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FOREIGN EXCHANGE EXPOSURE ON THE SPANISH STOCK MARKET: SOURCES OF RISK AND HEDGING

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A B S T R A C T

This paper examines the foreign exchange exposure of a sample of 67 non financial companies quoted in the Spanish Stock Exchange Market between January 1992 and December 1997. Therefore, time series regressions of stock returns on market return and movements in the exchange rates are carried out. Next, a cross-sectional analysis is executed in order to determine whether the level of economic exposure explains export, import, foreign debt levels and the foreign currency hedging proxies. The results indicate the existence of economic exposure in many companies. It has also been found that the cross sectional variation in exchange-rate risk of firms is related to the firm's operational and financial characteristics as well as foreign currency hedging proxies.

KEY WORDS: Foreign Exchange Rate Risk; Economic Exposure; Hedging; Stock Prices.

1.-INTRODUCTION.

Exchange rate movements can affect the value of companies, as it directly affects their cash flow, and indirectly affects their cost of capital. This is what is known as foreign exchange economic exposure, and results from changes of the home currency value of the firms to unexpected changes in exchange rates. The extent of this risk depends not only on the amount of international transactions the companies analysed execute, but also on the extent to which the economies in which they carry out their transactions are exposed to foreign influences. This exposure to risk, in turn, has two different facets, as Cornell and Shapiro (1983) point out: the *transaction exposure*, which is the possibility of incurring exchange gains or losses, upon settlement at a future date, on transactions already entered into and denominated in a foreign currency, the effects of which normally are in the short term, and the *operating exposure*, which results from the fluctuations in currency value, which, together with price adjustments, can affect the forecasted amount of the company's operational cash flow, thereby giving rise to long-term effects.

Considering the increasing globalization and interdependency of national economies that is taking place, it is logical to assume that there could be a link between the fluctuations in foreign currency exchange rates and the value of firms, even in the case of companies that are geared exclusively to their domestic markets. In this regard, many theoretical models, such as Heckerman's (1972), Shapiro's (1975), Choi's (1986) and Levi's (1990 and 1994) among others, emphasize the effect that exchange can have on a company's cash flow. However, the empirical studies aimed at analysing such a relationship [Jorion (1990) on the USA market, Loudon (1993) and Khoo (1994) on the Australian market or Martínez Solano and Gómez Sala (1996) on the Spanish market], show that only a small number of firms have been significantly affected by these fluctuations in the exchange rates. On the other hand, the studies published by Booth and Rotenberg (1990) and by Choi and Prasad (1995) on the Canadian and American markets respectively, show a greater number of companies being significantly affected.

Other studies have grouped the firms into portfolios, according to their specific type of operations. In this regard, Jorion (1991), Bodnar and Gentry (1993), Fang and Loo (1994) and Martínez Solano (1997) present groupings according to industries, while others

categories companies according to the sort of risk they're exposed to, grouping them for example as exporters, Amihud (1994), or as exporters after their import levels have been compensated for, as in the case of Allayannis (1995). Once again, their results show relatively low significant effects, although, with the inclusion of the lagged effects in the analyses of Amihud (1994) and Allayannis (1995), the final result proved to be more significant.

To justify this slight influence exerted by the contemporary fluctuations in the exchange rates, Bartov and Bodnar (1994) site the complexity of the evaluation, confirming the existence of lagged effects on the USA, while Doukas, Hall and Lang (1997) were unable to document any evidence in support of the lagged reponses hypothesis for Japanese firms. Moreover, Allayannis and Ofek (1996) demonstrate that, on the USA market, the application of derived instruments reduces the extent of economic exposure to exchange risk. This is also confirmed by Wong (1997). However, while the short-term impact (exposure on individual transactions) can be hedged by the use as financial instruments, the long-term effects (operational exposure) are much more difficult to control. On this point, Chow, Lee and Solt (1997) point out that the real effects of the exchange rates are seen in the long term, rather than on the short term, which is consistent with the difficulty found in trying to evaluate these effects on a month to month basis. Likewise, Rees and Unni (1996) suggest the need to consider longer horizons for estimating exposure of European firms.

Finally, many of the studies mentioned here have analysed whether exchange rate exposure is related to the degree of foreign involvement. Most notably, Booth and Rotenburg (1990) concentrate on the proportion of foreign to total sales, foreign to total assets and foreign to total long term debt, as well as other dummy variables that are only applicable to the Canadian market. Jorion (1990), Martínez Solano and Gómez Sala (1996), and Allayannis and Ofek (1996) have all analysed the levels of exportation. Bodnar and Gentry (1993) have attempted to explain the levels of exposure to risk according to industry, basing them on variables like export ratio, import ratio, foreign assets to total assets and a dummy variable for non-traded industries. Fang and Loo (1994), and Allayannis (1997), have, for their part, concentrated on the levels on both importation and exportation. Furthermore, Choi and Prasad (1995) have analysed the levels of exports, foreign assets and foreign operating profits. Finally, Doukas, Larry and Lang (1997) have studied the export ratio, the size and the foreign debt. In general terms, these studies conclude long positions in foreign currencies are

positively affected by the depreciation of the local currency, while short positions by appreciations.

The purpose of this study is to analyse the effects that the fluctuations in the foreign currency exchange rate have on a sample of quoted non financing companies in the Spanish Stock Exchange, and if the cause of these effects are found in the level of exports, imports, foreign debt and foreign currency hedging proxies of these companies. To this effect, we first evaluate the sensitivity of stock returns to the movements in the exchange rate of the Peseta from January 1992 to December 1997. We then contrast the determinant factors of the foreign exchange risk as well as the foreign currrency proxies, in an effort to evaluate their relevance and to determine how they affect the level of the exposure to foreign exchange risk. The results show that the rate of exchange affects a great number of firms, partly due to the levels of their commercial and financial operations abroad.

The study is presented as follows: In Sections II and III, methodology and data are presented. We then present the results obtained from our measurement of exchange risk exposure and the analysis of the determinant factors and hedging. In the last section, we present our main conclusions.

2.- METHODOLOGY OF THE RESEARCH.

Dumas (1978), Adler and Dumas (1984) and Hodder (1982) suggest the measurement of economic exposure to exchange-rate changes as the regression coefficient of the real value of the firm on the exchange rate across states of nature. Our evaluation of foreign exchange economic exposure has been done, following Jorion (1990) and others[2], by calculating the coefficient β_{xi} in the time series regression of returns on a given asset, R_{it}, with respect to the market returns, R_{mt}, and the monthly fluctuations of foreign exchange rate R_{xt}. In other words:

[2]Loudon (1993), Bodnar and Gentry (1993), Fang and Loo (1994), Amihud (1994), Khoo (1994), Allayannis (1995), Choi and Prasad (1995), Martínez Solano and Gómez Sala (1996), Allayannis and Ofek (1996), Doukas, Larry and Lang (1997).

$$R_{it} = b_{0i} + b_{mi} R_{mt} + b_{xi} R_{xt} + e_{it} \qquad \text{t= 1,...,T} \qquad [1]$$

In which the coefficients β_{mi} and β_{xi} represent a measure of sensitivity of stock return, ***i***, to market risk and exchange risk; ε_{it} is disturbance term. The introduction of market returns as second independent variable, explicitly controls for market movements, thereby reducing any correlation between disturbances and consistent with CAPM.

The value obtained for β_{xi}, for the different firms is interpreted as the level of exposure to foreign exchange rates, since it indicates the sensitivity that a stock shows towards these fluctuations. R_{xt} is the rate of change in a trade-weighted index value measured as the exchange rate of Spanish Peseta against the foreign currencies. A positive coefficient means that stock return increases when the Spanish Peseta is depreciated. As Schnabel (1989) points out that if the exposure coefficients to exchange-rate risk are to be expressed in as many independent variables as the number of foreign currencies that appear in firm's transactions, this multi-currency approach may well give rise to multicolineality problems, due to the high correlation that exists between the different exchange rates. For this reason we have employed in this study, as has been done in the majority of previous studies, an index that measures the effective exchange rate of the Peseta against all of the other currencies.

The time series regression [1] is used to examine the levels of exposure to foreign exchange rate changes that should be reflected in the statistic significance of the coefficient β_{xi}, (two-tailed test) and the direction of such exposure, which is indicated by the sign that accompanies the coefficient. The statistic significance of the sign is contrasted by one-tailed test.

In order to analyse the long horizon effects of exchange-rate movements on stock returns, the long horizon regression proposed by Hodrick (1992) between others has been applied. Specifically, the time series regression of the contemporary stock returns on the exchange-rate calculated over the long horizons. This specification, which has aggregated the

exchange-rate movements over the previous periods, has been chosen because many studies confirm lagged effects of foreign exchange-rate in the value of companies. The model is as follows:

$$R_{it} = \beta_{0i} + \beta_{mi} R_{mt} + \beta_{xi}^{n} \left[\prod_{j=0}^{n}(1 + R_{xt-j}) - 1\right] + \eta_{it} \qquad \textbf{t= 1,...,T} \qquad \textbf{[2]}$$

$$\textbf{j= 0,...,n}$$

In which, the independent variable $\left[\prod_{j=0}^{n}(1 + R_{xt-j}) - 1\right]$, represents the accumulated returns on the exchange rate changes, through the previous "n" periods, and β_{xi}^{n} is the coefficient; η_{xi} represents the error term, and all the other variables are exactly the same as those described above.

With regard to the identification of the determinant factors of the exposure to foreign exchange risk, we propose a cross-sectional regression between the coefficient of exposure, $\hat{b}_{xi}$ as estimated in equation [1], or the coefficients obtained from the long horizon regression [2], and the corresponding explanatory factors. The proposed model takes the following form:

$$\hat{\beta}_{xi} = \gamma_0 + \sum_{f=1}^{4} \gamma_f F_{fi} + \mu_i \qquad \textbf{i=1...N} \qquad \textbf{[3]}$$

In which F represents the value of the explanatory factor "f" for the company "i" during the period under analysis; parameter γ_f is the coefficient of the factor "f" and μ_i. is the error term.

Model [3] serves as a base for contrasting the explanatory factors of foreign exchange risk. The relevance and direction of each of these factors, therefore, are derived from the sign and the significance that applies to their corresponding coefficients within the regression equations previously mentioned.

The two stages evaluation process described and employed for the identification of the determinants of exchange-rate exposure, can give rise to several econometric problems. In the first place, if the error terms obtained in models [1] and [2] had any correlation across

companies, then the estimated exposure coefficients $\hat{b}_{xi}$, would not be independent. A correlation among coefficients would generate correlation across error terms in the cross-sectional regression that violates the classical OLS assumptions. However, the inclusion of market returns, as we have done in models (1) and (2), minimises this problem, since, as Jorion (1990) points out, it eliminates most of the correlation among the fluctuations.

The second econometric problem that arises is the measurement errors in the evaluation of the coefficients of foreign exchange exposure as calculated in the first stage, with the subsequent bias of the parameters γ_t to be evaluated in the second stage. The measurement errors in the dependent variable, however, do not represent an important problem in to estimating least squares.

3.- SAMPLE SELECTION AND DATA DESCRIPTION.

The period of analysis chosen was January 1992 to December 1997, in order to analyse the exchange risk economic exposure of Spanish companies after the European Monetary System crisis started at 1992.

We have used data taken from the continuos Spanish Stock Market, which comprises 125 common stocks, in which the prices of the shares have been adjusted for dividend and capitalisation changes. Furthermore, we have obtained information on the market returns from the general index of the Madrid Stock Exchange. Monthly compounded returns are calculated as the month to month changes in the price of the shares, after adjusted, and in the market index.

The original data base, which comprises 125 companies has been adjusted in two ways. On the one hand, we eliminated all those shares that belonged to banks (25), insurance firms (4), property companies (9), and investment trusts (9). These firms were excluded mainly because of the difficulty there would have been in establishing a homogeneous yard-stick with regard to the other firms, as far as their international transactions, exports and imports are concerned, all of which are necessary variables in establishing their level of exposure to exchange risk. On the other hand, we have not included any shares that have not

been traded on the Stock Exchange throughout either of the two periods we have chosen for analysis. Our final sample, therefore, consists of 67 companies for the whole period under analysis.

For evaluating the monthly exchange-rate change of the Peseta, we have used the nominal effective exchange-rate index, trade-weighted, on the Peseta. This has been calculated from the bilateral nominal rates on Peseta against the principal currencies of the more developed countries. The weights are based on data published by the Spanish Central Bank (Banco de España)[3]. Any increase of this index indicates a depreciation of the Spanish currency.

Finally, the data employed in the cross-sectional regression [3] are taken from different sources. The import and export ratios were taken from the publication *Duns 50,000* that is published by the firm Dun and Bradstreet International. In order to approach the debt ratios, foreign debt ratios and foreign currency adjustment, the figures were taken from the annual financial reports for the years 1992, 1993 and 1994. To be precise, we have used the average figure for the three years, except in a few cases where all of the data was not available. Furthermore, we should point out that the information we present with regard to these ratios is of a consolidated nature. Panel (A) in Table (4) reports statistics of these variables that have been used in cross-sectional analysis.

4.- TEST AND RESULTS.

We shall now present the results obtained from the regression through the generalised method of moments (GMM), with the condition that each of the right-hand variables is uncorrelated with the residual, which is equivalent to application of the OLS estimator. As serial correlation problems could arise in the regressions of time series [1] and [2], we have employed GMM in connection with the evaluation method proposed by Newey and West (1987) to obtain the covariance matrix in presence of both heteroscedasticity an autocorrelation. Furthermore, as problems of heteroscedasticity could arise in the cross-sectional regression [3], we have employed White's (1980) approach in evaluating this.

[3] Banco de España (1991): *Boletin Estadistico*, Noviembre.

Finally, because of the small correlation that exists between the independent variables of the time series regression, as can be see in Table (1), no problems of multicolineality are foreseen, so that orthogonalisation seems quite unnecessary.

4.1.- A firm level analysis.

We shall begin by examining the exchange risk sensitivity of individual firms in our sample for two different horizons: contemporary exchange-rate movements, model [1], and exchange-rate changes over the previous twelve months, model [2]. The distribution of the estimated exposure coefficients for the two horizons is presented in Panel (A), Table (2). The exchange-rate horizon for the second model has been established over twelve months because of previous studies like those by Allayannis (1995) who discovered the long-term impact of these fluctuations and a significant level of exchange risk exposure over the period of a year, as opposed to no significant level of exchange risk in the short-term. Moreover, Chow, Lee and Solt (1997), using long-horizon regression, confirm the long term effects of fluctuations in the exchange rates on the return of the firms, especially for twelve month periods and longer.

The results of our first examination show, as can be seen in Panel (A) of Table (2), that the average level of exposure for these firms does not indicate any great difference between the two horizons analysed, although these are a change in the sign of the mean impact, from a negative effect of the contemporary horizon, to a positive effect in the one year horizon. The individual exposure coefficients range from 2.0161 and -2.1171 for the contemporary exposure, whereas for the accumulated exposure the exposure coefficients are between 0.5785 and -0.4769.

Moreover, with regard to the significance levels of exchange-rate exposure coefficients, we can see that 14 out of 67 companies (20.90%) are significantly exposed to the contemporary fluctuations in the exchange-rate at the five percent level and 15 (22.39%) at the ten percent level. Nevertheless, the impact of exchange-rate movements on the

previous year show that the number of companies presenting statistically significant coefficients increased until 17 (25.37%) and 20 firms (29.85%) at five and ten percent respectively (see Panel (B) and Panel (C) in Table (2)).

Furthermore, for analysing the direction of exposure, a one-tailed test has was carried out in order to contrast significant signs of exposure. The results are presented in Panel (D) in Table (2). The contemporary exposure shows 24 firms with significant signs of exposure (35.82%) at ten per cent, mainly negative (17 of them), whereas for the long horizon regression was 32 companies (47.76%), most of them positive (28 firms).

In spite of the relevance exchange-rate changes have to the returns of a great number of firms, the percentage of return explained by it is minimal, as can be seen in the analysis of values obtained for R^2. Indeed, if we omit the variable R_{xt} from the equations [1] and [2], the mean value of R^2 is reduced by only 2.37% and 2.03% for the contemporary and year horizon effects.[4]

4.2.- Portfolio level analysis.

As can been seen from the individual analysis, the exposure coefficients differ greatly from one firm to another. We shall now examine the economic exposure of foreign exchange risk according to portfolios. In order to do this, we have grouped the companies according to their specific type of exposure to risk, regardless of the sector they belong to. The purpose of this exercise is to group firms which are homogenous in their levels of exposure (long or short positions), and who would therefore respond similarly to fluctuations in the exchange rate. These groups are as follows:

a) Portfolio of net exporters. Composed of those companies that having deducted their imports have shown an export percentage that is higher than 25% of their sales. There are eleven companies in this category.

[4] These low results are not exclusive to this study, but rather are better than the 1.17% obtained by Loudon (1993) for the Australian market, or the 1.08% found by Martínez Solano and Gómez Sala (1996) for the Spanish market in a previous period.

b) Portfolio of net importers. Made up of those companies that have had a level of imports that, after deducting their exports, is higher than 25% of their sales. There are three firms in this category.

c) Purely foreign debt portfolio. Composed of those firms that have had neither exports nor imports, but who show levels of debt in foreign currencies of at last 25% of their total debt. There are six companies in this category.

d) Purely domestic portfolio. Made up of those companies that have had no exports, no imports and no debts in foreign currencies. There are nine companies in this group.

In forming our portfolios of exporters, importers and firms with foreign currency debts, we decided to use only those companies that had high levels of net exposure (25%), so that the groups would be clearly defined, even at the cost of reducing the number of firms available for analysis.

Table (3) shows the results of the exposure coefficients for these different portfolios, as equally weighted as value weighted portfolio. As can be seen, in spite of their low levels of statistical significance, most of the groups have experienced the sort of effect, positive or negative, that would be expected for them. In other words, the export portfolio has benefited from the depreciations of the Peseta, while the importers, only for the contemporary exchange-rate changes, and those with foreign debt have suffered the negative effects of these depreciations. However, contemporary effects for domestic portfolio present a negative impact instead of the positive influence that a depreciation of Spanish currency might have had in the domestic-oriented companies.

With regard to the statistical significance of the different portfolios under analysis, the net exporters present relevant coefficients at 5% except for the contemporary effects on the equally weighted portfolio. In contrast, net importers and foreign debt portfolios have only been significantly affected at 10% level, two-tail and one-tail tests respectively, for the equally weighted portfolio with respect to the contemporary fluctuations in the exchange-rate. Finally, the domestic group has shown results statistically significant on the regression model [2]. These low results in the case of some portfolios are not exclusive to the Spanish market,

as the results of other studies, such as Amihud's (1994) clearly show for portfolios of exporters.

4.3.- Determinant factors of exchange rate exposure.

It has been clearly shown that the formation of portfolios of firms, according to their specific types of exposure to exchange risk, reveals results that are, in general, consistent and relevant, with regard to the impact of the exchange rate on the return of these portfolios. On the basis of these results, we shall now examine whether or not the firm's exchange-rate exposure is related to the degree of foreign involvement. To do this, we have applied the cross-sectional regression shown in model [3], where the determinant factors of exchange-rate exposure were: *Export ratio*, calculated as the proportion of foreign to total sales; *Import ratio*, calculated as the fraction of imports to total sales; and *Foreign Debt ratio*, calculated as a proportion of foreign to total debt.

In addition to these three variables, which clearly define the companies' foreign transactions, the *Debt ratio*, calculated as the proportion of total debt to total assets, is now introduced. This fourth new variable, which may seem to have little apparent relationship with the exposure to exchange-rate risk, has been included to ensure that the ratio that applies to debts in foreign currencies does not include the effect of the debt itself.

Exporting companies are expected to gain from a depreciation in their domestic currency. Therefore, positive relationship would be expected between the economic exposure coefficients and the export ratio. However, those companies that either buy their factors abroad or borrow in foreign currency, are affected negatively from a depreciation in their currency, and then the import ratio and the foreign debt ratio are expected to be inversely related to the firms's exchange-rate exposure. There is a sample of 67 firms an yet we have only considered 64 in some of the regressions because there were no data available on the imports and exports for three of them. Panel (B) in Table (4) reports the simple correlations of the different factors analysed here.

Panel (A), in Table (5), shows cross-sectional regressions between either the exposure coefficient of contemporary exchange-rate changes, equations (1) and (2), or the exposure

coefficients of exchange-rate changes on the previous 12 months, equations (3) and (4), and the explanatory factors. Furthermore, in equations (2) and (4) insignificant coefficients at least at 10% have been considered equal to zero.

The results show that exports appear to be explanatory factor of the contemporary foreign exchange risk at 5% level (equations (1) and (2)) and 10% level (equation (3)), while imports is significant at 10% (one-tail test) and 5% level (two-tail test) in the equations (1) and (2) respectively. The signs obtained (positive or negative) support the assumption that the depreciations of the Peseta have a positive effect on export companies and a negative effect on import firms.

However, foreign debt does not appear to be an important contemporary factor, only its sign is significant at 10% (one-taild test) in equation (2), although 40 firms bear such foreign debt, and in spite of the fact that it represents more than 10% of the total debt of 21 companies. Furthermore, it has a positive sign with no economic meaning, as it implies that the positive revaluations of the Peseta would negatively affect those firms that have debts in foreign currencies, although this situation actually implies a reduction of the principal debt and its interests. However, foreign debt appears to be a significant factor at 5% level (two-tail test) for the equation (3), with the negative sign that would be expected for it

The level of total variability of the contemporary coefficient $\hat{b}_{xi}$ as explained by the model (adjusted R^2) is only 8.82% for the equation (1) in spite of the fact that a great part of the determining factors of the level of economic exposure have been introduced. However, the adjusted R^2 increases to 18.29% when we consider the not significant coefficients as zero, which can be seen in equation (2) in Panel (A) of Table (5). In the case of the long horizon coefficients the results are much lower.

4.4.- Exchange rate risk hedging.

We shall now examine the relationship between the level of foreign exchange risk exposure and the foreign currency hedging of firms. The purpose of this exercise is to contrast whether or not the use of financial derivatives reduces the economic exposure of

firms. However, the main problem here is that Spanish companies are not required to publish theirs position on financial instruments that are usually off-balance. Therefore, in this case we must proxy the foreign currency hedging by other variables. Particularly, the *Size*, the *Absolute Value of Foreign Currency (FOREX) Adjustment to Size ratio* and the *Foreign Debt ratio*.

The basic idea is that foreign exchange risk hedging should reduce the economic exposure of firms. In this way, Bodnar, Hayt, Marston and Smithson (1995) show, through a survey for the USA market, that the use of financial instruments for hedging foreign currency risk is positively related to the size of the firm. Furthermore, Allayannis and Ofek (1996), whilst analysing the explanatory factors on the use of foreign currency derivatives, confirm this fact for the same market, namely that the size of firms is positively related to the use of foreign currency derivatives. In this way larger firms use more financial instruments for hedging foreign exchange risk than smaller firms. Therefore, our first proxy of hedging activities is the size measured as market capitalization[5]. Then, a negative relationship would be expected between the size of firms and the absolute value of their economic exposure coefficients.

The second variable used to analise the hedge of the firm was the absolute value of foreign currency adjustment over size ratio. Foreign currency adjustment represents net realized and unrealized exchange gain (loss) included in determination of income for the year. Therefore, companies with no foreign transactions will not present foreign currency adjustment, whereas those firms with foreign transactions will present foreign currency adjustment and these will be related to the level of hedging of their transactions abroad. Moreover, it is expected that companies with foreign operations and no hedge will have higher coefficients of exposure than companies with the same level of foreign operations but with hedging. Then a positive relationship should be expected between FOREX adjustment (in absolute value) over size ratio and the absolute value of exposure coefficients.

Next, we contrast the use of foreign debt for hedging the exchange-rate exposure. Companies with long positions in foreign currencies can use foreign debt as a natural hedge. Therefore, we shall analyse this possibility for firms with positive levels of exports after

reducing imports. In this case, the sample has only thirty companies in the cross-sectional regressions (6) and (8). A negative relationship is expected for these companies between the foreign debt level and their levels of economic exposure.

In order to analyse the exchange risk hedge effects on the levels of economic exposure, a cross-sectional regression has been carried out between either the absolute value exposure coefficients of contemporary exchange-rate changes, equations (5) and (6), or the absolute value exposure coefficients of exchange-rate changes on the previous twelve months, equations (7) and (8), and the hedging proxy variables.

Regression results for equations (5) to (8) are reported in Panel (B) of Table (5). First of all, we find that the market capitalization is negative and statistically significant for all of the equations analysed. This supports the hypothesis that currency hedging increases with the size of the firms and, therefore, reduces the exchange-rate exposure.

With regard to the second variable analysed, the absolute value of foreign currency adjustment over size, the results are consistent with our hypothesis for contemporary exposure, equations (5) and (6), showing a positive coefficient in both of them, although only in the first case has the coefficient been statistically significant at 5%. However, for equations (7) and (8) we have found a negative relationship, being only significant at 10% in the first one.

Finally, the last variable that we have used in order to proxy the foreign debt hedge strategy (in companies with foreign currency long position) implies that those firms with higher levels of foreign debt have presented higher levels of economic exposure. However, this result was only been significant for the contemporary exposure coefficients, as can be seen in equation (6). This result has no economic sense, nevertheless, we only know the foreign currency positions of these firms with respect to exports, imports and foreign debt but we do not the whole of positions, long or short, that they have been exposed to.

5.- CONCLUSIONS.

[5] This proxy has also been used in Doukas, Hall and Lang (1997).

In this paper, the foreign exchange economic exposure on the Spanish Stock Market and its determinant factors have been analysed. To do this, a sample of 67 non-financial companies quoted from January 1992 to December 1997 have been examined.

The level of exposure was obtained from time-series regressions between monthly return of firms or portfolios, as a dependent variable, and the monthly market return and the nominal effective exchange-rate change of the Spanish currency as independent variables. The coefficient of the variable exchange rate indicates the level of exposure of each company.

The results show that 20.90% of companies analysed have had their returns affected by the contemporary fluctuations in the exchange rate, although this percentage increases to 25.37% when the exchange-rate changes are calculated on the previous twelve months. The four specific portfolios that have been established (net exporters, net importers, foreign debtors and purely domestic), experience low levels of exposure, except exports portfolio as well as domestic portfolio on the long horizon.

The second part of our study was dedicated to the analysis of levels of exports, imports and foreign debt as possible explanatory factors of exchange rate risk exposure, as well as a study of effects of foreign currency hedging on the levels of economic exposure. Then, a cross-sectional regression between the exposure coefficients, as a dependent variable, and the previous factors as independent variables were carried out.

The results show that exports, imports and foreign debt are decisive factors in the level of economic exposure to exchange rate risk. Exports have a positive effect on returns as a result of the exchange rate changes, whereas imports have a negative effect. However, foreign debt is negative only for the one-year exchange-rate changes. Furthermore, the results suggest that economic exposure is inversely related to the size of firms, which has been used as foreign currency hedging proxy, confirming that foreign currency hedging reduces exchange-rate exposure.

REFERENCES.

Adler, M. and B. Dumas (1984): "Exposure to Currency Risk: Definition and measurement", *Financial Management*, Summer, pp. 40-50.

Allayannis, G. (1995): "Exchange Rate Exposure Revisited", 55th *Annual American Finance Association Conference*, Washington, (January 6-8).

Allayannis, G. (1997): "The Time-Variation of the Exchange Rate Exposure: An Industry Analysis", 57th *Annual American Finance Association Conference,* New Orleans, (January 5).

Allayannis, G. and E. Ofek (1996): "Exchange Rate Exposure, Hedging, and the Use of Foreign Currency Derivatives", *Working Paper*, Univ. of Virginia.

Amihud, Y. (1994): "Exchange Rates and the Valuation of Equity Shares", *en Amihud, Y. y R. Levich (eds)*: *Exchange Rates and Corporate Performance*, New York., Irwin, capítulo 4.

Banco de España (1991): *Boletín Estadístico,* noviembre.

Bartov, E. and G. M. Bodnar (1994): "Firm Valuation, Earnings Expectations, and the Exchange-Rate Exposure Effect", *Journal of Finance*, vol. 49, no. 5, December, pp. 1755-1785.

Bodnar, G. M. and W. M. Gentry (1993): "Exchange Rate Exposure and Industry Characteristics: Evidence from Canada, Japan, and the USA", *Journal of International Money and Finance*, vol. 12, February, pp. 29-45.

Bodnar, G. M.; G. Hayt; R Marston and W. Smithson (1995): "Wharton Survey of Derivatives Usage by U. S. Non-Financial Firms", *Financial Management*, vol. 24, Summer, pp. 104-114.

Booth, L. and W. Rotenberg (1990): "Assessing Foreign Exchange Exposure: Theory and Application Using Canadian Firms", *Journal of International Financial Management and Accounting*, vol. 2, June, pp. 1-22.

Choi, J. J. (1986): "A Model of Firm Valuation with Exchange Exposure", *Journal of International Business Studies*, Summer, pp. 153-160.

Choi, J. J. and A. M. Prasad (1995): "Exchange Risk Sensitivity and Its Determinants: A Firm and Industry Analysis of U.S. Multinationals", *Financial Management*, vol. 24, no. 3, Autumn, pp. 77-88.

Chow, E. H., W. Y. Lee and M. E. Solt (1997): "The Exchange-Rate Risk Exposure of Asset Returns", *Journal of Business*, vol. 70, no. 1, pp. 105-123.

Cornell, B. and A. C. Shapiro (1983): "Managing Foreign Exchange Risks", *Midland Corporate Finance Journal*, Fall, pp. 16-31.

Doukas, J. P. H. Hall y L. H. P. Lang (1997): "Exchange-Rate Exposure, Stock Returns and the Pricing of the Currency Risk in Japan", *Annual EFMA-FMA European Conference*, Istanbul, June.

Dumas, B. (1978): "The Theory of the Firm Revised", *Journal of Finance*, vol. 33, no. 3, June, pp. 1019-1033.

Dun & Bradstreet (1994): *Duns 50.000*, Barcelona.

Dun & Bradstreet (1995): *Duns 50.000*, Barcelona.

Fang, H. and Loo, J. C. H. (1994): "Dollar Value and Stock Returns" *International Review of Economics and Finance*, vol. 3, no. 2, pp. 221-231.

Heckerman, D. (1972): "The Exchange Risks of Foreign Operations", *Journal of Business*, vol. 45, no. 1, January, pp. 42-48.

Hodder, J. E. (1982): " Exposure to Exchange-Rate Movements", *Journal of International Economics*, vol. 13, November, pp. 375-386.

Hodrick, R. J. (1992): " Dividend Yields and Expected Stock Returns: Alternative Procedures for Inference and Measurement", *Review of Financial Studies*, vol. 5, pp. 357-386.

Jorion, P. (1990): "The Exchange-Rate Exposure of U.S. Multinationals", *Journal of Business*, vol. 63, no. 3, pp. 331-345.

Jorion, P. (1991): "The Pricing of Exchange Rate Risk in the Stock Market", *Journal of Financial and Quantitative Analysis*, vol. 26, no. 3, September, pp. 363-376.

Khoo, A. (1994): "Estimation of Foreign Exchange Exposure: an Application to Mining Companies in Australia", *Journal of International Money and Finance*, vol. 13, no. 3, pp. 342-363.

Levi, M. D. (1990): "*International Finance. The Markets and Financial Management of Multinational Business*, Singapore, McGraw-Hill, capítulo 18.

Levi, M. D. (1994): "Exchanges Rates and the Valuation of firms", *en Amihud, Y. y R.. Levich (eds)*: *Exchange Rates and Corporate Performance*, New York, Irwin, capítulo 3.

Loudon, G. (1993): "The Foreign Exchange Operating Exposure of Australian Stocks", *Accounting and Finance*, vol. 33, no. 1, May, pp. 19-32.

Martínez Solano, P. (1997): "La sensibilidad al riesgo de cambio en función de las características sectoriales", *Actualidad Financiera*, no.11, Noviembre, pp.61-71.

Martínez Solano, P. and J. C.” Gómez Sala (1996): "Exposición económica al riesgo de cambio de las empresas cotizadas", *Revista Europea de Dirección y Economía de la Empresa*, vol. 5, no. 1, pp. 51-60.

Newey, W. and K. West (1987): "A Simple Positive Semi-definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix", *Econometrica*, vol. 55, no. 3, May, pp. 703-708.

Pringle, J. J and R. A. Connolly (1993): "The Nature and Causes of Foreign Currency Exposure", *Journal of Applied Corporate Finance*, vol. 6, no. 3, Fall, pp. 61-72.

Rees, W. and S. Unni (1996): "Exchange Rate Exposure among European Firms: Evidence from France, Germany and the UK", *Annual EFMA-FMA European Conference*, Innsbruck.

Shapiro, A. C. (1975): "Exchange Rate Change, Inflation, and the Value of the Multinational Corporations", *Journal of Finance*, vol. 30, no.2, May, pp. 485-503.

Schnabel, J. A. (1989): "Exposure to Foreign Exchange Risk: A Multi-currency Extension", *Managerial & Decision Economics*, vol. 10, December, pp. 331-333.

White; H: (1980): "A Heteroscedasticity-Consistent Covariance Matrix and a Direct Test for Heteroscedasticity", *Econometrica*, vol. 48, no. 4, May, pp. 817-838.

Wong, M. H. F. (1997): "The Usefulness of SFAS 119 Derivatives Disclosures for Assessing the Foreign Exchange Risk Exposure of Manufacturing Firms", *Working paper*, University of California at Berkeley.

TABLE 1
CORRELATION MATRIX OF MARKET RETURNS AND FOREIGN EXCHANGE-RATE CHANGES

	R_m	R_x	$[\prod_{j=0}^{n}(1+R_{xt-j})-1]$
R_m	1		
R_x	0.0371	1	
$[\prod_{j=0}^{n}(1+R_{xt-j})-1]$	0.1742	0.2419***	1

R_m is the monthly return on general index of the Madrid Stock Exchange.
R_x is the monthly rate of change in the nominal effective exchange rate index on the Spanish.
$[\prod_{j=0}^{n}(1+R_{xt-j})-1]$ is the monthly compounded change on the exchange rate changes, throughtout the previous twelve months and up to the present moment
(***) Statistically significant at 5%.

TABLE 2
DISTRIBUTION OF ESTIMATED EXCHANGE RATE EXPOSURE COEFFICIENTS FOR NON-FINANCIAL SPANISH COMPANIES
(January 1992 - December 1997)

This table reports the statistics and significance coefficients for the estimated economic exposure of a sample of 67 Spanish firms. These coefficients have been estimated from the monthly time-series regressions of stock returns on market returns and exchange rate changes on two different horizons: contemporary exchange rate changes (model [1]) and the exchange rate changes on the previous twelve months (model [2])

	Foreign exchange-rate change horizon	
	Contemporary coefficients	Twelve months coefficients
Panel (A): Descriptive statistics		
Mean	-0.0924	0.1134
Standard Deviation	0.7181	0.1857
Maximum	2.0161	0.5851
Third quartile	0.2457	0.2220
Median	-0.1540	0.0899
First quartile	-0.3772	-0.0181
Minimum	-2.1171	-0.4769
Firms in sample	67	67
Mean R^2	0.0237	0.0203
Panel (B): Significant at 5 % (Two-tailed test)		
Number of firms	14	17
Positive	5	15
Negative	9	2
Percent of total	20.90%	25.37%
Panel (C): Significant at 10 % (Two-tailed test)		
Number of firms	15	20
Positive	6	17
Negative	9	3
Percent of total	22.39%	29.85%
Panel (D): Significant at 10 % (One-tailed test)		
Number of firms	24	32
Positive	7	28
Negative	17	4
Percent of total	35.82%	47.76%

The statistical significance has been computed from Hansen (1982) and Newey-West (1987) t-statistics

TABLE 3
EXCHANGE RATE EXPOSURE COEFFICIENTS OF SPECIFIC PORTFOLIOS
(January 1992 - December 1997)

This table reports the exposure coefficients of four portfolios equal weighting and weighted by market capitalisation. These coefficients have been estimated from the monthly time-series regressions of portfolio returns on market returns and exchange rate changes on two different horizons: contemporary exchange rate changes (model [1]) and the exchange rate changes on the previous twelve months (model [2])

	Foreign exchange-rate change horizon	
	Contemporary coefficients	Twelve months coefficients
Portfolio A: Net exporters > 25% (11 companies)		
Equal weighting	0.3549	0.2209***
	(1.0868)	(2.5771)
Weighted by market capitalisation	0.6926***	0.1879***
	(2.6734)	(2.1254)
Portfolio B: Net importers > 25% (3 companies)		
Equal weighting	-0.3081**	0.0441
	(-1.8234)	(0.7840)
Weighted by market capitalisation	-0.2061	0.0176
	(-1.0317)	(0.2928)
Portfolio C: Foreign debt > 25% (6 companies)		
Equal weighting	-0.2365*	-0.0529
	(-1.5102)	(-1.1937)
Weighted by market capitalisation	-0.1048	-0.0318
	(-0.9239)	(-0.8151)
Portfolio D: Domestic (9 companies)		
Equal weighting	-0.0130	0.0878***
	(-0.7376)	(2.0499)
Weighted by market capitalisation	-0.0953*	0.0342*
	(-1.5152)	(1.4532)

Note: Hansen (1982) and Newey-West (1987) t-statistics in parentheses. (***) Significant at 5%, (**) at 10% in two-tailed test. (*) Significant at 10% in one-tailed test.

TABLE 4
DESCRIPTIVE STATISTICS AND CORRELATIONS OF DETERMINANT FACTORS

This table reports statistics and the correlation matrix for different determinant factors of exchange rate risk and hedging. The data summaries have been calculated as the average level in the years 1992, 1993 and 1994.

Panel (A): Descriptive statistics

	Mean	Median	Stdv.	Max.	Q3	Q1	Min.
Exports/Total Sales (%)	0.1480	0.0623	0.2130	0.8500	0.2425	0	0
Imports/Total Sales (%)	0.0738	0	0.2001	1	0.0214	0	0
Foreign Debt/Total Debt (%)	0.1022	0.0322	0.1725	0.9345	0.1431	0	0
Total Debt/Total Assets (%)	0.5195	0.5323	0.1866	0.9300	0.6349	0.3879	0.0703
Size (Mill.)[1]	121,374	35,142	271,926	1,408,236	98,610	12,101	642
Total Assets (Mill.)	295,345	74,194	701,583	4,289,418	185,802	34,759	1,537
Foreign Currency Adj. (Mill.)	-1,245	-14.33	4,825	1,324	8.66	-190.02	-32,710

Panel (B): Correlation matrix

	Exports/ T. Sales	Imports/ T. Sales	F. Debt/ T. Debt	T. Debt/ T.Assets	Size	Total Assets	|FOREX| Adj.
Exports/Total Sales (%)	1						
Imports/Total Sales (%)	0.163	1					
Foreign Debt/Total Debt (%)	-0.044	-0.139	1				
Total Debt/Total Assets (%)	0.163	-0.011	-0.107	1			
Size[2]	-0.249***	-0.046	0.278***	-0.262***	1		
Total Assets[2]	-0.236**	-0.035	0.299***	-0.016	0.903***	1	
Foreign Currency Adj. (Mill.)	0.136	0.074	-0.209**	-0.098	-0.437***	-0.534***	1
|FOREX Adj.| / Size[3]	-0.001	0.010	0.203**	0.254***	0.035	0.214**	-0.541***

[1] The size has been calculated as the market capitalisation.
[2] Calculated as the log(size) and log(total assets).
[3] Calculated as the absolute value of foreign currency adjustment over the size.
(***) Statistically significant at 5%.
(**) Statistically significant at 10%.

TABLE 5
DETERMINANT FACTORS OF EXCHANGE RATE EXPOSURE

	Contemporary exposure coefficients		Twelve months exposure coefficients	
Panel (A): Economic exposure determinants[1]				
	(1) β_x	(2) β_x	(3) β^n_{xi}	(4) β^n_{xi}
Intercept	0.1286	-0.1408	0.0896	-0.0163
	(0.5203)	(-0.8951)	(1.2183)	(-1.0722)
Exports/Total Sales (%)	1.0159***	0.9083***	0.2176**	0.1072
	(2.8947)	(3.0376)	(1.8966)	(1.0722)
Imports/Total Sales (%)	-0.4611*	-0.4851***	-0.0392	-0.0152
	(-1.4417)	(-2.1020)	(-0.4659)	(-0.1875)
Foreign Debt/Total Debt (%)	0.3648	0.4169*	-0.1991***	-0.0899
	(0.9222)	(1.3741)	(-2.5529)	(-1.1697)
Total Debt/Total Assets (%)	-0.6395	0.0236	0.0272	0.1632
	(-1.1951)	(0.0676)	(0.1648)	(1.1356)
No. Observations	64	64	64	64
R^2	0.1461	0.2343	0.0982	0.0674
Adjusted R^2	0.0882	0.1824	0.0370	0.0042
Panel (B): Exchange risk hedge[2]				
	(5) $\lvert\beta_x\rvert$	(6) $\lvert\beta_x\rvert$	(7) $\lvert\beta^n_{xi}\rvert$	(8) $\lvert\beta^n_{xi}\rvert$
Intercept	1.8937***	1.8702***	0.4927***	0.6787***
	(4.4014)	(3.9102)	(4.5537)	(3.2269)
Log(Size)	-0.1390***	-0.1503***	-0.0299***	-0.0472***
	(-3.5996)	(-3.3629)	(-3.016)	(-2.4059)
|FOREX Adj.| / Size (%)	9.7890***	1.1816	-2.1210**	-4.7399
	(2.5521)	(0.3114)	(-1.7438)	(-1.2106)
Foreign Debt/Total Debt (%)	-	2.4584***	-	0.2435
		(5.4527)		(0.5804)
No. Observations	67	30	67	30
R^2	0.2610	0.4435	0.1586	0.1773
Adjusted R^2	0.2379	0.3793	0.1323	0.0824

[1] Cross-sectional regression between either the exposure coefficients of contemporary exchange-rate changes, equations (1) and (2), or the exposure coefficients of exchange-rate changes on the previous twelve months, equations (3) and (4), and the explanatory factors. In equations (2) and (4) not significant coefficients at least at 10% are equal to zero.

[2] Cross-sectional regression between either the absolute value exposure coefficients of contemporary exchange-rate changes, equations (5) and (6),or the absolute value exposure coefficients of exchange-rate changes on the previous twelve months, equations (7) and (8), and the hedging proxy variables.

Note: Hansen (1982) and White (1980) t-statistics in parentheses. (***) Significant at 5%, (**) at 10% two-tailed test. (*) Significant at 10% one-tailed test.