establishing sale and/or distribution affiliates, instead of production foreign plants, with the purpose of increasing market shares in local countries, the complementarity between FDI and exports will be almost ensured. In this case, the location advantage arises from the possibility of providing distribution mechanisms and customer services that will promote exports and sales in those final markets (Bergsten et al. 1978).¹⁷

III TIME SERIES ANALYSIS OF OUTWARD FOREIGN DIRECT INVESTMENT AND EXPORTS

As pointed out above, it is possible to conceive situations in which FDI acts either as a complement or as a substitute to exports. To empirically overcome this controversial issue, we follow Sims' (1980) suggestion, and formulate a vector autoregressive (VAR) system, where *a priori* restrictions nor the endogenous or exogenous character of variables are established at a first stage¹⁸. The Granger's concept of causality is then used to investigate the temporal relationship between outward foreign direct investment and exports.¹⁹

In this work, we employ aggregate data of foreign direct investment and exports from the Spanish economy, in real terms, covering the period 1970(I)-1992(III)²⁰. To account for potential income and price effects, we include further the real OECD GDP²¹, the real Spanish GDP and the Spanish peseta to US dollar real exchange rate as additional variables.²² By doing this, we try to avoid the possibility of spurious associations as a consequence of variations in these common determinants.

The importance of all these variables on exports has been broadly treated in trade literature²³. In this way, we will expect that a real exchange rate depreciation implies an

advantage for goods produced at home. Similarly, it is also expected that a growth in foreign income conveys to a greater level of domestic goods sales toward these foreign countries. In contrast, a rise in the own country's demand will probably exert a negative impact over exports, given the existence of an anti-cyclical component in exports.

However, the influence of all these variables over foreign direct investment appears to be slightly less obvious. In this sense, if a greater foreign demand can certainly be perceived as an indicator of higher expected profits for these investment flows, the effect of an increase in the domestic income over FDI is not so clear, and it depends on whether supply or demand considerations prevails. On the other hand, the role of the real exchange rate as a determinant of FDI has also been a question. The permanent character of the foreign investment projects makes it difficult to think in definite effects evolving from the short-term movements of the real exchange rate. But, despite that in effect, variations in the exchange rate cannot affect the decision itself, it might alter the timing and the desire level of these investment flows.²⁴

In accordance with the above arguments, we start by considering a five-variable vector autoregressive model comprised of outward foreign direct investment (*fdi*), exports (*exp*), domestic income (*gdp*), foreign income (*oecd*), and real exchange rate (*rer*), all of them expressed in natural logs. As showed below in Model (1), all variables are symmetrically and endogenously considered at first.²⁵

$$\begin{bmatrix} fdi_t \\ exp_t \\ gdp_t \\ oecd_t \\ rer_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} fdi_{t-1} \\ exp_{t-1} \\ gdp_{t-1} \\ oecd_{t-1} \\ rer_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} fdi_{t-2} \\ exp_{t-2} \\ gdp_{t-2} \\ oecd_{t-2} \\ rer_{t-2} \end{bmatrix} + \dots + A_s \begin{bmatrix} fdi_{t-s} \\ exp_{t-s} \\ gdp_{t-s} \\ oecd_{t-s} \\ rer_{t-s} \end{bmatrix} + u_t \quad (1)$$

where A_0 is a vector of constant terms and A_i are all matrices of parameters, and $u_t \sim IN(0, \Sigma)$.

To analyse the causal relationship we need first to solve two main problems. Firstly, to determine the optimal lag length in the autoregressive model. Secondly, to identify the possible long-run relationships among the variables included in the system. In absence of a cointegration vector, with $I(1)$ series, valid results in Granger causality testing are obtained by simply first differentiate the VAR model. By ensuring the stationarity of all series in the dynamic model, we rule out the possibility of “spurious regression” results, as the type mentioned by Granger and Newbold (1974)²⁶. With cointegrated variables, Granger causality will further require inclusion of an error correction mechanism (ECM) in the stationary model in order to capture the short-run deviations of series from their long-run equilibrium path.²⁷ Moreover, taking into account that the ECM term variables share a common trend, we cannot ignore this new channel of causality (even though this fact moves away from the standard Granger test of causality).²⁸ Actually, the evidence of cointegration between variables rules out the possibility of Granger non causality, albeit it does not say anything about the direction of this causal relationship. The application of a vector error correction model (VECM), in this case, will allow the revelation of the direction of the causality, as well as distinguishing between the short-run and the long-run Granger causality.

In selecting the number of lag to be included in the model we consider two opposing issues. On one hand, we know that too short lag length might produce serially correlated errors. On the other hand, a highly overparameterised model could induce insignificant and inefficient parameters.²⁹ To overcome this problem, we followed the procedure suggested by Hendry and Mizon (1993) and Hendry and Doornik (1994), and sequentially looked at the statistical significance of the different lags by a joint F test statistic. Starting with a length of six we stop reducing the model conditional on the absence of significance of the last lag considered.³⁰ Once the optimum lag length was

found and the congruency of the VAR was duly examined, we tested for both multivariate cointegration and weak exogeneity of the variables embodied in the model by using Johansen's (1988) and Johansen and Juselius's (1992) technique.

Finally, in addition to short- and long-run causality testing by the traditional Wald and t tests, we employed the impulse response analysis described by Sims (1988) in an attempt to analyse the dynamic properties of the model following certain shocks. Thus, the variance decomposition and the plots of impulse response completed the causal analysis between outward foreign direct investment and exports in this work.

Empirical Results

With respect to the order of the VAR model, we opted for a system with a lag length of five, i.e. a VAR(5) model. As shown in Table 1, lag 6 of all variables are insignificantly different from zero in the five equations. The fifth-period lag however appears to be significant at 1 per cent, at least in one equation, *gdp* equation, and at 5 per cent in the overall system. Moreover, in contrast with the six-lag version of the model, in this five-lag system no evidence of serially correlated residuals exists and no evidence of structural breaks is found after the impulse dummies for outliers are accounted for.³¹

Table 1: Model selection

Statistic	d.o.f.	Equation					VAR
		<i>fdi</i>	<i>exp</i>	<i>rer</i>	<i>oecd</i>	<i>gdp</i>	
Lag-length = 6							
$F_{s=6}$	(5,52)	1.73	0.53	0.24	0.82	1.98	-
	(25,179)	-	-	-	-	-	0.94
$F_{ar\ 1-5}^V(125,118) = 1.374^b$							
Lag-length = 5							
$F_{s=5}$	(5,57)	0.81	1.76	0.24	1.51	3.58 ^a	-
	(25,198)	-	-	-	-	-	1.79 ^b
$F_{ar\ 1-5}^V(125,147) = 1.294$							

Note: The uppercases “a” and “b” reject the null hypothesis of zero restriction at 1 per cent and 5 per cent significance level, respectively. *s* denotes both the order of the VAR and the lag analysed. Figures in parenthesis are degree of freedom (d.o.f.). $F_{ar\ 1-5}^V$ gives us information about the system test for no serial correlation (fifth order). See Doornik and Hendry (1994).

We proceed next to investigate the cointegration properties of the system. But prior to the identification of possible long-run relations, we need to verify that all variables are integrated of order one in levels, since this is a necessary, although not sufficient, condition for cointegration. For this purpose, we used both the Augmented Dickey Fuller (1979, 1981), and Phillips and Perron (1988) tests of unit root. On the basis of the results shown in Table 2, the null hypothesis of nonstationarity cannot be rejected for all variables considered in their levels. Following the Dickey and Pantula (1987) approach, we then tested for higher orders of integration excluding the possibility of I(2) series. The results of the unit root tests on the differentiated variables (denoted with Δ) suggest a stationary behaviour for Δfdi , Δexp , Δgdp , $\Delta oecd$, and Δrer . The null hypothesis of integrated of order one is clearly rejected in all these first differentiated series, indicating that they have a unit root in their levels.

Table 2: Tests of the unit root hypothesis

	Aug Dickey-Fuller statistic					Phillips-Perron statistic				
	τ_τ	ϕ_3	τ_μ	ϕ_1	τ	$Z(t_{\tilde{\alpha}})$	$Z(\phi_3)$	$Z(t_{\alpha^-})$	$Z(\phi_1)$	$Z(t_{\alpha})$
	(1)		(2)		(3)	(1)		(2)		(3)
Levels										
<i>fdi</i>	-2.69	4.04	-2.01	3.18	0.91	-7.89	31.34	-3.40	10.07	-0.43
<i>exp</i>	-4.13	8.76	-1.00	3.74	2.44	-3.03	45.9	-1.59	22.9	6.32
<i>gdp</i>	-3.82	8.16	-2.03	3.13	1.31	-1.89	2.45	-1.49	19.4	5.62
<i>oeecd</i>	-3.96	8.38	-1.21	5.12	2.83	-2.59	154.	-1.34	33.8	7.85
<i>rer</i>	-1.84	1.72	-1.51	1.80	-1.21	-1.53	1.18	-1.24	0.95	-1.46
First differences										
Δfdi	-5.10	13.3	-5.13	13.2	-4.94	-22.5	253.	-22.6	369.	-22.4
Δexp	-4.03	8.41	-4.11	8.59	-2.59	-3.63	6.38	-3.56	6.92	-2.31
Δgdp	-2.69	3.61	-2.65	3.89	-2.22	-2.89	4.57	-2.68	2.41	-1.73
$\Delta oeecd$	-3.98	7.93	-3.86	7.45	-1.84	-8.30	34.6	-8.22	19.4	-4.75
Δrer	-3.03	4.67	-3.06	4.71	-2.88	-5.99	18.0	-6.03	14.93	-5.85
Critical values										
Sig Level										
1%	-4.04	8.73	-3.51	6.70	-2.60	-4.04	8.73	-3.51	6.70	-2.60
5%	-3.45	6.49	-2.89	4.71	-1.95	-3.45	6.49	-2.89	4.71	-1.95

Notes: (1), (2) and (3) indicate the model statistics with drift and trend, with drift, and without either drift or trend, respectively. The optimal lag used for the Augmented Dickey-Fuller tests and the truncation lag parameter used for Phillips-Perron tests was selecting using the formula $m = \text{ent}[4(T/100)^{1/4}]$ suggested in Schwert (1989). Critical values, for $n = 100$, can be found in Fuller (1976) and Dickey and Fuller (1981). All data used are available on request from the authors.

In Table 3, we report the results of Johansen's maximum eigenvalue test ($\lambda_{\max}$) and trace test (λ_{trace}) for the presence of long-run relationships. Results in this table suggest that is possible to accept the hypothesis that a single cointegrating vector is present in our model, since the null that $r = 0$ (or alternatively $n - r = 5$) is rejected but the null that $r = 1$ (or alternatively $n - r = 4$) is not rejected.³² Consequently, following the Granger Representation Theorem, we add an ECM in each equation of the first differentiated VAR model. So that, it would be possible, in what follows, to separate the long-run relationship between the economic variables from their short-run responses.³³

Table 3: Johansen's test for multiple cointegration

Statistic/ $H_0: r$	$n - r$	Model 1	$\lambda(0.95)$	Model 2	$\lambda(0.95)$	Model 3	$\lambda(0.95)$
$\lambda_{\max}$							
0	5	58.11	34.4	57.42	33.5	67.64	37.5
1	4	24.48*	28.1	24.33	27.1	27.42	31.5
2	3	13.58	22.0	11.18	21.0	17.27	25.5
3	2	9.04	15.7	6.57	14.1	10.78	19.0
4	1	6.57	9.2	1.77	3.8	5.70	12.3
λ_{trace}							
0	5	111.8	76.1	101.3	68.5	128.8	87.3
1	4	53.68	53.1	43.87*	47.2	61.18	63.0
2	3	29.19	34.9	19.53	29.7	33.75	42.4
3	2	15.62	20.0	8.35	15.4	16.48	25.3
4	1	6.57	9.2	1.77	3.8	5.70	12.3

Notes: r indicates the number of cointegrating vectors under the null hypothesis. $n-r$ indicates the number of unit roots in the system. See Johansen (1988) and Osterwald-Lenum (1992) for critical values [$\lambda(0.95)$]. Model 1 represents the model with no linear trends in the levels of the data. Model 2 and Model 3 denote the model with linear and quadratic trends in the levels of the data, respectively. The impulse dummies variables D90 and D92 are unrestrictedly entered in all three models. * denotes the first time the null is not rejected.

To determine whether each variable enters in the cointegrating space, we then tested the significance of *fdi*, *exp*, *gdp*, *oecd* and *rer* within the equilibrium relationship by a χ^2 -statistic test. On the basis of the figures presented as Table 4, no variable can be excluded from the cointegrating vector. The chi-square statistics reject the null of exclusion in all cases analysed. In this table, we report results for the unconditional model, as well as for the model conditioned to the exogeneity of *rer* and *oecd* (conditional model), given that the values of the χ^2 test of zero restrictions on the adjustment of each variable to disequilibrium vector support that both *rer* and *oecd* could be considered weakly exogenous.³⁴ Moreover, the results of the conditional model enable jointly to test restrictions both on the cointegration space and the speed-of-adjustment parameters, and to derive the corresponding cointegration vector.

Table 4: Testing restrictions on cointegrating vector and weak exogeneity

χ^2 Test of restrictions				
$fdi = 0$	$exp = 0$	$gdp = 0$	$oecd = 0$	$rer = 0$
Unconditional Model				
3.05 ^b	32.21 ^a	7.53 ^a	32.64 ^a	22.90 ^a
Conditional Model				
8.95 ^a	32.29 ^a	13.18 ^a	32.64 ^a	27.27 ^a

COINTEGRATION VECTOR:

$$(exp - 0.0657 fdi - 0.2087 rer + 0.8210 gdp - 2.484 oecd)$$

Notes: The uppercases “a” and “b” indicate significance at the 5% and 10%, respectively. The chi-squared statistic with one degrees of freedom is used to test the restriction that each of the variables in the cointegration vector is statistically equal to zero (unconditional model) and with three degrees of freedom, to test for both the weak exogeneity of *rer* and *oecd* and the respective restriction on the cointegrating vector (conditional model).

Looking at the cointegration vector (Table 4, bottom section), and more concretely at the different signs and values of the parameters, we find that this long-run relationship largely agrees with those previously presented in the empirical literature concerning the Spanish demand for exports³⁵. However, unlike previous works, in the present paper the outflows of FDI are considered a positive long-run determinant for exports, with a significant, although small, impact.

Despite, in effect, the results of the cointegration analysis demonstrates that all these five variables are tied together by a long-run equilibrium relationship, it does not say anything about the direction of the Granger causality, which will be done by the analysis of results based on the VECM. Following Johansen and Juselius (1990) work, and according to the results previously obtained in model selection and cointegration analysis, the corresponding vector error-correction model can be now written as follows:

$$\begin{aligned}
\Delta fdi_t &= \alpha_{10} + \sum_{s=1}^4 \alpha_{11}(s) \Delta fdi_{t-s} + \sum_{s=1}^4 \alpha_{12}(s) \Delta exp_{t-s} + \sum_{s=1}^4 \alpha_{13}(s) \Delta gdp_{t-s} + \sum_{s=0}^4 \alpha_{14}(s) \Delta oecd_{t-s} \\
&\quad + \sum_{s=0}^4 \alpha_{15}(\alpha) \Delta rer_{t-s} + \gamma_1 ECM_{t-1} + \varepsilon_{1t} \\
\Delta exp_t &= \alpha_{20} + \sum_{s=1}^4 \alpha_{21}(s) \Delta fdi_{t-s} + \sum_{s=1}^4 \alpha_{22}(s) \Delta exp_{t-s} + \sum_{s=1}^4 \alpha_{23}(s) \Delta gdp_{t-s} + \sum_{s=0}^4 \alpha_{24}(s) \Delta oecd_{t-s} \\
&\quad + \sum_{s=0}^4 \alpha_{25}(\alpha) \Delta rer_{t-s} + \gamma_2 ECM_{t-1} + \varepsilon_{2t} \\
\Delta gdp_t &= \alpha_{30} + \sum_{s=1}^4 \alpha_{31}(s) \Delta fdi_{t-s} + \sum_{s=1}^4 \alpha_{32}(s) \Delta exp_{t-s} + \sum_{s=1}^4 \alpha_{33}(s) \Delta gdp_{t-s} + \sum_{s=0}^4 \alpha_{34}(s) \Delta oecd_{t-s} \\
&\quad + \sum_{s=0}^4 \alpha_{35}(\alpha) \Delta rer_{t-s} + \gamma_3 ECM_{t-1} + \varepsilon_{3t}
\end{aligned} \tag{2}$$

where α_{ij}, γ_i ($i = 1, 2, 3$ and $j = 1, 2, 3, 4, 5$) are all parameters and ε_i ($i = 1, 2, 3$) are white noise disturbances.

Accepting that the model is correctly specified,³⁶ we next focus on temporal Granger non causality testing. With an ECM term in the model, Granger non causality will imply both neither short- nor long-run causality between variables (Engle and Granger, 1987). Taking this view, causality can be derived through: a) the χ^2 -test of the joint significance of lags of other variables (Wald test), and b) the significance of the lagged ECM (t -test). The non significance of both t -test(s) as well as the χ^2 test in the VECM indicates econometric exogeneity of the dependent variables. Table 5 presents the results of temporal Granger causality testing. Since we are especially concerned with the relationship between fdi and exp , we report only the results for these two equations, although the outcomes showed have been obtained by jointly estimating with gdp .³⁷

Table 5: Temporal Granger-causality tests on VECM

Source of causation												ECM	
Δfdi		Δexp		Short run Δgdp		$\Delta oecd$		Δrer				ε_{t-1}	
Full model													
	$\chi^2(4)$	$\Sigma_{coeff.}$	$\chi^2(4)$	$\Sigma_{coeff.}$	$\chi^2(4)$	$\Sigma_{coeff.}$	$\chi^2(5)$	$\Sigma_{coeff.}$	$\chi^2(5)$	$\Sigma_{coeff.}$	t	Coeff.	
Δfdi	-	-	2.29	3.53	5.09	15.4	9.47 ^c	-17.6	2.25	0.39	0.09	0.16	
Δexp	11.3 ^b	-0.02	-	-	8.61 ^c	-0.01	13.5 ^b	-0.14	16.4 ^a	-0.03	-4.76 ^a	-0.13	
Parsimonious model													
	$\chi^2(2)$	$\Sigma_{coeff.}$	$\chi^2(2)$	$\Sigma_{coeff.}$	$\chi^2(1)$	$\Sigma_{coeff.}$	$\chi^2(2)$	$\Sigma_{coeff.}$	$\chi^2(1)$	$\Sigma_{coeff.}$	t	Coeff.	
Δfdi	-	-	0.32	1.68	2.52	13.1	4.58 ^b	-6.83	0.12	0.43	0.37	0.55	
Δexp	8.34 ^a	-0.01	-	-	2.29	-0.21	8.39 ^b	-0.01	7.26 ^a	-0.06	-5.74 ^a	-0.14	

Notes: The uppercases “a”, “b” and “c” denote significance at the 1%, 5% and 10%, respectively.

As far as the short-run Granger causality is concerned, the data show the presence of a short-run causal relationship going from *fdi*, *oecd* and *rer* to exports (as reflected in the significance, at 5 per cent, of the χ^2 -test of the lags of the differentiated variables). However, with respect to the outward foreign direct investment equation, we find that foreign income (*oecd*) appears to be the only significant determinant (at 10 per cent, in the full model, and at 5 per cent, in the parsimonious model) in explaining the variations of this variable in the short run. Neither *exp*, *gdp* nor *rer* seems to play a significant role in explaining the dynamic behaviour of *fdi*.

Focusing on the long-run causality, the results based on this table show that changes in exports are a function of the level of disequilibrium in the cointegrating relationship. This is not so for variations in foreign direct investment instead. That is, if the ECM is, in effect, statistically significant in the export equation, it appear not significant in the foreign direct investment equation, indicating that *fdi* may be considered here as an

exogenous variable. The ECM enters the *exp* equation with a coefficient of -0.13 and a highly significant *t*-statistic of -4.76 . This means that when exports exceed their long-run relationship with respect to relative price, foreign and domestic demand and foreign direct investment, they adjust downwards.³⁸ Note that the conditioned estimates of the ECM are those reported in Table 4 (bottom section).

These findings confirm the existence of a causal relationship running from *fdi* to *exp*, whereas no evidence of either short-run or long-run causality from exports to *fdi* exists.³⁹ Moreover, similar outcomes are obtained when insignificant lags are purged out of the full model to produce a parsimonious VAR representation.⁴⁰ We should however highlight that the impact of a change in foreign direct investment on export in the short run is negative (as indicated by the sum of coefficients of the lagged Δfdi) as opposed to its positive effect in the long run (as showed in the cointegrating vector).

Thus, for a more complete study of the causal relationship in a multivariate framework it is useful to examine the post-sample effects of shocks to the variables in the system.⁴¹ To analyse the dynamic properties of the model, when the cointegration relationship is also interacting among the variables, we estimated the impulse response functions and the variance decomposition of the different variables by solving back to the model in levels from the final VECM estimates. Having done this, the impulse response functions told us the response paths (beyond the sample period) of each variable to shocks in the others, also taking into account the short-run adjustment to long-run disequilibrium in the dependent variable.⁴² The variance decomposition technique provides, on the other hand, information about how rapidly this response occurs.

The responses of exports to shocks in *fdi* and *gdp* are presented in Figure 1. This plot indicates a positive effect of an exogenous increase in *fdi* on exports. As a consequence of a shock in *fdi*, exports increase sharply after two periods, keeping the long-run

equilibrium from the eighth quarter on. This largely agrees with our previous outcome in the ECM estimate, where the long-run positive relationship between exports and FDI dominated. Moreover, looking at this graph, it seems that the negative influence of the domestic income over exports is also confirmed. Note that the response of *exp* to shocks in *gdp* is negative after a four-quarter period.

Figure 1: Impulse Response of *exp* to One Standard Deviation Shock in:

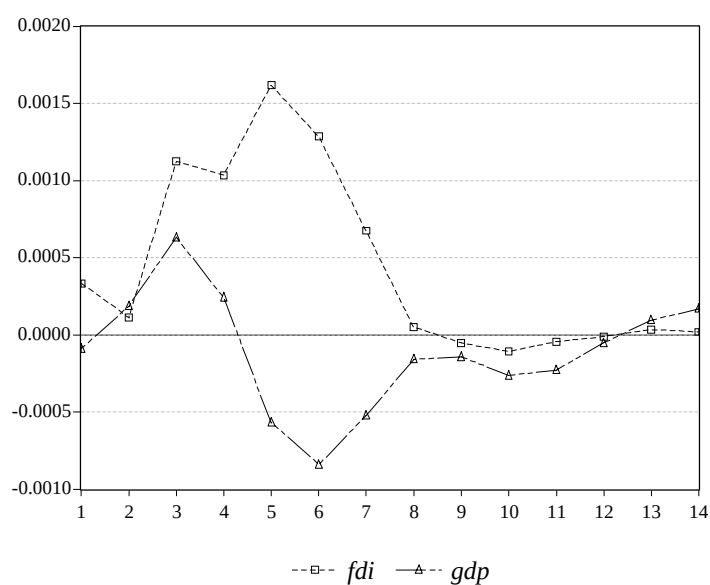


Figure 2: Impulse Response of fdi to One Standard Deviation Shock in:

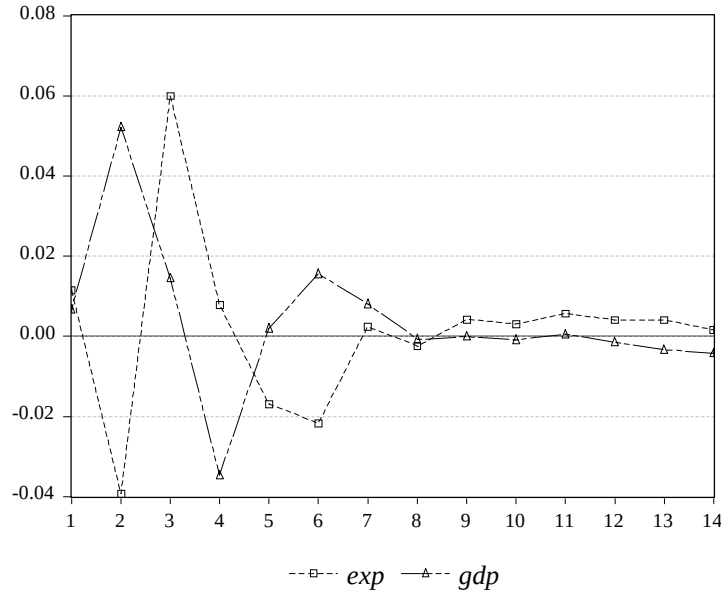


Figure 2 shows the response paths of fdi of a surprise increase in exports and in domestic income. A graphical examination of plotting the dynamic behaviour of fdi reflects lower sustained effects of this variable to shocks in the system. Foreign direct investment responds negatively in the initial periods after a shock in exports occurs, but then responds positively and negatively to go back to its pre-shock level eventually. On the other hand, increases in the gdp series seem to play a positive influence over fdi in the initial moment, to fall down after a period of three quarters. Afterwards, foreign direct investment increases and then declines to return to its long-run level.

In addition to the impulse response analysis the variance decomposition is put to use for the investigation of the quantitative impact of fdi on exp , and vice versa. With the variance decomposition we examine how much of the variability of one variable at time t is due to an innovation in itself or in any other variable. Since the results of these decompositions are sensitive to the relative ordering of variables, we report results for (i) exp, fdi, gdp order, and (ii) fdi, exp, gdp order.

Table 6: Variance Decomposition

		Percentage of forecast variance explained by innovations in:						
		Ordering: (i)			Ordering: (ii)			
t	σ	exp	fdi	gdp	fdi	exp	gdp	
Variance								
Decomposition of:								
exp	1	0.007	100.0	0.00	0.00	0.25	99.75	0.00
	4	0.035	99.37	0.59	0.04	0.13	99.83	0.04
	8	0.059	96.07	3.85	0.08	2.38	97.54	0.08
	12	0.076	94.17	5.65	0.19	3.74	96.06	0.19
	16	0.089	93.19	6.53	0.28	4.43	95.30	0.28
fdi	1	0.370	0.25	99.75	0.00	100.0	0.00	0.00
	4	0.388	1.65	92.44	5.90	92.81	1.29	5.90
	8	0.406	2.87	85.41	11.71	85.81	2.49	11.71
	12	0.426	2.77	77.83	19.39	78.18	2.43	19.39
	16	0.443	3.62	72.04	24.33	72.36	3.31	24.33

Notes: Figures in the last six columns refer to the variance decomposition of an orthogonal one standard deviation shock. t indicates the forecast horizon in quarters. σ denotes the forecast variance.

The results reported in Table 6 show the presence of a relatively rapid adjustment going from *fdi* to *exp*. The forecast error variance one period ahead is completely explained by movements in themselves [(i) order], but after two years approximately 4% of the shock in exports is explained by innovations in *fdi*. After a four-year period (16 quarters) this percentage has increased by up to 6.5%. Less than 1% of the forecast error variance of *exp* is however due to changes in *gdp*. On the other hand, as the findings based on the VECM estimate, exports do not appear to play a significant role in explaining the variance of *fdi*. After a two-year horizon the quantitative impact of a variation in *exp* are approximately 2.5% [(ii) order]. Two years later these percentages move up to 3.3%. Finally, although the within-sample results show that this variable is relatively unexplained by domestic income, the post-sample dynamic variance decomposition shows, however, that a substantial part of the variance of the forecast error of *fdi* is explained by *gdp*. Alternative ordering does not seem to significantly change these results.

IV CONCLUDING REMARKS

From a theoretical perspective, foreign direct investment and trade may be substitutes or complements. But, although the interdependence between both forms of firms' internationalisation has been, in effect, broadly documented in the trade theory, we cannot establish how they are related by simply looking at theoretical grounds. In this sense, according to the traditional models of trade foreign direct investment and exports may be conceived as perfect substitutes. Nevertheless, this contrast with more recent developments in the theory of trade and in the industrial organisation, which show that the volume of trade and the emergence of multinational firms may be both positively or negatively related. Moreover, in these recent models the location and the ownership advantages that justify both the emergence of multinational firms and the different types of expansion that take place within firms play an important role.

From this perspective, when foreign production results in a horizontal expansion of multinational firms, where the affiliates tend to replicate the parent's production activity, FDI will act as a substitute for trade in goods and services. But the pattern of these horizontal investment flows appear to be contrary to decisions of vertical expansion within the multinational enterprise, or to decisions of establishing distributional assets in local markets. Thus, firms may find it profitable to internationally spread different stages of their production or distribution processes, with the end of better fitting factor requirements with country's resources, or with the purpose of establishing distributional networks to attend demand requirements and increase market share.

Empirical evidence analysing the simultaneous relationship between foreign direct investment and exports is also mixed. Results are different depending not only on countries and time period considered, but also on methodology and data employed.

Whether the ratio of FDI and exports to the GDP or the levels of variables in real terms are considered, or whether aggregate or sectoral analysis is made might yield different results. By taking this view, the findings obtained of this work are not directly comparable to those of our earlier study. While in Alguacil and Orts (1998) we use the ratio between exports to the Spanish GDP, in the current paper the absolute value of this variable is employed instead. Thus the positive effect of FDI over domestic GDP, increasing the denominator of our initial dependent variable, is removed here. Actually, this might be the reason of the negative relationship found previously.⁴³

In the present work, we studied the temporal Granger causality between real exports and outflows of foreign direct investments in Spain, covering the period 1970(I)-1992(III). As is well known, the reliability of the causality test will depend on the correct specification of the model, and particularly on the inclusion of variables for common determinants, as well as on the presence of possible long-run relationships among them. To control for the effects of market size, pressure of domestic demand, and relative prices over exports and FDI in Spain, the Spanish GDP, the OECD GDP and the real exchange rate have been included in the model. On the other hand, it has also been possible to identify a long-run relationship, proceeding then to add the correspondent ECM in the system. In fact, in this long-run relationship we could easily recognise an amplified demand function for exports, in which not only relative prices, domestic and foreign activity levels appear to be significant and with the expected values, but also FDI outflows are positively related with exports in the long run.

On the basis of the VECM estimate and the impulse response analysis, we can say that a complementary relationship between exports and outward FDI in Spain exists. Despite having detected a short run negative impact, the positive long-run causal relationship, going from the outflows of foreign investment to exports, more than off sets this initial

effect. This outcome seems to agree more with the view of multinational firms searching favourable factor return conditions or investing in sale or distributional facilities than with a tariff-jumping approach. Moreover, this finding is coherent with the destination of our foreign investment flows, mainly the OECD area, and with the increasing importance of the investments in distribution channels within the overall Spanish FDI activity.

Finally, it is important to note that the complementarity between outward FDI and exports (in addition to the positive relationship found between FDI and the Spanish GDP) makes it difficult to believe in negative impacts of these investment projects over the domestic production activity, employment level and/or the quality of jobs. Although it is also probably true that a new analysis comprising of more disaggregating data will reveal different behaviours among several industries and firms.

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APPENDIX A: DIAGNOSTIC TESTS

Table A.1: Diagnostic tests of the VECM

	Statistic	Δfdi	Δexp	Δgdp	VECM
<i>Autocorrelation:</i>					
Lag 1-5	$F_{ar}(5,55)$	0.85	0.33	0.99	-
	$F_{ar\ 1-5}^V(45,128)$	-	-	-	1.00
<i>Heteroscedasticity:</i>					
ARCH(4)	$F_{arch}(4,52)$	0.26	0.77	1.10	-
White	$F_{het}(48,11)$	0.34	0.29	0.37	-
	$F_{het}^V(288,44)$	-	-	-	0.22
<i>Normality:</i>					
	$\chi_{nd}^2(2)$	1.24	0.74	3.22	-
	$\chi_{nd}^{2V}(6)$	-	-	-	6.40

Notes: Figures in parenthesis are degree of freedom. $F_{ar\ 1-5}$, F_{arch} , F_{het} , χ_{nd}^2 denote single-equation evaluation statistics for no correlation (fifth order), no ARCH (fourth order), no heteroscedasticity [White (1980)] and normality. Similar tests are performed for the system (denoted by ^V). See Doornik and Hendry (1994).

APPENDIX B: DESCRIPTIONS OF THE DATA

The data definitions used in our study are the following:

- *Foreign direct investments (FDI_t)*: they represent the gross payment for Spanish investments abroad, net of disinvestment in real terms using the Spanish GFCF (Gross Fixed Capital Formation) deflator computed by the authors. Data of foreign direct investments have been obtained from the *Banco de España* (Bank of Spain) and are expressed in billion Spanish pesetas. Information about GFCF in real and nominal terms used to calculate the GFCF deflator comes from the *Instituto Nacional de Estadística* (hereafter, INE).
- *Exports (EXP_t)*: Spanish exports of goods and services in billion Spanish pesetas of 1986. Source: INE.
- *Spanish Gross Domestic Product (GDP_t)*: is the volume index of the Spanish Gross Domestic Product, obtained from Main Economic Indicators, OECD Statistics. 1986 = 100.
- *OECD Gross Domestic Product ($OECD_t$)*: is the volume index of the OECD GDP. Source: Main Economic Indicators, OECD Statistics. 1986 = 100.
- *Real Exchange Rate (RER_t)*: Spanish peseta-dollar real exchange rate. To calculate this ratio the following procedure has been employed: $RER_t = NER_t * (USCPI_t / SPCPI_t)$, where NER_t represents the Spanish peseta-dollar nominal exchange rate (source: Bank of Spain), $USCPI_t$ is the USA Consumer Price Index (source: Main Economic Indicators, OECD Statistics), and $SPCPI_t$ is the Spanish Consumer Price Index (source:

INE).

All the series used are quarterly and seasonally adjusted, and all the variables employed in regressions are expressed in natural logs (small letters). The sample range for all series is 1970(I)-1992(III).

FOOTNOTES

¹ See Graham and Krugman (1993) and Markusen and Venables (1998).

² In fact, it was in the early 70's when manufacturing FDI, based mainly on ownership advantage, started to be significant in this country. The percentage of Spanish manufacturing FDI over the total FDI climbed from 20 in the early 1970's to 40 by the mid-1970 (see Campa and Guillén, 1996).

³ A survey of these kind of effects can be found in Graham (1995).

⁴ Foreign direct investment is said to be a substitute (complement) for exports if an exogenous increase in FDI produces a decrease (increase) in exports from this country, or vice versa, a decrease in FDI leads to a greater (lower) level of goods exports.

⁵ Actually, this author finds a complementary relationship between foreign production and parent exports of intermediate goods, that appears to be more than offset by the diminishing effect over exports of finished goods.

⁶ For a more detailed discussion see Blomström and Kokko (1994).

⁷ The existence of some evidence of complementary between exports and outward foreign direct investment is also presented by Markusen (1995) as one of the macro facts from the aggregate data.

⁸ In an early and descriptive study, Caballero et al. (1989) report evidence of a substitution relationship between outward FDI and exports in Spain.

⁹ Since the Spanish foreign direct investment in the last quarter of 1992 took a negative value, this quarter has been excluded from the sampling period.

¹⁰ See, for example, Helpman and Krugman (1985), Ch. 1.

¹¹ In these cases, trade is a consequence of technology differences, increasing returns or imperfect competition.

¹² See Graham (1995).

¹³ Dunning (1977, 1981).

¹⁴ We can find arguments supporting this idea in Vernon (1966) and Grossman and Helpman (1989).

¹⁵ See Markusen (1995).

¹⁶ Once either R&D, advertising or marketing activity is made, the number of production plants to be served within the corporation becomes an irrelevant issue (Markusen (1984)).

¹⁷ In this line, Yamawaki (1991) pointed out that the success of Japanese firms in the US markets stems mainly from the fact that, unlike other foreign investors, Japanese companies concentrate their local operations on distributional activities.

¹⁸ This author proposed to specify unrestricted autorregressive models in order to avoid infecting the model with false identifying restrictions

¹⁹ Following Granger (1969), x is said to Granger cause y if and only if $y(t)$ is predicted better by using the past history of x , together with the past history of y itself, rather than by using just the past history of y .

²⁰ The methodological change in the elaboration of the Spanish Balance of Payment from 1993 on makes it difficult to jointly work with trade and capital movements data before and after 1992.

²¹ Taking into account that for the period analysed more than 80 per cent of the Spanish exports have gone towards the OECD countries, the OECD GDP can be considered a good proxy of foreign demand for Spanish goods.

²² This is very much in line with the empirical works of Spanish export demand, where the volume of the Spanish exports is related to the level of income in the importing region, the relative prices and the domestic pressure of demand. A brief reference of these works is found in Moreno (1997).

²³ See Goldstein and Khan (1985).

²⁴ Caves (1982).

²⁵ All series are quarterly and seasonally adjusted.

²⁶ In a seminar paper, these authors argued that regression involving non stationary variables might produce misleading results in the standard significance tests. Concretely, they highlighted the possibility of finding significant relationships between $I(1)$ series when in fact they were independent.

²⁷ We construct the model with the $I(0)$ variables and the ECM in an attempt to capture the short-run dynamic of variables, although with cointegrated $I(1)$ series the VAR model can also be constructed in terms of the levels of the data.

²⁸ Granger (1986) displayed that when two time series are cointegrated there will exist a causal relationship in at least one direction.

²⁹ Detailed discussion of this issue is presented in Canova (1995).

³⁰ We consider that six quarters cover time enough to capture the short-run behaviour of variables.

³¹ It was found necessary to include two dummies that took a value of one in 1990:II (D90) and 1992:IV

(D92) to account for outliers.

³² Detailed discussion of the Johansen (1988) technique is found in Banerjee et al. (1993), Ch. 8, and Harris (1995), Ch. 5.

³³ According to the Granger Representation Theorem, with cointegrated I(1) series, an ECM has to be included in the differenced model in order to capture the equilibrium relationship among the cointegrated variables in their dynamic behaviour.

³⁴ However with a chi-squared statistic value of 19.5 (with one degree of freedom), we reject the null of zero restriction on the adjustment of *gdp* variable to disequilibrium vector at 1% level.

³⁵ we can find a review of some of these studies in Moreno (1997).

³⁶ Several diagnostic tests of this VECM are reported in the appendix (Table A.1). As can be seen, there is no evidence of serial correlation, or heteroskedasticity in the residuals. Testimony of deviations from normality does not appear either.

³⁷ All estimated coefficients of the VECM, though not presented due to space constraints, are available on request from the authors.

³⁸ The significance of the ECM in the export equation is an indication that neglecting the long-run trend of variables can induce misspecific results in the causality test.

³⁹ Although not reported, we also found a positive relationship running from *fdi* to *gdp*.

⁴⁰ To construct the reduced or parsimonious version of the VAR model, we use the standard “general-to-specific” procedure proposed by Hendry (1985).

⁴¹ See Mellander et al. (1992) on the estimation of the impulse-response function using the error-correction form of cointegration.

⁴² The impulse response function has been plotted here taking first differences, in order to represent the dynamic behaviour of the different variables until their new long-term equilibrium level is reached.

⁴³ Blomström and Kokko (1994) pointed out a similar controversy, at a disaggregate level, for the Swedish FDI-trade relationship between the Blomström et al. (1988) and Svensson (1996).