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NICHOLAS APERGIS and COSTAS KATRAKILIDIS

DOES INFLATION UNCERTAINTY MATTER IN FOREIGN DIRECT INVESTMENT DECISIONS? AN EMPIRICAL INVESTIGATION FOR PORTUGAL, SPAIN AND GREECE

UNDER THE AUSPICES OF BOCCONI UNIVERSITY AND THE UNIVERSITY OF MILAN

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DOES INFLATION UNCERTAINTY MATTER IN FOREIGN DIRECT INVESTMENT DECISIONS? AN EMPIRICAL INVESTIGATION FOR PORTUGAL, SPAIN AND GREECE

by
NICHOLAS APERGIS* and COSTAS KATRAKILIDIS**

1. *Introduction*

During the 1980's, foreign direct investment (FDI) gained an increased share in the field of international economics, underlying the widely held view that FDI is replacing international trade. Indeed, FDI is considered as a key factor in the economic development of the less developed countries, since it is the only way for them to acquire capital, technology, and expertise. In addition, there is a reduction in other capital inflows such as private lending, thus, stretching the need for the governments of the host countries to show an increasing interest in order to attract FDI flows. Dunning (1993b) demonstrates that a firm decides to expand in another than the home country because of i) owner-specific advantages, ii) internalization incentive advantages, and iii) location-specific factors; consequently, the economic environment, in conjunction with the economic policy adopted, affects the business strategy of both domestic and foreign firms (Woodward and Rolfe, 1993; Brewer, 1993). Furthermore, along with the microeconomic factors, macroeconomic factors also give rise to opportunities and risks depending upon the level of uncertainty in the economic environment of the host country.

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The international literature concerning the empirical investigation of the main macroeconomic determinants of FDI inflows, connotes the importance of economic instability, wage rate increases, inflation rate, GDP growth, foreign exchange risk proxied by its own volatility, protectionist barriers, capital returns, and political instability (Bourlakis, 1987; Culem, 1988; Cushman, 1988; Papanastasiou and Pearce, 1992; Brewer, 1993; Dunning, 1993a and 1993b; Bajo-Rubio and Sosvilla-Rivero, 1994; Mainardi, 1992). Among the aforementioned determinants, the inflation rate as well as the uncertainty associated with it, have been widely considered as appropriate proxies for the degree of macroeconomic instability (Bajo-Rubio and Sosvilla-Rivero, 1994). At this point, we should note that there is substantial theoretical and empirical literature attempting to investigate possible causal effects between inflation and inflation uncertainty and their direction (Evans and Wachtel, 1993; Golob, 1994; Holland, 1995). Moreover, since it is generally accepted that economic policy responds differently and in an uncertain timing mode in cases of economic instability (Sauer and Bohara, 1995; Holland, 1995), the examination of both inflation and inflation uncertainty impacts must be considered simultaneously in order to explain FDI net flows behaviour. Neglecting to do so, biased results could be obtained.

In this paper, the analysis aims to spread more light on the macroeconomic determinants of FDI inflows by incorporating explicitly inflation uncertainty among the other explanatory factors that describe the macroeconomic environment of the host country. For our purpose, we focused on South-Europe and, in particular, we examined the cases of Greece, Portugal and Spain. This is justified by the following facts: i) Greece and Portugal have experienced the highest rates of inflation in Europe, a fact which is associated with situations of increased economic uncertainty, at least, over the period under examination, and ii) their European Union (EU) membership (Greece in 1980, Portugal and Spain in 1986), boosted FDI flows towards these countries and caused changes in their development process as well as in their trade flows with the remaining EU countries.

In our empirical analysis the Generalized Autoregressive Conditional Hederoskedasticity (GARCH) approach is employed to model inflation uncertainty. In the next step, Structural Vector Autoregressive (SVAR) modeling and Innovation Accounting techniques are used to determine the relative importance of the proposed macroeconomic factors, which are considered to influence FDI inflows in the examined host countries, with special emphasis on inflation uncertainty.

The rest of the paper is organized as follows: Section 2 discusses the

Section 4 provides some concluding remarks.

2. *Methodological Issues*

2.1. *The GARCH methodology.* - The empirical analysis employs the GARCH technique to model the uncertainty variable. GARCH modeling is considered to be superior among time series proxies, since it is possible to simultaneously model the mean and variance of a series. According to Enders (1995), conditional modeling is superior to unconditional modeling. Chou (1988), also argues in favour of GARCH models on the grounds that they are capable of capturing various dynamic structures of conditional variance, of incorporating heteroscedasticity into the estimation procedure, and of allowing simultaneous estimation of several parameters under examination.

If ε denotes the innovations in the mean for a specific stochastic process, $y(t)$, and h a time-varying, positive, and measurable function of the time t–1 information set, then the GARCH(p,q) model proposed by Bollerslev (1986) suggests that:

$$(1)\; h(t)^2 = \omega + \sum_{i=1}^{q} \alpha(i)\varepsilon(t-i)^2 + \sum_{i=1}^{p} \beta(i)h(t-i)^2 = \omega + \alpha(L)\varepsilon(t)^2 + \beta(L)h(t)^2$$

with

$$(2)\qquad 0 < \alpha(L) + \beta(L) < 1$$

Condition (2) ensures stationarity of the conditional volatility. Expression (1) could be interpreted as an ARMA model for $\varepsilon(t)^2$. Following Bollerslev (1988), the identification of equation (1) is similar to that proposed by Box and Jenkins methodology. Iterative maximum likelihood techniques are used to estimate the parameters of the GARCH model. (The employed algorithm has been developed by Berndt et al., 1974).

2.2. *The SVAR methodology.* - The (SVAR) approach is a modification of the "atheoretical" VAR approach developed by Sims (1980) who proposed that the orthogonalized innovations of the estimated VAR are interpreted as structural shocks.

Orthogonalization was achieved by ordering the variables in a way reflecting their contemporaneous causality relationships. This method was criticized on the ground that it was imposing theoretically implausible restrictions (Cooley and LeRoy, 1985). The SVAR technique, however, takes into account identifying restrictions that are derived from economic theory (Bernanke, 1986; Blanchard and Watson, 1986; Blanchard, 1989).

The variables of interest are the money supply (*M*), income (*Y*), the nominal exchange rate (*E*), prices (*P*), wages (*W*), inflation uncertainty (*H*), and foreign direct investment (*FDI*). Assume that the structural model is given by:

(3) $$X_t = \sum_{i=0}^{n} A_i X_{t-i} + u_t^x$$

where $X = (M, Y, E, P, W, H, FDI)'$, and $u^x = (u^M, u^Y, u^E, u^P, u^W, u^H, u^{FDI})'$ is the vector of the structural disturbances that are assumed to be uncorrelated. Therefore, $\boldsymbol{D} = E(u_t, u_s')$ is assumed to be diagonal and $E(u_t, u_s') = 0$ for $s \neq t$.

From (3) the estimated model is:

(4) $$X_t = \sum_{i=1}^{n} [I - A_0]^{-1} A_i X_{t-i} + [I - A_0]^{-1} u_t^x$$

or

(5) $$X_t = \sum_{i=1}^{n} C_i X_{t-i} + v_t$$

where $C_i = (I - A_0)^{-1} A_i$, and $v = (fdi, y, p, m, w, e, h)'$ are the estimated residuals. Now we have to go from the reduced form residuals (v) to the structural shocks (u). Equation (5) implies that:

(6) $$v_t = A_0 v_t + u_t$$

and:

(7) $$E v_t v_t' = (I - A_0)^{-1} \boldsymbol{D} \left[(I - A_0)^{-1} \right]'$$

The estimated variance-covariance matrix of ν, gives 49 parameters which must be identified by imposing restrictions on (6). From the 7-variable system we can have a maximum of 28 non-zero parameters in (6). A set of contemporaneous restrictions gives:

(8) $$fdi = q_1 y + q_2 p + q_3 m + q_4 w + q_5 e + q_6 h + u^{fdi}$$

(9) $$y = q_7 p + q_8 w + u^y$$

(10) $$p = q_9 y + q_{10} m + q_{11} w + q_{12} e + q_{13} h + u^p$$

(11) $$m = q_{14} y + q_{15} p + u^m$$

(12) $$w = q_{16} y + q_{17} p + q_{18} e + u^w$$

(13) $$e = q_{19} y + q_{20} p + u^e$$

(14) $$h = q_{21} p + u^h$$

Equation (8) allows the FDI to be affected by all innovations identified in the literature plus the variable of inflation volatility. Equations (9) and (10) are the equations for aggregate supply and aggregate demand, respectively. Equation (10) does not include the interest rate as a relevant variable because over most of the period under examination interest rates in Greece and Portugal were heavily regulated. Equation (11) describes a monetary policy rule. Money may respond to output, prices and the exchange rate. Equation (12) describes wage responses to income and prices, while in equation (13) the exchange rate is allowed to be affected by output and prices. Finally, in equation (14) price volatility is allowed to be affected by prices. Friedman (1977), states that higher (lower) rates of inflation are associated with higher (lower) inflation volatility. Similar results are reported in Evans and Wachtel (1993) and in Golob (1994).

To estimate the above set of contemporaneous equations, the method of moments (*GMM*) or the Instrumental Variables (*IV*) estimation method can be used. For the purposes of this research paper the former method, proposed by Bernanke (1986), has been adopted.

3. *The Empirical Analysis*

3.1. *Data*. - Quarterly data for prices (*P*), measured by the consumer price index (1990 = 100), income (*Y*), measured by the industrial production index (1990 = 100), money balances (*M*), measured by M1, the nominal effective exchange rate index (*E*) (1990 = 100), wages (*W*) measured by the hourly nominal earnings index (1990 = 100), and the foreign direct investment stock (*FDI*), measured as fixed capital inflows, for three countries, namely Portugal, Spain, and Greece were employed. The exchange rate is proxied by the effective exchange rate index, which represents the ratio of an index of the period average exchange rate of the currency in question to a weighted geometric average of exchange rates for the currencies of selected partner countries; thus, an increase in the index reflects an appreciation. The time period covered runs from 1980 to 1995 for Greece, from 1980 to 1994 for Spain, and from 1983 to 1991 for Portugal. Data were obtained from various sources of OECD Main Economic Indicators and IMF International Financial Statistics.

3.2. *Integration analysis*. - Many macroeconomic time series are characterised by unit root nonstationarities, implying that the classical *t* and *F*-tests are not appropriate (Fuller, 1985). Unit root nonstationarity is tested by using the methodology proposed by Dickey-Fuller (1981). Table 1 reports the unit root test results. The hypothesis of a unit root is rejected for all the series in first differences at the 5% significance level. Therefore, the presence of stochastic trends and the possible existence of a long-run relationship among the examined series should be investigated.

3.3. *Cointegration analysis*. - In the first step we proceed with the modeling of inflation, so as to obtain estimates of the unexpected inflation and thereafter to model the inflation uncertainty variable as the variance of the forecasting error of the inflation series, by means of the GARCH technique.

For this purpose, a VAR system for each one of the three investigated countries is postulated to obtain a long run relationship among a set of five endogenous variables, widely employed in the relevant empirical literature. These variables, in logarithmic form, are the price level (*LP*), the *FDI* (*LFDI*), the wage rate (*LW*), money (*LM*), income (*LY*) and the nominal exchange rate (*LE*). For the cases of Spain and Portugal, the VAR system includes a dummy variable that takes explicitly into consideration the 1986 accession of both countries in the EU. The strategy adopted in specifying the number of lags in the VAR models was based on Sims' (1980) Likelihood Ratio (LR) test corrected for the degrees of freedom. The LR test statistic selected a 2-lag VAR for the case of Portugal, a 3-lag VAR for the case of Spain, and a 4-lag for the case of Greece.

Table 1. Unit root tests

Variable:	*LM*	*LP*	*LE*	*LY*	*LW*	*LFI*
Portugal						
(no trend)						
Levels	–0.86	–2.83	–2.66	–1.11	–2.05	–0.16
	(4)	(4)	(4)	(4)	(4)	(4)
First diffs	–7.73*	–3.91*	–3.95*	–5.32*	–5.59*	–4.09*
	(2)	(2)	(1)	(2)	(0)	(2)
(with trend)						
Levels	–2.19	–2.16	–2.32	–1.13	–1.60	–2.20
	(4)	(4)	(4)	(4)	(4)	(4)
First diffs	–7.76*	–3.71*	–3.95*	–5.73*	–5.55*	–5.07*
	(2)	(2)	(1)	(2)	(0)	(2)
Spain						
(no trend)						
Levels	–0.73	–2.08	–1.85	–1.26	–1.39	–1.16
	(4)	(4)	(4)	(2)	(2)	(4)
First diffs	–9.35*	–3.60*	–4.34*	–4.97*	–11.91*	–8.14*
	(1)	(3)	(3)	(1)	(1)	(2)
(with trend)						
Levels	–2.39	–2.72	–1.92	–1.27	–2.35	–2.13
	(4)	(4)	(4)	(2)	(2)	(4)
First diffs	–9.27*	–3.81*	–4.35*	–5.07*	–12.11*	–7.94*
	(1)	(3)	(3)	(1)	(1)	(2)
Greece						
(no trend)						
Levels	–0.71	–0.51	–0.11	–2.57	–2.71	–0.56
	(4)	(4)	(4)	(1)	(4)	(4)
First diffs	–4.84*	–4.56*	–3.92*	–4.97*	–11.91*	–6.57*
	(4)	(2)	(4)	(1)	(4)	(4)
(with trend)						
Levels	–2.69	–2.19	–2.04	–2.51	–0.41	–2.88
	(4)	(4)	(4)	(1)	(4)	(4)
First diffs	–4.86*	–8.32*	–3.92*	–5.07*	–12.11*	–6.40*
	(4)	(2)	(4)	(1)	(4)	(4)

Notes: Numbers in parentheses denote the number of lags for the augmentation terms that ensure white noise residuals.
* indicates significance at 5%.

Table 2. Cointegration tests

List of variables included in the cointegrating vector: *LP LW LY LM LE intercept*					
r	$n-r$	$m.\lambda.$	95%	Tr	95%
Portugal (3 lags)					
r=0	r=1	57.438	34.400	135.368	76.069
r<=1	r=2	40.025	28.138	77.929	53.116
r<=2	r=3	17.075	22.002	37.903	34.910
r<=3	r=4	16.151	15.672	20.827	19.964
r<=4	r=5	4.676	9.243	4.676	9.243
Spain (4 lags)					
r=0	r=1	65.220	34.400	121.958	76.069
r<=1	r=2	20.034	28.138	56.738	53.116
r<=2	r=3	19.756	22.002	36.704	34.910
r<=3	r=4	9.745	15.672	16.948	19.964
r<=4	r=5	7.204	9.243	7.204	9.243
Greece (5 lags)					
r=0	r=1	41.034	34.400	95.309	76.069
r<=1	r=2	34.023	28.138	64.274	53.116
r<=2	r=3	19.004	22.002	40.025	34.910
r<=3	r=4	11.152	15.672	21.247	19.964
r<=4	r=5	9.095	9.243	9.095	9.243

Notes: r = number of cointegrating vectors
$n-r$ = number of common trends
$m.\lambda.$ = maximum eigenvalue statistic
Tr = trace statistic

The multi-cointegration technique proposed by Johansen and Juselius (1990) on identifying a long-run relationship among a set of $I(1)$ variables, e.g., stationary in first differences, is used. The examined relationship is yielded as an equilibrium condition between equations (10) and (11). The cointegration results appear in Table 2. For the case of Portugal the maximum eigenvalue test statistic suggests that there are two cointegrating vectors at the 5% significance level. The trace test statistic, however, suggests that there are four possible cointegrating vectors. Johansen and Juselius (1990), have argued that the maximum eigenvalue test is expected to provide more powerful results. For the same reason, for the cases of Spain and Greece, one and two cointegrating vectors respectively, exist. Normalizing the cointegrating vectors on prices and based on theoretical arguments and visual inspection for the stationarity of cointegration residuals yields the following equations:

Portugal

(15) $$p = 1.021 + 0.653\,w + 0.136\,m - 0.084\,e - 0.14\,y$$

Spain

(16) $$p = 4.665 + 0.913\,w + 0.188\,m - 0.013\,e - 0.316\,y$$

Greece

(17) $$p = 5.705 + 0.29\,w + 0.372\,m - 0.53\,e - 0.608\,y$$

3.4. *The error correction (EC) analysis*. - Having established that prices are cointegrated with wages, money, nominal exchange rates and income, it is appropriate to examine the associated EC mechanism which describes the short-run dynamics. The EC equation is in a form such as:

(18) $$\begin{aligned}\Delta p(t) = \sum_{i=1}^{j-1} a_{1i}\Delta p(t-i) + \sum_{i=1}^{j-1} a_{2i}\Delta w(t-i) + \sum_{i=1}^{j-1} a_{3i}\Delta m(t-i) + \\ + \sum_{i=1}^{j-1} a_{4i}\Delta e(t-i) + \sum_{i=1}^{j-1} a_{5i}\Delta y(t-i) + b_1 ECT(t-1) + \eta(t)\end{aligned}$$

with $b_1<0$ and ECT denoting the residuals from the cointegrating equation. All insignificant lagged variables in the above estimated equation have been omitted. The results are reported in Table 3. All ECT terms are negative and significant, indicating that prices adjust to restore long-run equilibrium after a short-run disturbance. The estimated equations satisfy absence of serial correlation and absence of functional misspecification. Next, a kurtosis test is applied in order to examine the distributional properties of the above estimated residuals obtained from the corresponding EC equations. The results, shown in Table 4, indicate the rejection of the normality hypothesis for all the residuals series, thus suggesting a further investigation for the existence of possible ARCH effects. The results obtained from the ARCH tests are also reported in Table 4 and confirm the presence of ARCH effects for the three residual series.

Table 3. Error-correction estimates

Portugal

$$\Delta LP = \underset{(5.72)^*}{0.638}\Delta LP(-1) + \underset{(3.53)^*}{0.08}\Delta LW(-1) + \underset{(4.51)^*}{0.155}\Delta LW(-2) + \underset{(3.15)^*}{0.233}\Delta LM(-1) - \underset{(-2.25)^*}{0.094}\Delta LY(-1) + \underset{(2.82)^*}{0.264}\Delta LE(-2) - \underset{(-3.62)^*}{0.248}ECT(-1)$$

$R^2 = 0.72$ $LM = 8.55$ [0.70] $RESET = 0.36$ [0.55]

Spain

$$\Delta LP = \underset{(6.37)^*}{0.475}\Delta LP(-3) + \underset{(6.33)^*}{0.096}\Delta LW(-1) + \underset{(3.21)^*}{0.064}\Delta LW(-3) + \underset{(2.14)^*}{0.041}\Delta LM(-2) + \underset{(2.63)^*}{0.089}\Delta LY(-1) - \underset{(1.92)^*}{0.097}\Delta LE(-3) + \underset{(2.30)^*}{0.043}ECT(-1)$$

$R^2 = 0.62$ $LM = 6.91$ [0.14] $RESET = 0.92$ [0.34]

Greece

$$\Delta LP = \underset{(3.48)^*}{0.251}\Delta LP(-1) + \underset{(5.87)^*}{0.51}\Delta LP(-4) + \underset{(3.75)^*}{0.213}\Delta LW(-3) + \underset{(1.89)^*}{0.04}\Delta LM(-1) + \underset{(1.93)^*}{0.05}\Delta LM(-2) + \underset{(2.41)^*}{0.031}\Delta LM(-4) + \underset{(2.50)^*}{0.058}\Delta LY(-2) + \underset{(2.20)^*}{0.094}\Delta LY(-4) - \underset{(2.63)^*}{0.085}ECT(-1)$$

$R^2 = 0.73$ $LM = 9.81$ [0.05] $RESET = 0.06$ [0.81]

Notes: Numbers in parentheses denote *t*-statistics, while numbers in brackets denote *p*-values. The symbols *LM*, and *RESET*, denote serial correlation and functional form.
* indicates significance at 5%.

Table 4. Distributional properties of the estimated residuals

Variable	Kurtosis test	*ARCH* test
RES_{POR}	5.68 (0.000)	*ARCH*(3) =11.39 (0.000)
RES_{SP}	7.15 (0.000)	*ARCH*(3) = 9.27 (0.000)
RES_{GR}	4.89 (0.000)	*ARCH*(4) = 10.24 (0.000)

3.5. *GARCH estimates.* - Having estimated the residuals from the EC processes, and having detected ARCH effects, the analysis proceeds with the estimation of the appropriate specifications for the conditional variances of the series, as proxies for the respective inflation uncertainty variables, employing the GARCH technique. A GARCH(2, 2), a GARCH(1, 2), and a GARCH(1, 2) models are identified for the cases of Portugal, Spain, and Greece, respectively. The estimation process involves a simultaneous equation model that consists of two equations, e.g., the inflation process and the GARCH process. The results are reported in Table 5.

Table 5. *GARCH* **estimates of inflation volatility**

Portugal

$$\Delta LP = \underset{(2.37)^*}{0.045}\,\Delta LP(-1) + \underset{(3.12)^*}{0.039}\,\Delta LW(-1) + \underset{(2.56)^*}{0.026}\,\Delta LW(-2) +$$

$$- \underset{(2.68)^*}{0.003}\,\Delta LM(-1) - \underset{(-1.90)^*}{0.167}\,\Delta LY(-1) - \underset{(2.88)^*}{0.199}\,\Delta LE(-2) - \underset{(2.02)^*}{0.002}\,ECT(-1)$$

$$h = \underset{(2.77)^*}{0.00015} + \underset{(2.04)^*}{0.029}\,h(-1) + \underset{(2.29)^*}{0.0075}h(-2) + \underset{(3.15)^*}{0.155}\eta^2(-1) + \underset{(2.78)^*}{0.074}\eta^2(-2)$$

Spain

$$\Delta LP = \underset{(7.65)^*}{0.516}\,\Delta LP(-3) + \underset{(5.41)^*}{0.087}\,\Delta LW(-1) + \underset{(3.05)^*}{0.046}\,\Delta LW(-3) - \underset{(2.05)^*}{0.016}\,\Delta LM(-2) +$$

$$+ \underset{(2.27)^*}{0.157}\,\Delta LY(-1) - \underset{(1.78)^*}{0.071}\,\Delta LE(-3) + \underset{(4.36)^*}{0.060}\,ECT(-1)$$

$$h = \underset{(1.04)^*}{0.000007} + \underset{(2.66)^*}{0.167}\,h(-1) + \underset{(2.58)^*}{0.274}\eta^2(-1) + \underset{(5.8)^*}{0.0979}\eta^2(-2)$$

Greece

$$\Delta LP = \underset{(4.13)^*}{0.019}\,\Delta LP(-1) + \underset{(7.19)^*}{0.436}\,\Delta LP(-4) + \underset{(6.63)^*}{0.203}\,\Delta LW(-3) + \underset{(2.80)^*}{0.036}\,\Delta LM(-1) +$$

$$+ \underset{(3.43)^*}{0.067}\,\Delta LM(-2) + \underset{(2.49)^*}{0.008}\,\Delta LM(-4) + \underset{(1.81)^*}{0.074}\,\Delta LY(-2) + \underset{(3.60)^*}{0.122}\,\Delta LY(-4) +$$

$$- \underset{(4.42)^*}{0.106}\,ECT(-1)$$

$$h = \underset{(1.99)^*}{0.00007} + \underset{(1.67)^*}{0.42}\,h(-1) + \underset{(3.02)^*}{0.345}\eta^2(-1) + \underset{(2.68)^*}{0.054}\eta^2(-2)$$

Notes: Numbers in parentheses denote absolute *t*-statistics, while numbers in brackets denote *p*-values. * indicates significance at 5%.

Once conditional estimates for inflation volatility are obtained (the fitted values of each equation), it can also be observed that they all obey a non-negative and non-explosive variance of inflation. These conditional estimates, in turn, are then used to estimate the SVAR model defined in equations (8)-(14) so as to explore the determinants of FDI inflows in the examined countries, especially focusing on the respective impact of the inflation uncertainty. This is carried over by estimating the contemporaneous equations for the series under examination and by applying innovation accounting techniques on the SVAR innovations (residuals).

3.6. *Variance decompositions and impulse response functions.* - Table 6 shows the variance decompositions for the variance of foreign direct investment. The numbers reported, indicate the percentage of the forecast error in each variable that can be attributed to each of the structural innovations at different horizons. The percentages are reported for six different horizons, i.e., 1, 4, 8, and 20 quarters, respectively. Following Blanchard and Watson (1986), the horizons are interpreted as the short-run (1 quarter ahead), the medium run (4 to 8 quarters ahead), and the long-run (20 quarters ahead).

Table 6. Variance decompositions of FDI (in %)

Forecasting horizon	Variance error of FDI due to shocks in						
	FDI	Income	Prices	Money	Wages	Ex-rate	Infl. Uncertainty
Portugal							
1	2.07	10.02	20.02	0.05	10.01	5.82	35.52
4	0.13	10.05	24.17	5.47	14.08	3.12	38.21
8	0.08	11.02	30.21	5.36	13.10	3.53	37.19
20	0.07	11.42	32.66	4.58	14.19	4.91	37.67
Spain							
1	80.76	1.81	39.42	1.05	17.82	1.65	34.39
4	0.01	2.35	41.86	2.77	12.43	3.29	37.19
8	0.00	3.44	39.55	3.92	13.63	3.48	35.66
20	0.00	3.89	37.86	5.63	16.13	3.54	35.13
Greece							
1	84.60	9.84	11.03	4.39	2.68	4.55	20.98
4	9.15	12.35	15.64	4.26	2.78	6.67	21.57
8	14.62	13.81	18.90	5.21	2.22	6.30	25.50
20	16.05	14.90	19.46	5.68	2.70	6.98	28.61

For the case of Portugal the main impact on FDI is exerted by inflation uncertainty at all forecasting horizons. The percentage of the variation of FDI explained by the uncertainty proxy varies from about 35% in the short run to about 38% in the long run. The inflation rate follows closely with 20% in the short run, 24-30% in the medium run, while in the long run this percentage exceeds 32%. Regarding the other variables involved, only wages and income could be considered to contribute, but in a minor way, by explaining 10-14% and 10-11% respectively, over the whole forecasting horizon.

For the case of Spain, the variance of the FDI is explained, primarily, by the inflation rate (37.9-41.9%), closely followed by the inflation uncertainty (35-37.2%), in all examined horizons. Wages exert secondary but significant in magnitude effects, varying from about 13.6% to about 17.8%.

Finally, for the case of Greece, the contribution of inflation uncertainty dominates over all horizons with percentages varying from about 21% in the short run to about 28.5% in the long run. The inflation rate and the income appear to have a minor contribution, mainly in the medium run and in the long run with a 15.6-19.5% and 12.3-14.9%, for the two variables respectively.

Next, Table 7 displays the results from the impulse response analysis. The figures report the response of FDI to typical shocks of one standard deviation in the variables of the estimated VARs for the examined countries.

Table 7. Impulse responses

Forecasting horizon	Response of FDI to shocks in	
	Inflation rate	Inflation uncertainty
Portugal		
1	−0.024400 (0.0375)	−0.013391 (0.0313)
4	−0.007630 (0.01415)	−0.003585 (0.02356)
8	−0.000540 (0.00274)	−0.001746 (0.00497)
20	−0.000008 (0.00005)	−0.000003 (0.00002)
Spain		
1	−0.010595 (0.0391)	−0.015776 (0.0186)
4	−0.004620 (0.0153)	−0.003173 (0.00834)
8	−0.001790 (0.00421)	−0.000713 (0.00175)
20	−0.000020 (0.00011)	−0.000008 (0.00003)
Greece		
1	−0.08220 (0.0469)	−0.048690 (0.06788)
4	−0.00904 (0.0358)	−0.015115 (0.03887)
8	−0.00541 (0.02014)	−0.005560 (0.01475)
20	−0.00180 (0.00745)	−0.001320 (0.00283)

Note: Numbers in parentheses denote standard deviation of the response

Based on variance decompositions as well as on the focus of this research paper, that is, the impact of inflation uncertainty on FDI inflows, we report only the figures obtained when the inflation rate and the inflation uncertainty are being shocked. The findings stress the negative impact of these two variables on FDI inflows. Furthermore, the response of FDI, in all the examined countries, seems to attain its peak during the short run and declines after the fourth quarter.

Overall, the variance decompositions stretch the role of inflation volatility (uncertainty) in the host economy as the major factor affecting the behaviour of foreign direct investment. Therefore, policy makers to encourage more FDI inflows in the host economies must reduce inflation and, therefore, inflation uncertainty.

4. *Concluding Remarks*

We have examined throughout this paper the relevance of inflation volatility (uncertainty) to the behaviour of FDI inflows received by three European economies, namely, Spain, Portugal, and Greece. To this end, variance decompositions and impulse response functions were employed to detect the relative contribution of the variability of inflation, in conjunction with other certain economic variables characterizing the macroeconomic environment of the host country, namely, prices, income, money, wages, and the nominal exchange rate.

After using an EC equation to model inflation, the GARCH methodology was employed in order to estimate inflation uncertainty. The latter was next used to built a SVAR model – associated with certain theoretical restrictions – which involved explicitly inflation uncertainty as an endogenous variable.

Overall, the variance decompositions as well as the impulse response results provided support to the thesis that inflation uncertainty in the host country seems to play a significant role in explaining FDI movements.

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ABSTRACT

This paper examines the relevance of inflation uncertainty to the behaviour of FDI inflows received by three European economies, namely, Spain, Portugal and Greece. To this end, the GARCH approach and SVAR modeling are used in conjuction with variance decompositions and impulse response functions. The results from the empirical analysis support the thesis that inflation uncertainty in the host country significantly affects FDI movements.

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