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MEAN-VARIANCE-SKEWNESS ANALYSIS: AN APPLICATION TO RISK PREMIA IN THE SPANISH STOCK MARKET

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The purpose of this paper is to analyze whether an asset pricing model that considers both the covariance and the coskewness of an asset with the market portfolio as explanatory factors for risk premia (the 3MCAPM), represents a better empirical approximation to the Spanish stock market. Our results, based on the generalized method of moments, confirm the rejection of the traditional CAPM. In contrast, the results for the 3MCAPM are mixed, since although the evidence against the model overidentifying restrictions is weak, the estimates of the parameter of preferences for skewness is not specially significant. (*JEL* G12)

1. Introduction

Since its origins in the work of Sharpe (1964), Lintner (1965) and Mossin (1966), the Capital Asset Pricing Model, better known as the CAPM, represents a milestone in our understanding of the functioning of capital markets, and an unavoidable reference point in the study of the relation between systematic risk and expected return. Nevertheless, and despite the fact that there have been numerous studies which have empirically tested the theoretical restrictions of the CAPM for the case of the Spanish stock market, the existing evidence points against

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the existence of a positive linear relation between the average return on an asset over time, and the unconditional covariance of that asset with the market portfolio (see among others Palacios, 1973, Berges, 1984, Rubio, 1988, Gallego, Gómez and Marhuenda, 1992, Martínez Sedano, 1994, and Sentana, 1995). These results indicate the need to consider alternative asset pricing models.

Markowitz's (1952) mean-variance portfolio theory, on which the CAPM is based, can only be justified within the expected utility framework if we introduce certain simplifying assumptions (see Berk, 1997). And although there is no doubt of the economic importance of mean understood as expected return, and variance as a measure of risk, it is perhaps not surprising that later studies have extended the CAPM by including higher order moments. In particular, the third central moment of the return distribution has been used as a measure of skewness, which is undoubtedly a crucial determinant in games of chance and insurance contracts.

The development of an equilibrium asset pricing model similar to the CAPM but incorporating other moments beyond mean and variance, was sketched in the work of Jean (1972, 1973), Ingersoll (1975) and Schweser (1978), but it was Kraus and Litzenberger (1976) who finally developed an extension of the CAPM based on the first three moments (3MCAPM hereinafter). Using a two-stage method similar to the one employed by Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) for the CAPM, these authors found that US stock market investors show both risk aversion and a preference for positive skewness, which could explain the empirical rejections of the CAPM. Similar results were found by Barone-Adesi (1985) and Lim (1989) using alternative econometric methodologies.

The purpose of the present study is precisely to analyze whether the 3MCAPM represents a better approximation to risk premia than the traditional CAPM in the Spanish stock market. Taking the aforementioned study of Lim (1989) as a starting point, the main methodological contribution of the paper is the use of the generalized method of moments in the estimation and empirical testing of the model, in order to avoid some of the deficiencies of the tests usually employed in similar studies. The main advantage of one-stage tests such us ours is that inference can be made robust to temporal dependence and heteroskedasticity in the asset return distributions (see MacKinlay and Richardson, 1991). Furthermore, and unlike previous studies, our version of the 3MCAPM does not require any assumptions about the asymmetry in the distribution of the returns on the market portfolio.

The rest of the paper is divided in four sections. In Section 2, we derive the 3MCAPM, while in Section 3, we describe the Spanish stock market data used in the empirical analysis. In Section 4 we test the CAPM and 3MCAPM restrictions, as well as the skewness of the market portfolio. Finally, Section 5 summarizes the main conclusions.

2. The 3MCAPM

Formally, the 3MCAPM considers an economy with N primitive assets, with holding returns during period t given by R_{it} $(i = 1, \ldots, N)$, and a riskless asset, which is used as the no risk opportunity cost of the different investments, and whose return, R_{0t}, is known at the end of period $t-1$ when portfolio decisions are taken. This allows us to work in terms of returns measured in excess of the riskless asset, $r_{it} = R_{it} - R_{0t}$, so that their conditional means, $\mu_{it} = E_{t-1}(r_{it})$, coincide with the assets' risk premia.

An intuitive way to derive this asset pricing model is to assume that at the end of period $t-1$, each investor h effectively decides the portfolio allocation of her current wealth by maximizing a derived utility function which only depends on the conditional mean, variance and third moment of the returns on her portfolio over the following period, $R_{ht} = (1 - \sum_{i=1}^{N} w_{it-1}^{h})R_{0t} + \sum_{i=1}^{N} w_{it-1}^{h} R_{it}$, where w_{it-1}^{h} $(i = 1, ..., N)$ are the proportions of her wealth invested in each risky asset, and $(1 - \sum_{i=1}^{N} w_{it-1}^{h})$ the proportion invested in the riskless asset.

Specifically, it is assumed that the agent's problem can be expressed as

$$\max_{w_{it-1}^{h}} V(\nu_{ht}, \sigma_{hht}, \phi_{hhht}) \qquad [1]$$

where:

$$\begin{aligned} \nu_{ht} &= \sum_{i=0}^{N} w_{it-1}^{h} \nu_{it} \\ \sigma_{hht} &= \sum_{i=1}^{N} \sum_{j=1}^{N} w_{it-1}^{h} w_{jt-1}^{h} \sigma_{ijt} \\ \phi_{hhht} &= \sum_{i=1}^{N} \sum_{j=1}^{N} \sum_{k=1}^{N} w_{it-1}^{h} w_{jt-1}^{h} w_{kt-1}^{h} \phi_{ijkt} \end{aligned} \qquad [2]$$

are the first three centred moments of R_{ht}, with $\nu_{it} = E_{t-1}[R_{it}], \sigma_{ijt} = E_{t-1}[(R_{it} - \nu_{it})(R_{jt} - \nu_{jt})]$ and $\phi_{ijkt} = E_{t-1}[(R_{it} - \nu_{it})(R_{jt} - \nu_{jt})(R_{kt} - \nu_{kt})]$.

A crucial element of the model is the market portfolio, w^m_{it-1}, which maintains all risky assets in amounts proportional to their fixed supplies, and whose gross return is given by $R_{mt} = \sum_{i=1}^{N} w^m_{it-1} R_{it}$. If we introduce a fund separation assumption which guarantees that the relative proportions of the risky assets are the same for all investors (see Kraus and Litzenberger, 1976), and combine the first order conditions of the investor's problem [1] with an equilibrium market clearing condition, it can be proved that the risk premium on asset i will be given by:

$$\mu_{it} = \tau_{rt}\sigma_{imt} + \tau_{st}\phi_{immt} \qquad [3]$$

where σ_{imt} and ϕ_{immt} are defined as the covariance and coskewness of asset i with the market portfolio, i.e.:

$$\begin{aligned} \sigma_{imt} &= E_{t-1}\left[(R_{it} - \nu_{it})(R_{mt} - \nu_{mt})\right] \\ \phi_{immt} &= E_{t-1}\left[(R_{it} - \nu_{it})(R_{mt} - \nu_{mt})^2\right] \end{aligned} \qquad [4]$$

and the coefficients τ_{rt} and τ_{st} can be interpreted as the prices of risk associated with that covariance and coskewness. In this sense, it is important to mention that those prices are the same for all assets. Note also that if $\tau_{st} = 0$, [3] reduces to the usual expression for the CAPM, so that the additional term represents a risk premium for coskewness with the market portfolio.[1]

3. Data

The database used for the empirical tests contains arithmetic monthly returns (adjusted for dividends and stock splits) in percentage terms on 164 firms listed in the Spanish stock market between January 1963 and December 1992. In particular, we work with 360 monthly observations for ten equally-weighted size-ranked portfolios, and with an eleventh portfolio, hereinafter VW, which is a weighted average of all assets, with weights that depend on market capitalization at the end of the previous year. Studies for other markets suggest that a priori,

[1]The version of the 3MCAPM in Kraus and Litzenberger (1976) makes the additional assumption that the distribution of market returns R_{mt} is skewed, which allows [3] to be re-written as $\mu_{it} = \pi_{rt}\beta_{imt} + \pi_{st}\gamma_{immt}$, where $\beta_{imt} = \sigma_{imt}/\sigma_{mmt}$ and $\gamma_{imt} = \phi_{immt}/\phi_{mmmt}$. The advantage of expression [3] is that it remains valid even if the market returns distribution is symmetric (see Section 4.2)

such an aggregation should show more cross-sectional variation than a sectorial-based aggregation. It is important to mention that all the assets available in each period were used to form portfolios. As a safe asset, we used T-bill returns on the secondary market after 1982, and the average lending rate from banks and savings institutions before (see Rubio, 1988, for details).

The empirical tests have been carried out for the whole sample period, and for the subsamples 1963:01-1978:12 and 1979:01-1992:12. The motivation for the chosen sample split is twofold: the institutional changes in the Spanish stock market during 1977 and 1978, and the changes in capital gains taxation resulting from the 1979 fiscal reform.

4. Empirical Tests using the Generalized Method of Moments

4.1 CAPM Tests

As can be observed from [3], the basic result from the CAPM is that the risk premium on an asset (or a portfolio of assets) is proportional to the covariance of its return with the return on the market portfolio, with a common proportionality factor, or price of risk, which is the same for all assets. If we assume that the covariances with the market and the price of risk are constant over time, the CAPM restrictions on a set of $N+1$ assets which includes the market portfolio, can be written in a natural way in terms of the following $2(N+1)$ moment restrictions over r_{it} $(i = 1, \ldots, N, m)$:

$$\left.\begin{aligned} E(r_{it} - \tau_r \sigma_{im}) &= 0 \\ E[(r_{it} - \tau_r \sigma_{im})(r_{mt} - \tau_r \sigma_{mm})] &= \sigma_{im} \end{aligned}\right\} \qquad [5]$$

where the first restriction coincides with [3] under the maintained assumption that $\tau_s = 0$, and the second simply defines the covariance. Note that for each asset, except the market portfolio, there are two restrictions but only one parameter, so that there are N implicit overidentifying restrictions. Hansen's (1982) generalized method of moments (GMM) is therefore ideal to estimate the parameters and test those restrictions. Furthermore, it has the advantage that under regularity conditions, inference can be made robust to temporal dependence and heteroskedasticity in the joint distribution of the returns on the N assets given the returns on the market portfolio.

As is well known, GMM estimates are the parameter values that minimize a given norm of the vector of the $2(N+1)$ sample moments corresponding to [5]. Hansen (1982) develops the sample theory for such estimators, and explains how to select the optimal GMM criterion (or norm) *for a given finite set of moment conditions*, in the sense that the difference between the covariance matrices of the optimal estimator, and an estimator based in any other criterion is positive semidefinite. Furthermore, he shows that in the case of the optimal norm, the value of the GMM criterion evaluated at the minimum, multiplied by the sample size, is asymptotically distributed as a χ^2 with as many degrees of freedom as overidentifying restrictions (N in our case), under the null hypothesis of correct specification of [5].

It is important to mention that the traditional tests of the CAPM can also be put in this framework (see MacKinlay and Richardson, 1991). In particular, if we add N slack parameters,[2] $\alpha_1, \ldots, \alpha_N$, to the first $2N$ equations in [5], so that for $i = 1, \ldots, N$:

$$\left.\begin{aligned} E(r_{it} - \alpha_i - \tau_r \sigma_{im}) &= 0 \\ E[(r_{it} - \alpha_i - \tau_r \sigma_{im})(r_{mt} - \tau_r \sigma_{mm})] &= \sigma_{im} \end{aligned}\right\} \qquad [6]$$

the extended model is exactly identified since there are two parameters and two moment conditions for each asset, and the null hypothesis can be written as:

$$H_0 : \alpha_i = 0 \qquad i = 1, \ldots, N \qquad [7]$$

In this case, the parameter values can be chosen so that the sample moments corresponding to [6] are zero, which means that the GMM estimator is unique independently of the norm chosen, and simply involves replacing population moments by sample moments. In this way, we obtain $\hat{\sigma}_{im} = T^{-1} \sum_{t=1}^{T} (r_{it} - \hat{\mu}_i)(r_{mt} - \hat{\mu}_m)$, $\hat{\alpha}_i = \hat{\mu}_i - (\hat{\sigma}_{im}/\hat{\sigma}_{mm})\hat{\mu}_m$, and $\hat{\tau}_r = \hat{\mu}_m / \hat{\sigma}_{mm}$, where $\hat{\mu}_i = T^{-1} \sum_{t=1}^{T} r_{it}$. Given a consistent estimator of the covariance matrix of the parameter estimates, it is straightforward to compute a Wald test for the null hypothesis [7]. Such a test is also asymptotically distributed as a χ^2 with N degrees of freedom. But if we take into account that the unrestricted GMM estimators coincide with the maximum likelihood ones under the assumption that the joint distribution of the N asset returns, given the returns on the market portfolio, is normal and homoskedastic, it is possible to derive

[2] These coefficients, which measure abnormal returns from the point of view of the model, are known as Jensen's alphas in the portfolio evaluation literature.

an asymptotically equivalent F-type test, with an exact finite sample distribution as long as the additional distributional assumption is correct (see Gibbons, Ross and Shanken, 1989). In practice, this last test can be easily computed from the multivariate regression of r_{it} on a constant and r_{mt}.

All estimation and testing has been obtained using TSP 4.3. As GMM criterion, this programme computes an initial consistent estimator of the optimal weighting matrix for the sample moments associated with the optimal norm, and then computes the GMM estimator by minimizing that norm. In our case, we have computed the weightings using Newey and West (1987), with 0, 3 and 6 autocovariances or lags. The results of the tests are presented in Table 1. As can be seen, the p-values of the three tests for the whole sample period are less than 0.001, which clearly rejects the model restrictions, at least when we use the value weighted portfolio as the market portfolio. Such results are in line with other recent work (see e.g. Martínez Sedano, 1994, and Sentana, 1995). Besides, it is important to note that the estimated values for τ_r are positive, although not significantly different from zero (t-ratios 0.463, 0.686 and 0.882 for 0, 3 and 6 lags respectively).

The same conclusions can be obtained for the subsamples 1963:01-1978:12 and 1979:01-1992:12, although the values of the GMM overidentifying test decrease as we increase the number of autocovariances included.

Therefore, given that the CAPM does not seem to hold, it is certainly interesting to consider the 3MCAPM to see whether, in addition to systematic risk, the coskewness of an asset with the market is an explanatory variable for risk premia.

4.2 Tests of Skewness of the Market Portfolio

Nevertheless, and even though what really matters in expression [3] is the coskewness of each asset with the market, ϕ_{imm}, and not the third moment of the marginal distribution of the market, ϕ_{mmm}, it is of some interest to initially test the skewness of r_{mt} (see Peiró, 1996, for a more detailed analysis with daily data). The traditional test for skewness is based on the following statistic:

$$\hat{\phi}_{mmm} = T^{-1} \sum_{t=1}^{T} (r_{mt} - \hat{\mu}_m)^3$$

whose asymptotic distribution (scaled by $\sqrt{T}$) is $N(0, 6\sigma_{mm}^3)$ under the assumption that $r_{mt} \sim i.i.d.\ N(\mu_m, \sigma_{mm})$. Unfortunately, this distribution is very sensitive to the normality assumption. However, it is relatively easy to robustify it, since we only have to consider it as a moment test for the restriction $E(r_{mt} - \mu_m)^3 = 0$. In particular, we only need to regress the cube of the returns on the market portfolio (in deviations to the mean) on a constant, and use the t-ratio from that regression as our test statistic. An additional advantage of testing skewness in this way is that we can also make the test robust to heteroskedasticity and/or serial correlation by using alternative estimators of the standard error.

TABLE 1
GMM, Wald and F Test of the CAPM
Monthly excess return data (%)

Sample period (T)	GMM (p-value)	Wald (p-value)	F (p-value)
Number of autocovariances=0			
1933 01-1992 12	42.299	48.769	45.195
(360)	(0.000)	(0.000)	(0.000)
1963.01-1978:12	24.493	26.809	26 005
(192)	(0.009)	(0.003)	(0.004)
1979 01-1992:12	31.705	40.713	36.982
(168)	(0.000)	(0.000)	(0 000)
Number of autocovariances=3			
1933·01-1992·12	32 405	51.064	
(360)	(0.000)	(0.000)	
1963 01-1978:12	22 089	40 405	
(192)	(0.015)	(0.000)	
1979.01-1992·12	20.331	40 923	
(168)	(0 000)	(0.000)	
Number of autocovariances=6			
1933:01-1992:12	27.239	57.790	
(360)	(0.002)	(0.000)	
1963:01-1978:12	18.069	50.057	
(192)	(0.054)	(0.000)	
1979.01-1992:12	16.137	52.609	
(168)	(0.096)	(0.000)	

The results in Table 2 show that ϕ_{mmm} is not significantly different from zero, either in the whole period, or in the two subsamples. It is important to recall, though, that the potential validity of the 3MCAPM in [3] is not affected by this conclusion.

TABLE 2
Skewness tets robust to non-normality
Monthly excess returns on the market portfolio (%)

Sample period (T)	GMM (t-ratio)
1963:01-1992:12	-28.862
(360)	(-0.316)
1963:01-1978:12	-13.141
(192)	(-0.528)
1979:01-1992:12	-63.144
(168)	(-0.322)

4.3 Tests of the 3MCAPM

As we saw in Section 2, according to the 3MCAPM the risk premium on an asset is a linear combination of the covariance and the coskewness of its returns with the returns on the market portfolio, with proportionality factors which are the same for all assets. If we again assume that both covariances and coskewnesses, as well as their prices, are constant over time, the 3MCAPM restrictions for a set of N assets plus the market portfolio can be written in a natural way in terms of the following $3(N+1)$ moment restrictions on r_{it} $(i = 1, \ldots, N, m)$:

$$\left.\begin{aligned} E(r_{it} - \tau_r \sigma_{im} - \tau_s \phi_{imm}) &= 0 \\ E[(r_{it} - \tau_r \sigma_{im} - \tau_s \phi_{imm})(r_{mt} - \tau_r \sigma_{mm} - \tau_s \phi_{mmm})] &= \sigma_{im} \\ E[(r_{it} - \tau_r \sigma_{im} - \tau_s \phi_{imm})(r_{mt} - \tau_r \sigma_{mm} - \tau_s \phi_{mmm})^2] &= \phi_{imm} \end{aligned}\right\} \quad [8]$$

where the first restriction coincides with [3], and the second and third simply define covariance and coskewness according to [4]. Note that for each asset, except for the market portfolio, there are three restrictions but only two parameters, while for the market portfolio there are four parameter but only three restrictions, so that there are in all $N-1$ overidentifying restrictions. The loss of one degree of freedom relative to [5] in Section 3.1 is obviously due to the inclusion of the extra parameter τ_s, that was assumed equal to zero.

Again, GMM is ideal to carry out parameter estimation and hypothesis testing in this framework. In particular, we can compute the overidentifying restrictions test, which in this case will be distributed as a χ^2 with $N-1$ degrees of freedom under the null hypothesis of correct specification of [8].

Similarly, it is possible to obtain an equivalent Wald test if we add $N-1$ slack parameters to the first $3(N-1)$ equations in [8], so that:

$$\left.\begin{array}{r} E(r_{it}-\alpha_i-\tau_r\sigma_{im}-\tau_s\phi_{imm})=0 \\ E[(r_{it}-\alpha_i-\tau_r\sigma_{im}-\tau_s\phi_{imm})(r_{mt}-\tau_r\sigma_{mm}-\tau_s\phi_{mmm})]=\sigma_{im} \\ E[(r_{it}-\alpha_i-\tau_r\sigma_{im}-\tau_s\phi_{imm})(r_{mt}-\tau_r\sigma_{mm}-\tau_s\phi_{mmm})^2]=\phi_{imm} \end{array}\right\} \quad [9]$$

for $i=1,\ldots,N-1$.[3]

The empirical results are summarized in Table 3. Note that the overidentifying test indicates that the model restrictions cannot be rejected either in the whole sample period, or in any of the two subsamples. It is also important to mention that although the estimates of the parameter τ_s, which measures preferences for skewness, are positive, they are not highly significant (t-ratios 1.650, 1.635 and 1.762 with 0, 3 and 6 autocovariances respectively), which is in accordance with the results obtained in the Spanish case by Gallego and Marhuenda (1994) following an odd/even two-step method.

Similar results are obtained with the Wald test, except in the first subsample (1963:01-1978:12), in which the null hypothesis is rejected.

5. Conclusions

In this paper we initially test the traditional CAPM with data for the Spanish stock market using the generalized method of moments, which allows us to relax the usual assumptions on the distribution of returns. In this respect, our results clearly confirm the CAPM rejections found in many previous studies.

Secondly, we test the so-called 3MCAPM, which is an extension of the CAPM which adds the coskewness of an asset with the market portfolio as an explanatory factor for risk premia. In this sense, and unlike previous studies, our derivation of the 3MCAPM does not require any assumptions on the asymmetry in the distribution of returns on the market portfolio. This is particularly important in the Spanish case, as there is no empirical evidence in favour of such an asymmetry.

The results obtained for the 3MCAPM are mixed, and weaker than in

[3]This amounts to normalize by means of the condition $\alpha_N=0$, which asymptotically does not involve any loss of generality. In this sense, it is worth mentioning that we repeated the Wald tests eliminating one random α_i at a time without any significant difference in the results.

the US case: on the one hand, we cannot reject the associated overidentifying restrictions, although there is some unfavourable evidence for the subsample 1963-1978; on the other, our estimates of the parameter τ_s, which measures the market price of risk for skewness, are positive but not very significant.

TABLE 3
GMM and Wald Test of the 3MCAPM
Monthly excess returns (%)

Sample period (T)	GMM (p-value)	Wald (p-value)
	Number of autocovariances=0	
1993:01-1992.12	4.605	4.569
(360)	(0.867)	(0.870)
1963:01-1978:12	9.203	16.790
(192)	(0.419)	(0.052)
1979:01-1992:12	2.928	2.115
(168)	(0.967)	(0.990)
	Number of autocovariances=3	
1993:01-1992:12	6.947	9.589
(360)	(0.643)	(0.385)
1963.01-1978·12	7.507	18.837
(192)	(0.341)	(0.027)
1979.01-1992:12	6.594	4.056
(168)	(0.679)	(0.908)
	Number of autocovariances=6	
1963:01-1992:12	6.855	9.423
(360)	(0.652)	(0.399)
1963:01-1978:12	7.236	20.916
(192)	(0.613)	(0.013)
1979:01-1992:12	7.756	4.365
(168)	(0.559)	(0.886)

A maintained assumption in all our tests is that both the covariances and the coskewness of the asset returns with the market, as well as their risk prices are constant over time. But since there is an enormous empirical evidence suggesting that the distributions of returns conditional on the available information change over time, it would be interesting to find out in what sense the results obtained here would be affected if we explicitly allowed for time variation in the higher order moments of the distributions of stock returns.

References

Barone-Adesi, G. (1985): "Arbitrage equilibrium with skewed asset returns", *Journal of Financial and Quantitative Analysis* 20, pp. 299-313.

Berges, A. (1984), *El mercado de capitales español en un contexto internacional,* Ministerio de Economía y Hacienda, Madrid.

Berk, J.B. (1997): "Necessary conditions for the CAPM", *Journal of Economic Theory* 73, pp. 245-257.

Black, F., M.C. Jensen and M. Scholes (1972): "The capital asset pricing model: Some empirical tests", in Michael C. Jensen (ed.), *Studies in the Theory of Capital Markets,* Praeger Publishers, New York.

Fama, E. and J. MacBeth (1973): "Risk, return and equilibrium: Empirical tests", *Journal of Political Economy* 81, pp. 607-636.

Gallego, A., J.C. Gómez and J. Marhuenda (1992): "Evidencias empíricas del CAPM en el mercado español de capitales", Documento de Trabajo, WP-EC 92-13, Instituto Valenciano de Investigaciones Económicas .

Gallego, A. and J. Marhuenda (1994): "Riesgo sistemático, total y coasimetría en la valoración de activos", mimeo, Departamento de Economía Financiera, Universidad de Alicante.

Gibbons, M., S. Ross and J. Shanken (1989): "A test of the efficiency of a given portfolio", *Econometrica* 57, pp. 1121-1152.

Hansen, L.P. (1982): "Large sample properties of generalized method of moments estimators", *Econometrica* 50, pp. 1269-1286.

Ingersoll, J. (1975): "Multidimensional security pricing", *Journal of Financial and Quantitative Analysis* 10, pp. 785-798.

Jean, W. (1972): "Distribution moments and equilibrium: Reply", *Journal of Financial and Quantitative Analysis* 7, pp. 1435-1437.

Jean, W. (1973): "More on multidimensional portfolio analysis", *Journal of Financial and Quantitative Analysis* 8, pp. 475-490.

Kraus, A. and R. Litzenberger (1976): "Skewness preference and the valuation of risky assets", *Journal of Finance* 31, pp. 1085-1094.

Lim, K.-G. (1989): "A new test of the three-moment capital asset pricing model", *Journal of Financial and Quantitative Analysis* 24, pp. 205-216.

Lintner, J. (1965): "The valuation of risky assets and the selection of risky investments in stock portfolios and capital budgets", *Review of Economics and Statistics* 47, pp. 13-37.

MacKinlay, C.A. and M.P. Richardson (1991): "Using generalized method of moments to test mean-variance efficiency", *Journal of Finance* 46, pp. 511-527.

Markowitz, H. (1952): "Portfolio selection", *Journal of Finance* 8, pp. 77-91.

Martínez Sedano, M.A. (1994): "Restricciones de cartera y evaluación de la gestión de los fondos de inversión", Documento de Trabajo 94.17, Universidad del País Vasco.

Mossin, J. (1966): "Equilibrium in a capital asset market", *Econometrica* 34, pp. 768-783.

Newey, W.K. and K.D. West (1987): "A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica* 55, pp. 703-708.

Palacios, J. (1973): "The stock market in Spain: Tests of efficiency and capital market theory", unpublished PhD dissertation, Stanford University.

Peiró, A. (1996): "La propiedad de simetría en los rendimientos financieros diarios españoles", Documento de Trabajo WP-EC 96-03, Instituto Valenciano de Investigaciones Económicas.

Rubio, G. (1988): "Further international evidence on asset pricing: The case of the Spanish capital market", *Journal of Banking and Finance* 12, pp. 221-242.

Sánchez Torres, P. L. (1994): "Análisis media-varianza-asimetría: una aplicación a las primas de riesgo en el mercado de valores español", Documento de Trabajo 9426, CEMFI.

Schweser C. (1978): "Multidimensional security pricing: a correction", *Journal of Financial and Quantitative Analysis* 13, pp. 177-183.

Sentana, E. (1995): "Risk and return in the Spanish stock market", LSE Financial Markets Group Discussion Paper 212, published in Spanish as "Riesgo y rentabilidad en el mercado de valores español", Moneda y Crédito 200, pp. 133-160.

Sharpe, W. (1964): "Capital asset prices: A theory of market equilibrium under conditions of risk", *Journal of Finance* 19, pp. 425-442.

Resumen

El objetivo de este trabajo es analizar si el modelo de valoración de activos 3MCAPM, que considera la covarianza y cosimetría de un activo con la cartera de mercado como factores explicativo de las primas de riesgo, representa una mejor aproximación empírica al mercado de valores español Nuestros resultados, basados en el método generalizado de momentos, confirman el rechazo del CAPM tradicional. Por contra, los resultados para el 3MCAPM son mixtos, pues aunque la evidencia en contra de las restricciones de sobreidentificación del modelo es débil, las estimaciones del parámetro de preferencia por la asimetría no son esencialmente significativas.