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INWARD FOREIGN DIRECT INVESTMENT AND IMPORTS IN SPAIN

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Abstract

In this paper, we investigate the linkages between inward foreign direct investment and imports in Spain. We show that FDI in this country has be reater imports. A cointegration analysis in a multivariate VAR model is applied for Granger temporal causality testing. The strength and direction of the causal relationship are shown through the dynamic variance decomposition and the impulse response technique.

Key words: inward foreign direct investment; imports; multivariate cointegration; Granger causality

JEL Classification: F10; F20; F21

1 Introduction

Over the last thirty years, foreign direct investment (hereafter FDI) has become one of the most important elements in the globalization process, growing at a pace far exceeding the volume of international trade. The overall level of FDI has risen particularly sharply in the European Union (EU) countries, propelled by the single market programme.[1] The increased liberalization, brought about by reduced barriers to trade and investment within these economies, has led to the creation of new and bigger markets where multinational firms (MNFs) may locate their production and distribution activities. This results in both a market growth in their intra-EU FDI flows and a locational advantage for inward direct investment flows coming from the rest of the world.

Indeed, as Barrel and Pain (1999) have pointed out, the creation of a "closed" European Economic Area, where internal barriers have been gradually removed, but external restrictions remain, has significantly affected the scale of FDI in Europe.[2] The establishment of the single market has further altered the pattern of location of foreign firms within Europe. Countries like Portugal and Spain, both recently admitted into the EU, have experienced a spectacular rise in their FDI inflows during the eighties (Bajo and Sosvilla, 1994, and Barrel and Pain, 1997). As members of the European Union, investment within these economies is viewed, for non-member states, as offering access to a wider market. For member states, it represents to freely exploit potential locational advantages.

The Spanish experience can thus provide an interesting case study to evaluate the impact of these FDI flows. The combined effect of the development of her internal market and the increasing external opening of her economy, which culminates with the integration into the EU, have led not only to a continuous rise in her trade flows but also to a spectacular increase in foreign direct investment. Figure 1 represents the evolution of FDI inflows in this country (in terms of GDP shares) from 1970 to 1999[3]. As can be appreciated, after a declining trend during the first seventies, concurrent with the political instability experienced in those years[4], the percentage of FDI inflows in Spain has unceasingly increased for almost two decades, with

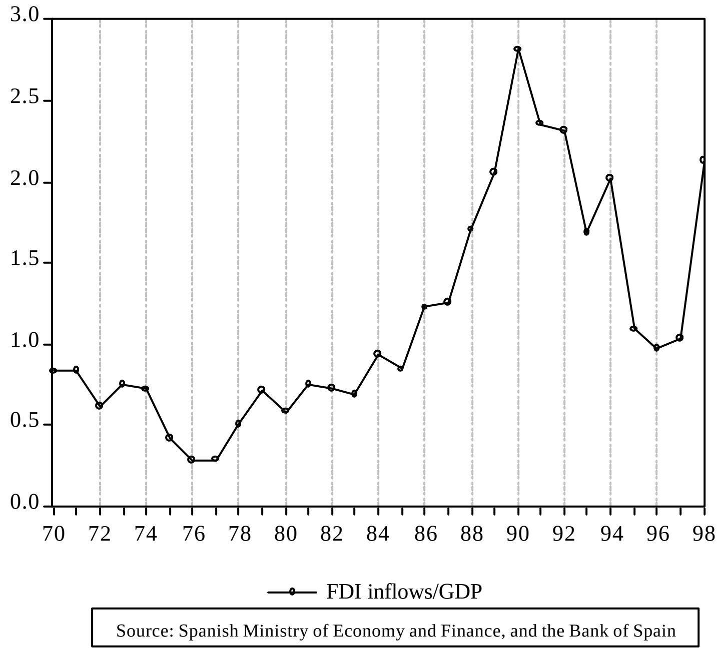
[1]As a prior stage to the European Union, the member governments decided to take part in a single market programme, and to increasingly remove their tariff and NTB barriers as well as their legal impediments for production factor movements.

[2]In particular, these authors find that the construction of a non-tariff barriers area has significantly affected the scale of Japanese FDI in Europe.

[3]Given the data break on FDI in Spain in 1992, when the fifth edition of the Balance of Payments Manual (International Monetary Fund, 1993) methodology was adopted, we have here extended forward these series using the rates of the new balance-of-payment data.

[4]Prior to the restoration of its democracy in 1977, Spain was involved in an important process of political instability and uncertainty.

Figure 1: FDI inflows in Spain, 1970-1999 (% of GDP)



a strengthened upward tendency after joining the European Union in 1986. This proportion reduces however in the early 1990s, such as it occurs in other EU countries.[5]

This important growth of FDI has revived the question about the cost and benefits of MNFs. From the point of view of the recipient economy, apart from being a source of extra capital, FDI is desirable for stimulating technology transfer and fostering exchange of managerial know-how (Kokko, et al., 1996).[6] It is also expected to enhance productivity and output growth through an increased rivalry engendered in sectors where multinational corporations, with higher productivity, enter (Markusen and Venables, 1999). FDI is thus believed to improve efficiency and to make economy more competitive. However, as FDI and trade are linked in a variety of ways, a full understanding of the effects of an increased openness will require to determine whether FDI affects trade, and particularly imports in the host economy, negatively or positively.

[5]This, for instance, happens also in Germany, Holland, Sweden and United Kingdom (source: IMF's *International Financial Statistics*).

[6]According to its definition, foreign direct investment involves effective management and ownership control of foreign firms. Its impact therefore will differ significantly from short-term speculative capital inflows. FDI creates deeper links between economies.

In principle, either relationship (positive or negative) between inward FDI and imports may exist from a theoretical point of view. When, for instance, FDI entails producing abroad products that had previously been exported from the investing country (motivated by lower transportation costs, avoidance of trade barriers, etc.), inflows of FDI and imports in the recipient economy are expected to be substitutes. If, instead, the motivation of FDI is to benefit from factor productivity and remuneration differentials across countries, a rise in foreign activity will probably be accompanied by an increased demand for inputs and intermediate goods. The latter will be provided either by the parent firm in the home country or by a subsidiary of the same group located in other economies. A similar positive relationship between FDI and imports is expected when, through foreign investment projects, MNEs try to consolidate market shares abroad, either by expanding marketing and distribution capabilities or by improving customer support.

But, while there are theoretical arguments that support both substitution and complementary effects, empirical works on this question (although hardly tested[7]) nearly always show a net complementarity relationship between imports and foreign direct investment, regardless of the country analyzed, the methodology or the data sets employed. For instance, de Mello and Fukasaku (2000), by means of bivariate vector error-correction models (VECM) and causality analysis, show that a positive relationship between imports and FDI inflows exists in some of the Latin American and Southeast Asian countries selected. Similarly, Brainard (1997), in an effort to test his proximity-concentration hypothesis[8], observes that foreign affiliate sales and imports in US are positively related to one another. His theory in the explanation of FDI in fact constitutes the starting point of some recent works that analyse the connection between imports and FDI inflows using gravity models. This is for example the case of Clausing (2000), who through the gravity equation, presents evidence supporting a complementary relationship between US imports and the activity of foreign affiliates operating in United States. Lin (1995), however, through the estimation of an import demand equation augmented with an inward FDI variable, finds no evidence of any impact from current inward FDI on imports in Taiwan.[9]

But, far from the agreement obtained about the benefits of FDI, the eval-

[7] Despite the fact that the connection between outward FDI and exports appears widely treated empirically (see, for instance, Lipsey and Weiss, 1981, 1984; Yamawaki, 1991; Pfaffermayr, 1994; Bajo and Montero, 2001, and Alguacil and Orts, 2001), whether inward FDI and imports are substitutes or complements has not been subject to extensive analysis.

[8] According to Brainard (1993), the emergence of multinational firms can be explained by the trade-off between the additional fixed costs of establishing a foreign plant against the costs of servicing this market via exporting.

[9] In the Spanish case, there exists some evidence of a positive relationship between a proxy of the aggregate foreign capital stock and imports (Bajo and Montero, 1995).

uation of the impact of a potential variation in imports is mixed. Detractors of FDI inflows argue that foreign owners tend to have a higher propensity to obtain their inputs from abroad than do their domestically owned counterparts, and contemplate the worsening of the trade deficit or the possible exchange rate weaknesses as negative consequences of this trade behaviour (Lipsey, 1991, Graham and Krugman, 1995). This view of FDI is however questioned when the economic gains from importing are also evaluated. As it has been recently pointed out by Rodrik (1999), imports may in fact promote economic growth and development through the importation of ideas, investment and intermediate goods.[10]

In this work, we seek to analyse the empirical relationship between imports and FDI inflows in Spain. To this aim, we use a multivariate model, in which other relevant factors (prices, income and macroeconomic instability) are allowed to exert their influence over these two basic variables. A vector autoregressive (VAR) approach and cointegration technique are employed to test for both the existence of a short-run and long-run Granger causality between both modes of foreign firm activity. The advantage of employing a VAR model is that it treats each variable in the system as potentially endogenous and it allows to explore this relationship over time.

The rest of the paper is organised as follows. In Section 2, the different theoretical arguments supporting either a substitution or a complementary relationship between imports and FDI are discussed. Section 3 is concerned with econometric methodology and data descriptions issues. The empirical results are shown in Section 4. Finally, Section 5 provides some concluding remarks and further comments.

2 FDI and Trade: Theoretical Relationships

Any microeconomic modelization of multinational firms (MNFs) outlines the choice between trade and foreign direct investment as alternative strategies of the international expansion of companies. According to Buckley and Casson (1981), for instance, in the decision of selling to a foreign market, firms compare between the higher fixed costs of foreign production and the higher costs per unit of exporting (transportation cost, tariffs, etc.). This implies that once a threshold level of sales is reached, firms will decide to change exports for foreign production. Besides, traditional models of trade, within the standard Heckscher–Ohlin general equilibrium context, contemplate FDI, in terms of capital mobility, and trade in goods as perfect substitutes. Insofar as the capital factor moves toward the capital-scarce country, attracted by higher relative prices, the differences between nations

[10] Khan (1994) already demonstrated that manufacturing imports might expand the domestic manufacturing production.

are reduced, and the factor-based trade removed (Mundell, 1957).[11]

But the perfectly competitive, constant-return world on which these models hinges on does not seem to be the appropriate framework to analyse FDI. Neither MNF nor the advantages that make sense of this sort of managerial organization has a specific place in this restricted world, in spite of FDI mainly refers to the international expansion of this kind of firms. In a perfect competitive context, atomistic or invisible firms have identical access to technology and markets, and there is no reason for firms to operate across national boundaries.[12]

In an attempt to introduce MNFs within a general equilibrium framework and to establish predictions about the relationship between multinational activity and trade, the modern theory of trade and FDI combines different approaches of ownership advantages and several types of location advantages from the well-known OLI paradigm of Dunning (1977, 1981)[13]. Some of these works, for example, rely on the "public-good" nature of the firm-specific inputs (like patented technology, specific management and marketing skills) to justify the emergence of the multinational, multiplant firm (Horstmann and Markusen, 1992; Brainard, 1993, 1997; Markusen, 1995; and Markusen and Venables, 1998). According to these models, insofar as these knowledge-base, firm-specific assets can be used in several plants, in different countries, with no productivity losses, multiplant production 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.[14] In particular, if the firm-specific costs are large in relation to plant-specific costs, the multiplant production dominates and a negative relationship between exports and FDI emerges. Locational considerations based on the tariff-jumping approach reinforce this negative relationship. In these models, the trade-off between the advantages of proximity and the scale or concentration advantages allows firms to choose either to export or to invest rather than doing both.

But the introduction in this analysis of a multistage production (with different concentration/proximity trade-offs) also allows for the possibility

[11] Alternatively, Markusen (1983) demonstrated that when the reasons for the factor price divergences are other than factor proportion (such as technology differences, increasing returns or imperfect competition) a complementary relationship between FDI and trade arises.

[12] As Hymer (1976) pointed out, the existence of MNF is based on market imperfections that makes it profitable for firms to substitute internal production for external transaction.

[13] In his work, Dunning highlights the existence of three necessary advantages for FDI: ownership, location and internalisation advantages.

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

of a complementary relationship between both means of firms' internationalization. This, for instance, happens when concentration advantages dominate in the corporation activities while proximity advantages dominate in production (Brainard, 1993). In this case, multinational activity enhances intra-firm trade in intermediate goods as well as the transmission of intangible services, while replacing trade in final goods. Moreover, when the multinational activity of the firm consists in establishing sale and/or distribution affiliates abroad, instead of foreign production plants, with the purpose of increasing the market share in local countries, the complementary relationship between FDI and trade will be almost ensured. The proximity advantage in this case arises from the possibility of providing distribution mechanisms and customer support that will promote sales in the host economy (Bergsten et al., 1978). It should also be noted that, as Lipsey and Weiss (1984) have pointed out, production in a foreign market might result in a higher demand for other goods produced by the firm in its home country.

A complementary relationship between trade and FDI also emerges when multinational activity is justified by significant differences in production costs across countries due to divergences in factor proportions. As demonstrated in the works of Helpman (1984), and Helpman and Krugman (1985), the possibility of geographically separating the corporate and the production activities, as well as their different factor intensities, provide arguments in favor of the vertical disintegration of the multinational corporation. In this context, the MNF will optimally decide to internationally spread its production process in different stages, bearing in mind factor requirements. 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 (specifically, in those countries relatively well endowed with the factor used intensively in these production stages).

In short, the location advantages in terms of factor proportions, plus the possibility of employing domestic intangible inputs in foreign production plants, will lead to the surge of vertically integrated multinationals, with parent firms importing final goods from their foreign affiliates, while exporting headquarter services and inputs to them.[15] FDI is therefore expected to enhance exchange of technology and managerial know-how between economies, both directly, though the generation of spillovers, and indirectly, through the importation of intermediate goods and inputs. In fact, most of the benefits that are likely to accrue to the host economy from foreign investment would not occur without this sort of trade.

Consequently, we can say that whether FDI and trade are on net substi-

[15] In these models, the firm-specific assets are contemplated as an essential stage in the production process.

tutes or complements (and what benefits we can expect from foreign investment) will basically depend on the incentives behind these foreign investment decisions, and on the character and nature of the MNFs involved in most of FDI flows. This question, hence, far from being determined theoretically, becomes an empirical matter.

3 Data Description and Econometric Specification

In this section, we investigate the relationship between aggregate imports and inward FDI empirically. With this aim, aggregate data for the Spanish economy in real terms is used for the period 1970.IV-1992.IV,[16] which covers the most important rise in FDI flows in this country.[17]

In Figure 2, we present the cross plot of imports against FDI inflows. As we can see, apart from the years with higher political and macroeconomic instability in Spain (early seventies), where the relationship between imports and inflows of FDI is indeterminate, these two variables appear to be positively related to one another. This correlation however might be driven by the presence of common determinants, leading thus to an erroneous interpretation of complementarity. To circumvent this problem, in this work, we simultaneously estimate imports and FDI, with three other variables that account for potential income and price effects, as well as for the impact of macroeconomic instability.

The positive influence of the domestic market size on imports and inward foreign direct investments is captured here by the domestic demand net on imports.[18] The inclusion of the price of imports relative to the Spanish consumption price index allows us to consider the potential price effects over imports and foreign direct investment flows.[19] According to this relative price definition, an increase in prices will imply an improvement in the

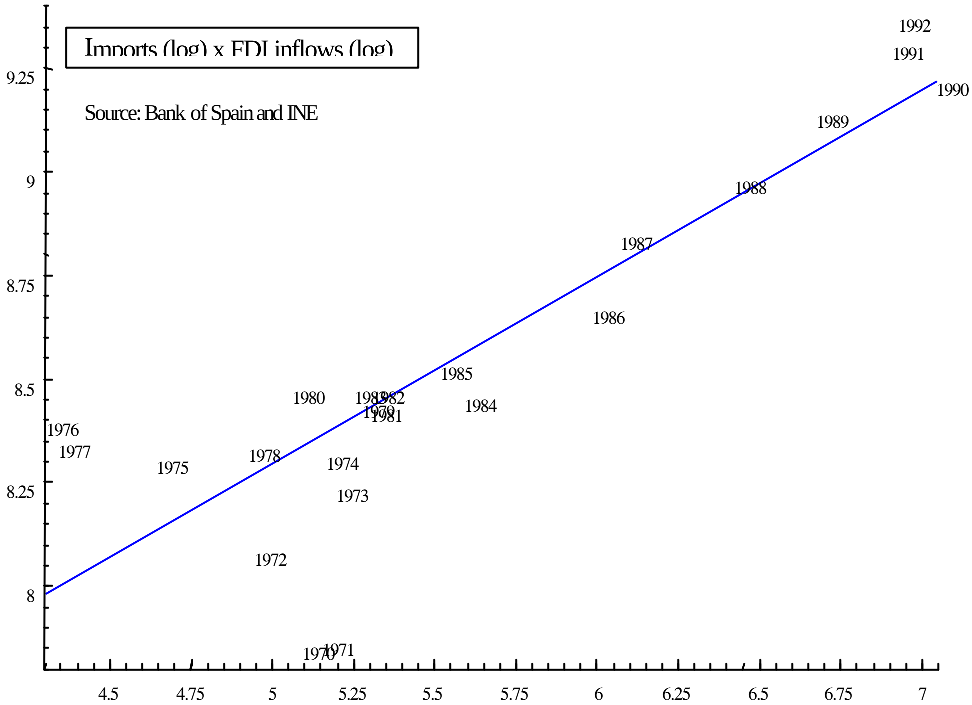
[16]We decided to finish the period to be studied in 1992 due to the data series break that came about in 1993 as a result of the adoption of the fifth edition of the Balance of Payments Manual (IMF, 1993) in the elaboration of the Spanish balance of payments. This methodological change mainly involved the accounts for capital flows, which makes it difficult to compare FDI figures before and after 1992.

[17]Apart from the mid-seventies where the arrival of foreign capital decreased due to the political instability experienced in those years, the flows of international capital in Spain increased practically without interruption from 1970 to 1991.

[18]The use of the domestic demand in the explanation of imports has been criticized for comprising the goods that have been previously imported (Doménech and Taguas, 1997: 30). That is to say, the explanatory variable in this case would contain the variable that it seeks to explain. In this work, we avoid this problem by removing imports from total domestic demand.

[19]Following Doménech and Taguas (1997), in the elaboration of the domestic prices we have also employed the Spanish GDP deflator. However, because no better results were found, we finally opted for reporting only results for the case of the consumption price index.

Figure 2: Imports against FDI inflows in Spain by years, 1970-1992 (log values, in real terms)



competitiveness of the domestically produced goods and thus a decline in the demand for imported goods. The net effect of this variation over foreign direct investment is however not so clear, since this index might capture both the relative cost of the investment projects and the rate at which the benefits of these investment flows are discounted. Finally, we employ the Spanish inflation in terms of the GDP deflator to represent macroeconomic instability and uncertainty, which is expected, at least in principle, to negatively affect both FDI and imports. Although, as Reuber (1973) and de Mello and Fukasaku (1995), among others, have mentioned, in a globalized economy, macroeconomic instability diminishes the locational advantage of a country in the competition for inward FDI, leading exports to be relatively more profitable than foreign investment for the home country. From this perspective, this variable would exert an opposite impact over FDI and imports in the host economy.

Since all the time series mentioned are potentially endogenous, we specify the following unrestricted VAR model made up of inward foreign direct investments ($ifdi$), imports (imp), domestic demand (dmd), relative prices (prc) and inflation (inf)[20], where no *a priori* restrictions nor the endogenous or exogenous character of variables are established at a first stage.[21]

$$\begin{bmatrix} imp_t \\ ifdi_t \\ dmd_t \\ prc_t \\ inf_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} imp_{t-1} \\ ifdi_{t-1} \\ dmd_{t-1} \\ prc_{t-1} \\ inf_{t-1} \end{bmatrix} + \cdots + A_s \begin{bmatrix} imp_{t-s} \\ ifdi_{t-s} \\ dmd_{t-s} \\ prc_{t-s} \\ inf_{t-s} \end{bmatrix} + u_t \quad (1)$$

where A_0 is a vector of constant terms, $A_{i=1,\dots,s}$ are all matrices of parameters, and $u_t \sim IN(0, \Sigma)$.

In order to determine the optimum lag length of this model, we follow Hendry and Mizon's (1993) and Hendry and Doornik's (1994) proposal, and sequentially look at the statistical significance of the different lags by a joint F test statistic. The Granger's (1969) concept of causality is then employed to test the relationship between imports and inward FDI.[22] But, as Engle and Granger (1987) and Granger (1986) have pointed out, a VAR model in levels with nonstationary variables may lead to spurious associations and a VAR model in first differences with cointegrated variables is misspecified. According to the representation theorem, if series are cointegrated, the model in first differences need to be augmented with error correction terms. In fact, the evidence of cointegration between variables rules out the possibility of Granger non causality, although it does not say anything about the direction of this causal relationship.[23] The application of a vector error correction model (VECM), in this case, will enable both the direction of the causality to be revealed, and to distinguish between short- and long-run Granger causality. The order of integration of the series is determined here by the Augmented Dickey and Fuller (1979, 1981), and Phillips and Perron (1988) tests. To investigate for multivariate cointegration and weak exogeneity, we employ the maximum likelihood procedure of Johansen (1988) and Johansen and Juselius (1990, 1992).[24]

Finally, and given that it is difficult to interpret the estimated coefficients of the VAR model by themselves and that the F- and t-tests only indicate the Granger-exogeneity or endogeneity of variables within the sample period,

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[20]All series are expressed in log terms and seasonally adjusted.

[21]Sims (1980) proposed specifying unrestricted autoregressive models in order to avoid infecting the model with false identifying restrictions.

[22]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.

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

[24]This method is more efficient in a multivariate setting than the two-step procedure suggested by Engle and Granger (1987).

we analyse the dynamic behaviour of the different variables beyond this period through the impulse response analysis proposed by Sims (1988). Thus, the plots of the impulse response functions and the forecast error variance decomposition will allow us to identify the current and future behaviour of trade and foreign direct investment after certain external shocks occur in the rest of the variables. But, as is well known, the orthogonalization of the matrix of variance and covariance innovations is necessary to estimate the dynamic response of variables to external shocks. This triangulation is made here by the Cholesky decomposition method.[25]

Once the basic aspects of the methodology employed has been described, in the following sections we comment on the results obtained in our estimations.

4 Empirical Results

In Table 1, we show the outcomes of the model selection procedure. As derived from the F-tests, a system with a lag length of seven, i.e. a VAR(7), model is opted for. Lag seven of all variables appears to be significantly different from zero at 10 per cent in the overall system, showing particularly significance in the $ifdi$ and inf equations. Moreover, in contrast with the eight-lag version of the model, in this seven-lag system no evidence of serially correlated residuals exists. Although it was necessary to include an impulse dummy variable, $D86$, to account for the integration of Spain in the European Union (EU).[26]

Concerning the order of integration of variables, the τ and $Z(t)$ statistics presented in Table 6 and Table 7 of Appendix A, respectively, suggest a non-stationary behaviour of imp, $ifdi$, dmd, prc, and inf. The null hypothesis of variables integrated of order one is however clearly rejected in the differentiated variables (denoted with Δ), indicating that they have a unit root in their levels. In Table 2, we report the results of Johansen's maximum eigenvalue test, $\lambda_{\max}$, and trace test, λ_{trace}. As we can see, outcomes in this table indicate that two cointegration vectors are presented in the model. The null that $r = 1$ (or alternatively $n - r = 4$) is rejected, but the null that $r = 2$ (or alternatively $n - r = 3$) is not rejected.[27] Consequently, following the Granger representation theorem, two Error Correction Mechanisms (ECM) should be added in each equation of the first differentiated VAR model.

According to these outcomes, the analyzed series are indeed tied together by two long-run equilibrium paths. However, as Harris (1995: 100) has

[25] This involves transforming the variance and covariance into a lower triangular matrix so that the transformed innovations are serially and contemporaneously uncorrelated.

[26] This variable takes a value of one in 1986.I and zero otherwise.

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

Table 1: Model selection

Statistic		Equation					VAR
Lag-length		*imp*	*ifdi*	*dmd*	*prc*	*inf*	
$s=8$	$F(5,38)$	1.26	2.06^b	0.57	0.34	0.65	-
	$F(25,138)$	-	-	-	-	-	0.90
		$F^v_{ar\ 1-5}(125,63)=1.92^a$ $\chi^2_{nd}(10)=14.5$					
$s=7$	$F(5,43)$	0.75	2.57^a	1.54	1.42	2.18^b	-
	$F(25,157)$	-	-	-	-	-	1.51^b
		$F^v_{ar\ 1-5}(125,88)=1.22$ $\chi^2_{nd}(10)=13.2$					

Note: The superscripts a and b reject the null hypothesis of zero restriction at 5 and 10 per cent significance level, respectively; s denotes both the order of the VAR and the lag analyzed. Figures in parentheses are degree of freedom. $F^v_{ar\ 1\text{-}5}$ gives us information about system test for no serial correlation (fifth order); χ^2_{nd} test for normality in the system. See Doornik and Hendry (1994).

pointed out, testing for weak exogeneity in a particular cointegration vector presumes that this vector represents a structural long-run relationship between the variables in the model, and not a linear combination. Consequently, in order to study the adjustment of different variables to the disequilibrium vectors, we try next to identify these structural relationships by testing for some restrictions on the cointegration vectors that respond to economic arguments.

We test first whether one of the cointegration relationships represents the long-run demand for imports. We also inquire as to whether, together with domestic income and relative prices, inward foreign direct investment flows can be considered as a structural determinant of imports. This in fact would mean accepting the existence of a long-run causal relationship between foreign direct investment and imports. Secondly, we check whether the other cointegration vector corresponds either to an equilibrium path between income and inflation, as established by the well-known Phillips curve proposition, or to a long-run equation for foreign direct investment.

Table 3 presents the χ^2-test statistics obtained together with the restricted cointegration vectors. H_i $(i=1,..8)$ depicts the linear economic

Table 2: Johansen's test for multiple cointegration

$H_o:$		Model 1	$\lambda(0.95)$	Model 2	$\lambda(0.95)$	Model 3	$\lambda(0.95)$
r	$n-r$			$\lambda_{\max}$			
0	5	55.88	34.4	54.07	33.5	54.07	37.5
1	4	50.99	28.1	46.22	27.1	47.13	31.5
2	3	15.51*	22.0	12.63	21.0	33.91	25.5
3	2	9.35	15.7	8.16	14.1	12.44	19.0
4	1	4.61	9.2	0.03	3.8	8.12	12.3
				λ_{traza}			
0	5	136.4	76.1	121.1	68.5	155.7	87.3
1	4	80.47	53.1	67.05	47.2	101.6	63.0
2	3	29.48*	34.9	20.83	29.7	54.47	42.4
3	2	13.97	20.0	8.16	15.4	20.56	25.3
4	1	4.61	9.2	0.03	3.8	8.12	12.3

Note: r indicates the number of cointegrating vectors under the null hypothesis. $n-r$ indicates the number of eigenvalues (obtained from the Johansen approach) that are no different from zero under the null hypothesis. See Johansen (1988) and Obterwald-Lenun (1992) for critical values [$\lambda(0.95)$], Table 1. 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 dummy variable D86 is entered unrestrictedly in all models. * denotes the first time the null is not rejected.

hypothesis tested in each case, as is shown in Table 8 of Appendix B. As can be appreciated, the results for H_1, H_2, H_3 and H_4 tests confirm the hypotheses that one of the cointegration vectors (ci) corresponds to the long-run demand for imports while the other (cii) represents a long-run relationship between foreign direct investment, relative prices and inflation. Among all these hypotheses, only H_3 cannot be rejected at the standard levels of significance. The tests of H_5, H_6 and H_7 provide further support about the significance of foreign direct investment in the import demand. In addition, from the rejection of H_8, the hypothesis that (cii) contains a stationary relationship between the inflation rate and domestic output is rejected. To sum up, we can say that long-run relationships between imp, $ifdi$, dmd, and prc, and between foreign direct investment, relative prices and inflation do exist.

Table 3: Testing for structural restrictions on cointegration vectors

Test		Restricted cointegration vector					LR statistic	p-value.
		imp	*ifdi*	*dmd*	*inf*	*prc*		
H_1	*ci*	1.000	-0.178	-2.153	0.000	0.026	$\chi^2(1) = 3.91$	0.04
	cii	-0.055	1.000	0.000	1.827	0.000		
H_2	*ci*	1.000	-0.175	-2.168	0.000	0.026	$\chi^2(1) = 3.91$	0.04
	cii	0.000	1.000	0.083	1.905	0.000		
H_3	*ci*	1.000	-0.172	-2.161	0.000	0.005	$\chi^2(1) = 0.01$	0.98
	cii	0.000	1.000	0.000	1.990	0.300		
H_4	*ci*	1.000	-0.178	-2.153	0.000	0.026	$\chi^2(1) = 3.91$	0.04
	cii	-0.055	1.000	1.827	0.000	0.000		
H_5	*ci*	1.000	0.000	7.251	0.000	-7.358	$\chi^2(2) = 37.3$	0.00
	cii	0.000	1.000	0.000	2.081	0.465		
H_6	*ci*	1.000	0.000	-3.847	0.000	0.098	$\chi^2(1) = 31.7$	0.00
	cii	-6.708	1.000	0.000	3.251	0.260		
H_7	*ci*	1.000	0.000	-3.794	0.000	0.069	$\chi^2(2) = 31.7$	0.00
	cii	-6.871	1.000	0.000	-3.480	0.000		
H_8	*ci*	1.000	0.036	-1.594	0.000	0.068	$\chi^2(2) = 38.2$	0.00
	cii	0.000	0.000	1.000	-0.735	0.000		

Note: The χ^2 statistics test zero restrictions in the cointegrating vectors, as pointed out in Table 9, Appendix B. The last column gives us the probability of accepting the null hypothesis. Figures in parentheses are degree of freedom. The first vector is always normalized on *imp*, and the other vector is normalized on *ifdi* or *dmd*.

Table 4: Testing for weak exogeneity

Statistic	Equation				
$\mathrm{H}_0 : \alpha_i = 0$	Δimp	$\Delta ifdi$	Δdmd	Δinf	Δprc
$\chi^2(3)$	35.74^a	10.04^b	11.46^a	8.97^b	7.29

Note: The superscripts a and b indicate significance at the 1% and 5%, respectively. Figures in parentheses are degrees of freedom. α_i $(i = 1, 2)$ represent the coefficients of the speed of adjustment to disequilibrium with respect to to the first and second cointegrating vectors.

Testing that these cointegration vectors do not enter into each short-run equation is then followed up. The resulting LR tests for the identification together with weak exogeneity of each series to both long-run relationships are given in Table 4. The values of the χ^2 test of zero restrictions on the adjustment of each variable to disequilibrium vectors indicate that only prc can be considered as weakly exogenous for the long-run parameters. Thus, efficient estimates of coefficients of imports and inward foreign direct investment equations can be obtained condition the VECM on relative prices. This amounts to estimating a four-equation system.

Accordingly, we let z_t be the log of either imports (imp_t), inward foreign direct investment $(ifdi_t)$, domestic demand (dmd_t) or inflation rate (inf_t):

$$\Delta z_t = \beta_0 + \sum_{s=1}^{6} \beta_1(s)\Delta imp_{t-s} + \sum_{s=1}^{6} \beta_2(s)\Delta ifdi_{t-s} + \sum_{s=1}^{6} \beta_3(s)\Delta dmd_{t-s} + \sum_{s=1}^{6} \beta_4(s)\Delta inf_{t-s} + \sum_{s=0}^{6} \beta_5(s)\Delta prc_{t-s} + \delta_1 W_{1,t-1} + \delta_2 W_{2,t-1} + \varepsilon_t \quad (2a)$$

where β_i, and δ_j $(i = 0, 1, 2, 3, 4, 5$ and $j = 1, 2)$ are all parameters, ε is a white noise disturbance, and W_1 and W_2 depict the first and second cointegration vectors, respectively.

Once the model is correctly specified and estimated[28], we then focus on temporal Granger non-causality testing.[29] With cointegrated vectors in the model, Granger noncausality will imply there is both neither short- nor long-run causality between variables. Since interest is specially with the

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

[29] Several diagnostic tests of this VECM are reported in the Appendix C (Table 9). As can be seen, there is no evidence of serial correlation, or heteroscedasticity in the residuals. Testimony of deviations from normality does not appear either.

relationship between $ifdi$ and imp, only the results for these two equations are reported, although the outcomes showed have been obtained by jointly estimating with dmd and inf (see Table 5).

As far as the short-run Granger causality is concerned, the data show a causal relationship going from $ifdi$, dmd, inf, and prc to imports (as reflected in the significance, at 5%, of the χ^2-test of the lags of the differentiated variables, in both the full and parsimonious models[30]). We also found evidence of a short-run influence of imports, inflation and relative prices on the dynamic behaviour of foreign direct investment. The domestic demand however is not relevant in this equation. In fact, the lack of significance of this variable in the explanation of FDI both in the short- and long-run (as shown in the second cointegration vector) is not surprising if we think, for instance, of foreign firms in Spain that are more interested in exporting to third countries than in supplying the domestic market.

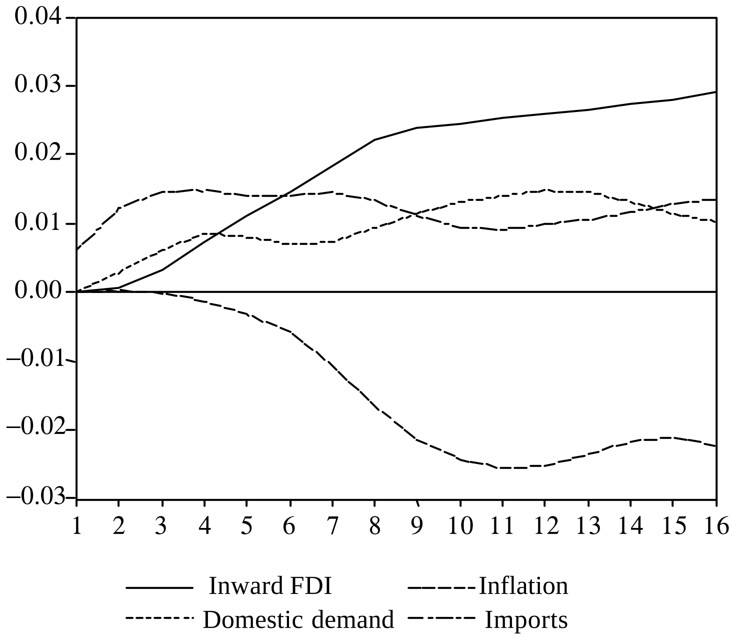
With respect to the long-run causality, estimates of the t-statistics show both error-correction terms, W_1 and W_2, to be statistically significant in the imports equation. In the foreign investment equation however only W_2 appears to be significant. These results would imply that a long-run causal relationship running from $ifdi$ to imports exists, although not in the opposite direction, that is, from imports to foreign direct investment.[31] Similar outcomes are obtained when insignificant lags are purged out of the full model to produce the parsimonious VAR representation.

It is also worth to noting the concordance between the signs of the coefficients in these equilibrium relationships and the hypotheses previously outlined (see Table 5, bottom part). In the imports demand equation, for instance, we found the expected positive and negative elasticity with respect to domestic income and relative prices, respectively. More specifically, an income elasticity greater than one seems to agree with the consideration of import goods as superior goods. Additionally, this relationship offers proof of the existence of a long-run positive relationship between foreign direct investment and imports. In the second long-run relationship, the signs obtained are also coherent with the economic intuition. With a negative coefficient, the inflation rate in this equation is probably picking up the harmful character of the macroeconomic uncertainty on foreign direct investment. A negative elasticity with respect to relative prices, on the other hand, would show that the negative impact of an increase in relative prices on FDI dominates.

[30] To construct the parsimonious or reduced version of the VAR model, the standard "general-to-specific" procedure proposed by Hendry (1985) was used. This model has been estimated by the maximum likelyhood method.

[31] It should, however, be pointed out that the impact of a change in foreign direct investment on imports in the short run is negative (as indicated by the sum of coefficients of the lagged $\Delta ifdi$) as opposed to its positive effect in the long run (as shown in the cointegrating vector).

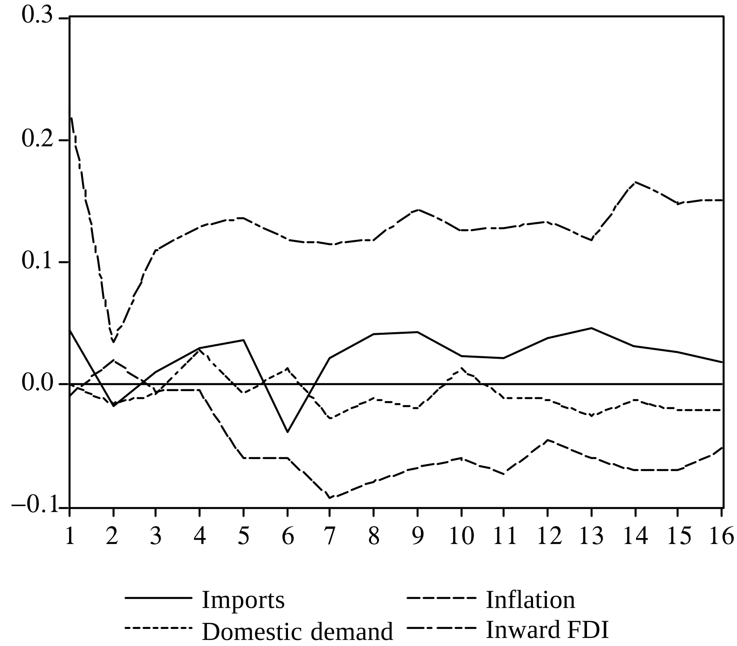
Figure 3: Impulse response of *imp* to one standard deviation shock in inward foreign direct investment, domestic demand, inflation and in itself



For a more complete and intuitive study of the causal relationship in this multivariate framework, we investigated the post-sample effects of shocks to the variables in the system through impulse response analysis. The impulse response functions and the variance decomposition of the different variables are here estimated by solving back to the model in levels from the final VECM estimates. The simulated effect on imports of an innovation in $ifdi$, dmd, and inf are depicted in Figure 3, while the response paths (beyond the sample period) of foreign direct investment to shocks in imp, dmd, and inf are shown in Figure 4. In both cases, the dynamic behaviour of these variables due to unexpected changes in themselves are also included.

The growing response of imports to shocks in $ifdi$, once the adjustment to disequilibrium to the long-run relationship is considered, confirms the existence of a positive influence of foreign direct investment on the dynamic behaviour of imp. Similarly, increases in the dmd variable seems to have a positive effect over import demand. Besides, a negative impact of the

Figure 4: Impulse response of *ifdi* to one standard deviation shock in imports, domestic demand, inflation and in itself



inflation rate in the dynamic behaviour of imports is observed. This is especially stressed in the first ten periods. The graphical examination of the response paths of $ifdi$ to surprise increases in imports and domestic income reflects lower sustained effects of this variable to shocks in the system. In both cases, the impulse-response functions move around the zero line. The inflation rate, however, would exert a clear negative impact on foreign investment projects. The response of $ifdi$ to shocks in inf is negative after a three-quarter period.

Table 6 presents the results of the variance decomposition procedure by reporting the percentage of 0- to 16-quarters of $ifdi$ and imp forecast error variance accounted for by innovations in each of the four endogenous variables. Since the results of these decompositions are sensitive to the relative ordering of variables, due to the orthogonalizing transformation of the error covariance matrix, we report here outcomes for two alternatively orders: (*i*) imp, $ifdi$, inf, dmd, and (*ii*) $ifdi$, imp, inf, dmd order.

The variance decomposition for imports shows the presence of a relatively

Table 5: Variance decomposition

			Percentage of σ explained by innovations in:							
			Order (i)				Order (ii)			
	T	σ	imp	$ifdi$	inf	dmd	$ifdi$	imp	inf	dmd
Variance decomposition of:										
imp	1	0.006	100.0	0.00	0.00	0.00	0.99	99.01	0.00	0.00
	4	0.021	81.26	4.73	0.64	13.37	8.20	77.80	0.64	13.36
	8	0.034	34.88	25.48	33.34	6.30	28.09	32.28	33.35	6.28
	12	0.059	11.79	31.24	54.66	2.31	32.17	10.86	54.66	2.31
	16	0.078	7.02	44.39	44.12	4.47	45.19	6.22	44.12	4.47
$ifdi$	1	0.174	0.99	99.01	0.00	0.00	100.0	0.00	0.00	0.00
	4	0.266	3.90	93.74	0.52	1.84	93.10	4.53	0.52	1.85
	8	0.303	3.91	79.41	9.62	6.06	78.52	5.80	9.62	6.06
	12	0.352	3.64	75.36	11.25	9.75	74.50	4.49	11.24	9.77
	16	0.403	2.91	71.96	9.75	15.38	70.59	4.27	9.75	15.39

Note: Figures in the last eight columns refer to the variance decomposition of an orthogonal one standard deviation shock. T indicates the forecast horizon in quarters, and σ denotes the forecast standard error.

rapid adjustment of this variable to unexpected changes in the system. After a sixteen-quarter period, only 7.02% of their forecast error variance is due to shocks in itself. The rest of this variation is a consequence of innovation in $ifdi$, inf, and dmd (order i). Conversely, a relatively slow reaction of foreign direct investment to shocks in the rest of the variables is observed. The forecast error variance of $ifdi$ four-quarter periods ahead is more than 93% explained by movements within itself. Three years later, this percentage moves up to only 29.41 (order ii). This result illustrates that innovations in other time series variables only marginally affect foreign direct investment movements.

5 Concluding remarks

This paper contributes to the debate of the importance of foreign direct investment to the recipient economy by investigating the relationship between imports and inward FDI in Spain. The knowledge of this association for the Spanish economy enables to obtain a more complete picture of the effects of FDI, which have been increasingly received by this country during last decades.

From a theoretical perspective, it is possible to conceive situations in which FDI acts either as a complement or as a substitute to imports. When, for instance, foreign production results in a horizontal expansion of multinational firms, where the affiliates tend to replicate the parent's production activity, FDI and imports from the investing country will probably be substitutes. But, the pattern of these horizontal investment flows appears to be contrary to decisions of a vertical expansion within the multinational enterprise that attends factor requirements, or to decisions of establishing distributional assets in local markets. In these cases, a complementarity between both ways of firm's internationalization would be almost ensured. Empirically, in spite of its importance for the evaluation of the impact of foreign investment, the relationship between inward FDI and imports has not been subject to much investigation.

In this work, we analyzed the temporal relationship between real imports and inflows of foreign direct investment in Spain, using an aggregate time-series approach. We employed a vector autoregressive model for both Granger causality testing and multivariate cointegration analysis. To control for common determinants of imports and FDI, we included further domestic demand, relative price and inflation rate in our model.

On the basis of the cointegration tests, two long-run relationships have been identified. In fact, in one of them, we have easily recognized an amplified demand function for imports, in which not only relative prices and domestic demand are significant and with the expected values, but also FDI inflows appear positively related with imports in the long run. The second cointegration vector refers to a long-run relationship between foreign direct investment, relative prices and inflation. In this last equilibrium path, a negative link between FDI and inflation would confirm the harmful influence of uncertainty and economic instability over foreign direct investment projects. The VECM estimate and impulse response analysis corroborate these findings and indicate the existence of a uni-directional causality, in the Granger sense, going from FDI to imports, but not in the opposite direction.

From the outcomes obtained, it can be stated that a complementary relationship between imports and inward FDI exists in Spain. This complementarity is in fact more in agreement with the view of multinational firms seeking favorable factor return conditions or investing in sale or distributional facilities than with a tariff-jumping approach. Additionally, the lack of relevance of domestic demand, as well as the role played by macroeconomic instability in FDI would confirm that foreign investors are more interesting in exporting to third countries than in supplying the domestic market. Therefore, although from this analysis we cannot strictly derive the complete impact of foreign investment, and particularly of the increased imports, the own character of these investment projects suggests that their effects will be closer to the benefits pointed out by Rodrick (1999) than to the negative influence argued by detractors of FDI. This result would provide hence empirical support to the idea of trade-oriented foreign investment that encourages positive spillover effects and the importation of ideas, inputs and intermediate goods.

A UNIT ROOT TESTS

Table 6: Augmented Dickey-Fuller test for unit roots

	τ_τ	ϕ_3	τ_μ	ϕ_1	τ
			Levels		
$ifdi$	-2.51	3.62	-0.49	0.48	0.74
imp	-1.90	1.88	-1.05	3.01	2.13
dmd	-3.37	6.40	-2.28	3.38	1.17
prc	-1.52	1.27	-1.61	1.29	-0.20
inf	-3.41	6.58	-1.99	2.01	-0.96
			First differences		
$\Delta ifdi$	-4.37	6.40	-4.33	9.38	-4.24
Δimp	-2.95	4.74	-3.07	4.75	-2.33
Δdmd	-2.50	3.13	-2.44	3.20	-2.20
Δprc	-3.28	5.43	-3.29	5.41	-3.31
Δinf	-5.95	17.7	-5.77	16.7	-5.81
			Critical values at 5% significance		
	-3.45	6.49	-2.89	4.71	-1.95

Note: Critical values for $n = 100$ can be found in Fuller (1976) and Dickey and Fuller (1981). The optimal lag used was selected by employing the formula $m = ent[4(N/100)^{1/4}]$, suggested by Schwert (1989), where N is the number of observations. All data used are available on request from the authors.

Table 7: Phillips-Perron tests for unit roots

	$Z(t_{\tilde{\alpha}})$	$Z(\phi_3)$	$Z(t_{\alpha *})$	$Z(\phi_1)$	$Z(t_{\hat{\alpha}})$
			Levels		
$ifdi$	-3.93	7.49	-1.35	8.22	0.72
imp	-1.27	0.97	0.11	6.71	3.62
dmd	-3.82	7.33	-1.63	7.53	3.68
prc	-1.14	0.92	-1.31	0.05	-0.34
inf	-3.99	8.56	-2.97	6.15	-1.13
			First differences		
$\Delta ifdi$	-19.0	174.	-18.8	229.	-18.5
Δimp	-2.95	4.89	-3.10	0.37	-2.60
Δdmd	-2.89	4.40	-2.69	2.11	-2.10
Δprc	-8.92	17.1	-5.92	13.9	-5.92
Δinf	-10.2	49.2	-9.98	114.	-9.98
			Critical values at 5% significance		
	-3.45	6.49	-2.89	4.71	-1.95

Note: Critical values for $n = 100$ can be found in Fuller (1976) and Dickey and Fuller (1981). The truncation lag parameter used was selected by employing the formula $m = ent[4(N/100)^{1/4}]$, suggested by Schwert (1989), where N is the number of observations. All data used are available on request from the authors.

B RESTRICTIONS ON COINTEGRATION VECTORS

Table 8: Testing for structural restrictions on cointegration vectors

Test		Restrictions				
		imp	$ifdi$	dmd	inf	prc
H_1	ci	1	$*$	$*$	0	$*$
	cii	$*$	1	0	$*$	0
H_2	ci	1	$*$	$*$	0	$*$
	cii	0	1	$*$	$*$	0
H_3	ci	1	$*$	$*$	0	$*$
	cii	0	1	0	$*$	$*$
H_4	ci	1	$*$	$*$	0	$*$
	cii	$*$	1	$*$	0	0
H_5	ci	1	0	$*$	0	$*$
	cii	0	1	0	$*$	$*$
H_6	ci	1	0	$*$	0	$*$
	cii	$*$	1	0	$*$	$*$
H_7	ci	1	0	$*$	0	$*$
	cii	$*$	1	0	$*$	0
H_8	ci	1	$*$	$*$	0	$*$
	cii	0	0	1	$*$	0

C DIAGNOSTIC TESTS

Table 9: Residual analysis of the VECM

Statistic		Equation				System
		Δimp	$\Delta ifdi$	Δdmd	Δinf	
Autocorrelation:						
	$F_{ar\ 1\text{-}5}(5,60)$	1.29	0.97	0.58	0.99	-
	$F^{v}_{ar}(80,168)$	-	-	-	-	0.96
Heteroscedasticity:						
ARCH(4)	$F_{arch}(4,57)$	0.52	0.71	1.10	1.78	-
White	$F_{het}(35,29)$	0.89	0.57	1.01	1.48	-
	$F^{v}_{het}(350,220)$	-	-	-	-	0.62
Normality:						
	$\chi^2_{nd}(2)$	0.39	0.16	0.13	8.67^a	-
	$\chi^{2^v}_{nd}(8)$	-	-	-	-	8.65

Note: Figures in parentheses are degree of freedom. The superscripts a denotes significance at 5 per cent. $F_{ar\ 1\text{-}5}$, F_{arch}, F_{het} and χ^2_{nd} are single-equation evaluation statistics for no correlation (fifth order), no ARCH (fourth order), no heteroscedasticity and normality. Similar tests are performed for the system (denoted by ^{v}). See Doornik and Hendrik (1994).

D DATA DEFINITIONS

The data definitions used in this study are the following:

Inward foreign direct investments ($IFDI_t$): they represent the gross payment for foreign investment in Spain, net of disinvestment in real terms using the GFCF (Gross Fixed Capital Formation) deflator computed by the authors. Data of foreign direct investment 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* (INE)

Imports (IMP_t): Spanish imports of goods and services in billion Spanish pesetas of 1986. Source: INE.

Domestic demand net of imports (DMD_t): Spanish demand (in billion Spanish pesetas of 1986) excluded imports of goods and services, such as defined above. Source: INE.

Relative price: To calculate this ratio the following procedure has been employed: $PRC_t = NER_t \times \frac{MP_t}{CPI_t}$, where NER is the Spanish peseta-dollar nominal exchange rate (source: *Banco de España*), and MP represents the price of Spanish imports in dollars (Spanish Unit Value Index of Imports, 1986 = 100). These figures are obtained by the Spanish Ministry of Economy, and Finance. CPI is the Spanish Consumption Price Index (source: INE).

Inflation rate (INF_t): Spanish inflation has been computed as the growth rate of the Spanish GDP deflator (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).

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