An analysis of the long-run effects of foreign direct investment: The Spanish case

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PRELIMINARY VERSION

1 Introduction

Foreign direct investment (FDI henceforth) has played in last years an increasing role as a way of internationalization of the economic activity, registering higher growth rates than both world trade and output.

On the other hand, FDI has been a crucial factor in the process of intense growth enjoyed by the Spanish economy since the beginning of the sixties. And even more, following the Spanish integration into the European Community (now European Union, EU) in 1986, as well as the prospects about the completion of the Single European Market by 1992, FDI substantially increased its prominent role as a factor of economic development. An overview of FDI trends during this period can be found in Bajo-Rubio and Torres (2001).

There have appeared in last years several studies on the main features of FDI received by the Spanish economy. In Bajo-Rubio and Sosvilla-Rivero (1994) the macroeconomic factors behind FDI inflows received between 1964 and 1989 were analysed; and the sectoral allocation in manufacturing is examined in Bajo–Rubio and López-Pueyo (2002). However, and despite the importance of FDI in the Spanish economy, their macroeconomic effects have been hardly explored; an exception is Sosvilla-Rivero and Herce (1998), where the role of FDI in fostering the favourable effects of the European Single Market is stressed.

The objective of this paper is to analyse the long-run effects of FDI in Spain, by estimating a production function including the foreign capital stock, for the period 1964-1997. In addition to the additional insight that this exercise might provide on the role of FDI in the Spanish economy, the Spanish case might be also a relevant case study. Spain can be considered a medium-size economy, given the size of her main macroeconomic variables, which has experienced a process of rapid growth in the last forty years, starting from a relatively weak position as compared to the rest of Western European countries. This has been particularly true after her accession to the EU in 1986, allowing her an even deeper integration with other more advanced economies, so Spain has been able to join the Economic and Monetary Union from its start. In sum, the Spanish experience could be of interest for other medium-size economies expected to follow a process of integration with other relatively more advanced countries, such as those of Central and Eastern Europe.

The rest of the paper is organized as follows: the theoretical framework is presented in Section 2, and the main empirical results are shown in Section 3; finally, the main conclusions are summarized in Section 4.

2 Theoretical framework

Our starting point will be a simple production function that includes human capital (as in Mankiw, Romer and Weil, 1992), written for simplicity in a Cobb-Douglas form:

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{\gamma} \tag{1}$$

where Y, K, H, and L denote, respectively, output, physical capital, human capital, and labour; and A is an index of the level of technology. Dividing by L

and taking logs, the above function would become:

$$\log \left(\frac{Y}{L}\right)_t = \log A_t + (\alpha + \beta + \gamma - 1) \log L_t + \alpha \log \left(\frac{K}{L}\right)_t + \beta \log \left(\frac{H}{L}\right)_t \quad (2)$$

where $\alpha + \beta + \gamma$ would indicate the degree of returns to scale for all production factors. The question now would be: how does FDI enter the above equation? The main arguments below are taken from Bajo-Rubio and Díaz-Roldán (2002), who present a survey on the relationship between FDI, productivity growth, and technological innovation by the multinational enterprise (MNE).

In the standard neoclassical growth model, FDI would be considered as an addition to the capital stock of the host economy (see, e.g., Brems, 1970), so that the effect of foreign capital would be indistinguishable from that of domestic capital. Notice that, in this case, the assumption of diminishing returns to capital would imply that FDI would affect growth only in the short run, i.e., during the transition to the steady-state growth path. Such a characterisation, however, is unsatisfactory given the recent trends in FDI. In fact, the main role of FDI would seem to be that of transferring assets from less efficient to more efficient owners, so that in practice FDI would consist of offsetting two-way flows that would be hardly related to productive investment (Lipsey, 2001). In other words, FDI would be less and less "greenfield", i.e., that FDI devoted to enlarge the production capacity of the host economy.

Endogenous growth models allow for a greater impact of FDI on growth. On the one hand, FDI could lead to externalities on the domestic production factors; the effect on growth, however, would be permanent only if the resulting returns to scale over all factors (i.e., including the externality) turn to be increasing. More importantly, the endogenous growth literature has tried to formalise technological innovation, which would emerge as a response to economic incentives, that is, profit opportunities detected by firms that would be influenced by the institutional, legal, and economic environment in which they act (Grossman and Helpman, 1994). And, in turn, this would lead to stress the role of FDI and, in general, the degree of economic integration, on influencing technological progress and consequently growth rates. So, a higher integration would mean an increase in market size, which would lead to greater incentives to R&D and hence higher growth; and it would facilitate the diffusion of knowledge among countries and avoid duplication of the research activity (Romer, 1990; Grossman and Helpman, 1991). In particular, integration among relatively similar economies would lead to a higher growth rate in the long run, since it would allow the exploitation at the world level of the increasing returns that would exist in the R&D sector (Rivera-Batiz and Romer, 1991).

On the other hand, FDI has acquired in last years an increasing importance as a way of internationalisation of economic activity in the industrialised countries, enjoying growth rates remarkably above those of world trade. Indeed, the importance of FDI would not be limited to its spectacular growth in merely quantitative grounds, since it would have performed a crucial role in the diffusion of ideas and innovations across the borders (Romer, 1993). In fact, the possibility to gain access to modern technologies is probably the main reason behind the interest on the side of the less technologically advanced countries to attract FDI. The reason is that MNEs conduct a great part of world R&D, as well as generating and controlling much of the most advanced production techniques. Still, in order to get a fully satisfactory transmission of such advanced

technologies, the host countries should possess a minimum social capability, in the sense of an educated labour force and adequate organisational structures.

The literature has also analysed extensively the possible presence of spillovers of the MNEs activities, when establishing a subsidiary leads to productivity or efficiency benefits for the host country's local firms, and the MNEs are not able to internalise the full value of these benefits (Blomström and Kokko, 1998). That is, the more evolved production methods, organisational and managerial techniques, marketing activities, and the like, of the MNEs, can be spread over the host country's local firms through several channels such as imitation, the higher competition associated with the presence of the subsidiary, or the mobility of the labour force previously trained and familiar with the more advanced techniques developed by the MNEs (Görg and Greenaway, 2004).

In general, a greater opening to FDI coming from the most advanced countries would lead to an increase in the rate of technological progress in the host country, and hence its rate of growth (Wang, 1990). Indeed, the incentive of a MNE to transfer technology would be inversely related to its perceived operation risks in the host country, which would explain that the average age of technologies transferred to their subsidiaries in developed countries is considerably lower than those transferred to developing countries; and technological transfer via FDI would be positively related to the investment in learning made by the host country's firms (Wang and Blomström, 1992).

According to the above theoretical arguments, we will assume that the level of technology A depends on its initial value, A_0, and on the stock of foreign capital, FK, per employee:

$$A_t = A_0 \left(\frac{FK}{L} \right)_t^{\theta} \tag{3}$$

where FK is measured as the accumulated sum of FDI inflows. Finally, replacing (3) in (2):

$$\begin{aligned} \log \left(\frac{Y}{L} \right)_t &= \log A_0 + (\alpha + \beta + \gamma - 1) \log L_t \\ &\quad + \alpha \log \left(\frac{K}{L} \right)_t + \beta \log \left(\frac{H}{L} \right)_t + \theta \log \left(\frac{FK}{L} \right)_t \end{aligned} \tag{4}$$

or, denoting by y, k, h, and fk the logs of Y/L, K/L, H/L, and FK/L, respectively, we get

$$y_t = \log A_0 + (\alpha + \beta + \gamma - 1) \log L_t + \alpha k_t + \beta h_t + \theta f k_t \tag{5}$$

which will be the equation to be estimated econometrically.

3 Empirical results

In this section, we will present some econometric estimates of the production function (5). Our empirical methodology will make use of cointegration techniques, which will allow us to avoid any spurious regression, at the same time that the long-run information is retained. We will use annual data for the period 1964-1997. The variables are defined as follows:

- Real labour productivity, y_t: GDP at 1986 prices, divided by the labor force employed.
- Real fixed capital per employee, k_t: physical capital stock (private and public) at 1986 prices, divided by the labor force employed.
- Human capital per employee, h_t: labor force employed with two levels of higher education (first cycle or shorter courses, and second cycle or full-length courses).
- Real foreign capital per employee, fk_t: accumulated sum of FDI gross receipts, net of disinvestments payments, at 1986 prices, divided by the labor force employed.

Regarding data sources, GDP has been obtained from the Spanish National Accounts, elaborated by the National Institute of Statistics; physical capital from Fundación BBVA (2003); human capital and employment from Mas et al. (1998); and net FDI from the Spanish Balance of Payments, elaborated by the Bnak of Spain.

We begin by examining the time-series properties of the series. To this end, we will use a modified version of the Phillips and Perron (1988) tests proposed by Ng and Perron (2001), which try to solve the main problems present in the conventional tests for unit roots. According to the results in Table 1, the null hypothesis of nonstationarity for all the series in levels cannot be rejected, independently of the test. The presence of two unit roots is clearly rejected for y_t and h_t at the usual significance levels, so that both series would be I(1). On the other hand, from the $\bar{M}SB^{GLS}$ and ADF^{GLS} tests the null of two unit roots can be rejected only at the 10 per cent significance level for the variable fk_t, whereas for the variable k_t the same null is not rejected; hence, these two series could be I(2) or I(1).

A potential difficulty in assessing the time series properties of macroeconomic variables is the possible presence of structural breaks in the form of infrequent changes in the mean or the drift of the series, due to eventual exogenous structural or policy shocks. Therefore, we have also applied the unit root test proposed by Perron and Vogelsang (1992a, 1992b), which have power against alternatives of stationarity with structural changes. Two approaches, and two types of models, have been considered: the "innovational outlier model" (IOM), where the break occurs slowly over time and feeding back into the process dynamics; and the "additive outlier model" (AOM), where the change is assumed to occur instantly with no further effects on future observations. The results of these tests are presented in Table 2, and show that the null hypothesis of nonstationarity in the first differences of the series can be rejected at the 1% significance level for fk_t, and at the 10% level for k_t, so that both variables could be I(1) with a structural change.

Once analysed the order of integration of the series, we will estimate the long-run or cointegration relationship between labour productivity and its determinants shown in equation (5). Given the relatively small sample size and the presence of only one cointegrating relationship, the estimation will be made using the Dynamic Ordinary Least Squares (DOLS) method of Stock and Watson (1993), following the methodology proposed by Shin (1994). This method

provides a robust correction to the possible presence of endogeneity in the explanatory variables, as well as of serial correlation in the error terms of the OLS estimation. Also, in order to overcome the problem of the low power of the classical cointegration tests under the presence of persistent roots in the residuals of the cointegration regression, Shin (1994) suggested a new test where the null hypothesis is that of cointegration. The first step in this methodology would consist of estimating a long-run dynamic equation that includes leads and lags of all the explanatory variables, the so-called DOLS regression; in our case[1]:

$$\begin{aligned} y_t &= \kappa + \gamma t + \alpha k_t + \beta h_t + \theta f k_t \\ &\quad + \sum_{j=-q} \psi_{1j} \Delta k_{t-j} + \sum_{j=-q} \psi_{2j} \Delta h_{t-j} + \sum_{j=-q} \psi_{3j} \Delta f k_{t-j} + \varepsilon_t \end{aligned} \tag{6}$$

In a second step, two LM statistics from the DOLS residuals would be computed, namely C_μ and C_τ, which test for deterministic (i.e., when $\gamma = 0$) and stochastic (i.e., when $\gamma \neq 0$) cointegration, respectively.

The coefficient estimates from the DOLS regression and the results of the Shin cointegration test are reported in Table 3. Since the concept of deterministic cointegration is stronger than the concept of stochastic cointegration, we first test for the presence of the latter and then test for the former. As can be seen in column [1], all the coefficients have the expected signs and are statistically significant; however, the null of stochastic cointegration is rejected at the 1% level. When we test for the presence of deterministic cointegration in column [2], the coefficient on the foreign capital stock shows a negative and significant coefficient (although very small in absolute value), the null of deterministic cointegration is rejected at the 10% level.

Next, we have introduced a multiplicative variable, constructed from the human and foreign capital variables (as in Borensztein, De Gregorio and Lee, 1998), which would indicate the existence of complementarity between them. According to the results in tables 1 and 2, this variable could be I(1) with a structural change. Now, when testing for stochastic cointegration in column [3], some of the coefficients show unexpected signs, but the null of stochastic cointegration is rejected at the 5% level. More satisfactory results appear in column [4], at the same time that the null of deterministic cointegration is not rejected. As can be seen, the elasticities of labour productivity with respect to physical capital and foreign capital would be estimated at 0.31 and 0.01, respectively; whereas the elasticity with respect to the interaction between human capital and foreign capital would be estimated at 0.07. In particular, the latter result would mean that the favourable effect of foreign capital on productivity would depend on the availability of some minimum endowments of human capital, which would proxy the necessary social capability of the host economy to incorporate the new technologies.

[1] Notice that we have dropped the variable $\log L_t$, since its coefficient did not prove to be significant in any of the estimations. In other words, this would point to the presence of constant returns to scale at the aggregate level.

4 Conclusions

The objective of this paper has been to analyse the long-run effects of FDI in Spain, by estimating a production function including the foreign capital stock, for the period 1964-1997. We found a positive role of the stock of foreign capital on the evolution of labour productivity, both directly, and through its impact on human capital accumulation. This result would mean that the favourable effect of foreign capital on productivity would depend on the availability of some minimum endowments of human capital, which would proxy the necessary social capability of the host economy to incorporate the new technologies.

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Table 1
Ng-Perron tests of unit roots

I(2) vs. I(1)	Case: $p = 0, \bar{c} = -7.0$			
Variable	$\bar{M}Z_{\alpha}^{GLS}$	$\bar{M}Z_{t}^{GLS}$	$\bar{M}SB^{GLS}$	ADF^{GLS}
Δy_t	-9.50***	-2.04**	0.214**	-2.59***
Δk_t	-3.68	-1.13	0.308	-1.25
Δh_t	-13.58**	-2.60***	0.191**	-4.03***
Δfk_t	-5.54	-1.31	0.236*	-1.89*
$\Delta(h \cdot fk)_t$	-3.78	-1.06	0.281	-1.59
I(1) vs. I(0)	Case: $p = 1, \bar{c} = -13.5$			
Variable	$\bar{M}Z_{\alpha}^{GLS}$	$\bar{M}Z_{t}^{GLS}$	$\bar{M}SB^{GLS}$	ADF^{GLS}
y_t	0.46	0.30	0.667	-0.36
k_t	0.38	0.25	0.664	-0.16
h_t	-6.16	-1.74	0.283	-2.28
fk_t	-2.04	-0.99	0.486	-1.47
$h_t \cdot fk_t$	-1.81	-0.61	0.340	-1.21

Notes:

[a] *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. The critical values are taken from Ng and Perron (2001), Table 1.

[b] The autoregressive truncation lag, k, has been selected using the $MAIC$ information criterion, as proposed by Perron and Ng (1996).

Table 2
Perron-Vogelsang tests of unit roots with structural changes

Variable	Model	T_b	k	$\hat{\delta}$	$\hat{\theta}$	$\hat{\alpha}$	$t_{\hat{\alpha}}$
Δk_t	IOM	1983	3	-0.03	0.03	0.85	-4.58*
				(2.94)	(2.74)		
Δfk_t	AOM	1982	4	0.09	—	-0.13	-5.88***
				(4.27)			
$\Delta(h \cdot fk)_t$	IOM	1987	0	87332	-46293	-0.30	-5.16**
				(5.21)	(-2.53)		

Notes:

[a] *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. The critical values are taken from Perron and Vogelsang (1992a), Table 1 (AOM model) and Table 2 (IOM model), $T = 50$.

[b] t statistics in parentheses.

[c] The significant t has been selected according to the maximum order of k; in our case, $k = 5$.

[d] The estimated models are:

(i) IOM:

$$z_t = \mu + \delta DU_t + \theta D(T_b)_t + \alpha z_{t-1} + \sum_{i=1}^{k} c_i \Delta z_{t-i} + e_t$$

where $D(T_b)_t = 1$ if $t = T_b + 1$, 0 otherwise; and $DU_t = 1$ if $t > T_b$, 0 otherwise.

(ii) AOM:

$z_t = \mu + \delta DU_t + \tilde{z}_t$

where $\tilde{z}_t = \sum_{i=0}^{k} \omega_i D(T_b)_{t-i} + \alpha \tilde{z}_{t-1} + \sum_{i=1}^{k} c_i \Delta \tilde{z}_{t-i} + e_t$.

Table 3
Estimation of long-run relationships:
Stock-Watson-Shin cointegration tests

Variable	[1]	[2]	[3]	[4]
constant	5.97	2.28	-6.26	0.39
	(4.38)	(1.80)	(-114.8)	(31.4)
trend	-0.05		-0.18	—
	(-27.2)		(-122.2)	
k_t	0.20	0.30	-0.55	0.31
	(46.4)	(73.6)	(-71.2)	(20.4)
h_t	1.23	0.31	—	—
	(36.3)	(78.5)		
fk_t	0.07	-0.008	-0.80	0.01
	(24.2)	(-8.55)	(-117.6)	(2.94)
$h_t \cdot fk_t$	—	—	1.27	0.07
			(129.4)	(20.7)
C_μ	—	0.132*		0.079
C_τ	0.138***		0.091**	—

Notes:

[a] *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. The critical values are taken from Shin (1994), Table 1.

[b] t-statistics in parentheses.

[c] The number of leads and lags selected has been $q = 3 \simeq INT\left[T^{1/3}\right]$, as proposed in Stock and Watson (1993). The long-run variance of the cointegrating regression residual has been estimated using the Bartlett window with $l = 5 \simeq INT\left[T^{1/2}\right]$, as proposed in Newey and West (1987).

[d] C_μ and C_τ are the LM statistics for cointegration using the DOLS residuals from deterministic and stochastic cointegration, respectively, as proposed in Shin (1994).