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SUMMARY

This paper analyses the informational content of financial prices in Spain, mainly from the viewpoint of a central bank. In particular, we examine the informational content of domestic yields and yield spreads, foreign-domestic spreads, credit quality spreads, stock prices and exchange rates on the inflation rate, the 3-month interest rate and output. Three alternative empirical approaches are considered. First, we compare the out-of-sample performance of equations containing each financial indicator with a simple univariate equation containing only lagged values of the dependent variable. Next, we consider financial prices as 'qualitative' indicators and estimate Probit models to forecast inflationary upturns, output slowdowns and monetary policy tightenings as reflected by interest rate upturns. Finally, we analyse the possibility of using financial prices as expectation indicators, independently of their ability as predictors.

According to our results, none of the financial indicators considered seems to hold a stable empirical relationship with any of the fundamentals. This discards the possibility of using such indicators as nominal anchors for monetary policy decisions. Nevertheless, they can be useful both as 'qualitative' indicators to complement the quantitative information provided by other non-financial indicators, and as expectation indicators signalling potential credibility problems and potential misunderstandings of monetary policy actions. In this respect, indicators derived from the zero-coupon yield curve (interest rate levels and spreads) emerge as the most informative financial prices.

1. INTRODUCTION

Agents participating in financial markets are often characterised as being forward-looking. Accordingly, financial prices can also be considered forward-looking regarding those macroeconomic variables that can affect them and, therefore, should contain valuable information on their future or expected behaviour. Moreover, in comparison with other potential sources of information, financial prices are easier and cheaper to obtain and can be recorded for higher frequencies.

Unsurprisingly, then, there is a relatively extensive literature focused on extracting the informational content of financial prices on future macroeconomic fundamentals. In the early 90s a number of papers analysed the US case and found that several financial indicators, mainly those related to the term structure, provided reliable information on future interest rates -Campbell and Shiller (1991)-, inflation -Mishkin (1990)- or real activity -Estrella and Hardouvelis (1991)-. Similar results were later found for other economies -Estrella and Miskhin (1996), Davis and Fagan (1996), Bernard and Gerlach (1996)-.

This paper builds on this literature and attempts to analyse the informational content of financial prices in Spain, mainly from the viewpoint of a central bank. There are two main reasons why this analysis of the Spanish case may be relevant. First, the process of liberalisation and modernisation of the Spanish financial system, though extraordinarily fast, was initiated only very recently compared to other Western countries. Indeed, until very recently, there have not been data covering a period long enough as to allow for a systematic analysis of the informational content of financial indicators. Even now, data are still insufficient or of poor quality in some cases. This explains why the issue has not been much studied in the Spanish case.[1]

Second, until 1994 Spanish monetary policy followed a classical two-level strategy, with a monetary aggregate playing the role of an intermediate target. In this framework, monetary indicators pushed other indicators to a secondary level of importance. Since 1995, a new monetary strategy has been implemented in which

[1] Some exceptions are Martínez-Resano (1993), Davis and Fagan (1996) or Alonso *et al.* (1997).

inflation is directly targeted. This new framework has given scope to other non-monetary indicators, among which financial indicators are potentially useful. In particular, there is a new demand for indicators in order to make projections regarding relevant macroeconomic variables. Those variables are typically inflation, short-term interest rates and also output. As recently stressed in Svensson (1997), direct inflation targeting does not necessarily imply that a Central Bank should not worry about output deviations from a reference or targeted level.

This paper examines from an empirical standpoint the informational content of the most usual financial indicators considered in the literature: domestic yields and yield spreads, foreign-domestic spreads, credit quality spreads, stock prices and exchange rates. We focus on their informational content on the inflation rate, the 3-month interest rate and output.

As to the methodology, we aim to provide an overall view of the usefulness of these indicators and therefore consider three alternative approaches. First, we analyse the predictive power of financial prices by comparing the out-of-sample performance of equations containing each financial indicator with a simple univariate equation containing only lagged values of the dependent variable. Next, following a recent work by Estrella and Miskhin (1996), we also address the possibility of using financial prices as 'qualitative' indicators and estimate Probit models to forecast inflationary upturns, output slowdowns and monetary policy tightenings as reflected by interest rate upturns. Finally, we analyse the possibility of using financial prices as expectation indicators, independently of their ability as predictors.

The structure of the paper is as follows. Section 2 presents our methodological approach to assess the quantitative informational content of the different indicators considered. The main results of this approach are presented in section 3, showing that, in general, financial prices do not outperform simple univariate models. Given this result, two alternative routes are further explored. In section 4, the results of a rough approach to analyse the usefulness of financial prices as 'qualitative' indicators to predict specific episodes are presented. In Section 5 we comment on the relationship between predictors and expectation indicators and consider the potential usefulness of financial prices as indicators of expectations on future inflation and interest rates. Finally, section 5 summarises the main conclusions of the analysis and extracts some policy implications.

2. AN APPROACH TO ASSESS THE QUANTITATIVE INFORMATIONAL CONTENT OF SPANISH FINANCIAL PRICES

2.1 Empirical strategy

It is not an easy task to come to any conclusion on the informational content of a variable regarding the future behaviour of another. Such an assessment will always be conditional upon, at least, three assumptions regarding, first, the information set included -the indicator, the indicator plus lagged values of the variable to be forecast, third variables...; second, the predictive horizon we are interested in; and third, the criterion to assess performance. Before presenting our approach, it is worth revising the competing alternatives to specify the relevant assumptions.

In the ample existing literature most papers follow what we could call a 'basic approach': one or several regressions are run in which the macrofundamental to be predicted is on the left-hand side and (some transformation of) the indicator is included on the right-hand side. Apart from this common root, differences are considerable. Regarding the specification of the information set, some authors take a static bivariate approach in which the indicator -usually lagged- is the only regressor (Mishkin, 1990). Other authors also use a bivariate model but follow a 'Granger causality' approach, thus introducing some dynamics in the analysis and considering lagged values of both the dependent variable and the indicator on the right-hand side (Davis and Fagan, 1996). A third approach consists of including on the right-hand side of the equations several indicators to allow for some competition among them (Bernanke, 1990). Finally, there are also examples of VAR analysis in which more than one fundamental is simultaneously predicted (Davis and Fagan, 1996).

Regarding horizons, most papers consider simultaneously several horizons and special attention is paid to the distinction between the short and the long term. As to the performance criterion, two main approaches can be mentioned. In some papers, usual goodness-of-fit in-sample statistics are used to test the significance of the indicators in the regressions and their contribution to reducing the residual standard error. Other papers, however, focus on the out-of-sample forecasts.

Our aim in this paper is to analyse to what extent financial prices contain useful information for the Spanish monetary authorities on the future or expected behaviour of inflation, output and short-term interest rates, other than the information that the past pattern of each macroeconomic variable can provide. Thus, we will consider equations including lagged values of the dependent variable and lagged values of the financial indicators. In particular, we consider up to 12 quarterly lags which provide a maximum delay of 3 years between the indicator and the fundamental.

Nevertheless, we do not combine either macrofundamentals or indicators. Our data base does not cover a period long enough as to allow for a more complex analysis in which we could look at more than one indicator -or more than one fundamental- at the same time.

Regarding the performance criteria, although we test in-sample joint significance we focus on out-of-sample properties to assess the usefulness of the different indicators. In particular, we compare the mean squared errors of forecasts 1, 4, 8 and 12 quarters ahead of both the univariate equation and the equation including the indicator. Therefore, we consider different prediction horizons spanning 1 quarter to 3 years.

Our approach can be summarised in the following steps:

1. A univariate autoregressive model is estimated for quarterly data on the (stationary transformation of the) macrofundamental y :

$$y_t = a_0 + \sum_{i=1}^{p} a_i y_{t-i} + \epsilon_t \qquad [1]$$

The maximum lag p has been chosen testing the estimated residual autocorrelations, the joint significance of the included lags and the joint (non-)significance of the excluded lags between 1 and 12.

2. We check the order of integration of the indicator. If the macrofundamental and the indicator are of the same order, we check whether both are cointegrated.[2] If this is the case, a lagged standard error correction term $-ecm-$ and 12 lagged values of

[2] See Appendix B for more details.

the (stationary transformation of the) indicator x are added. If there is no cointegration, only the 12 lags are included. In both cases, the joint significance of the new regressors is tested. If they are not significant, we stop the analysis and conclude that this is not a useful indicator. If they are significant, the following exercise is undertaken to determine the length of the lag polynomial: the first and/or last lags are subsequently excluded and, after each exclusion, the joint significance of the included lags and the joint (non-)significance of the excluded ones is tested. This yields the following equation:

$$y_t = a_0 + \sum_{i=1}^{p} a_i y_{t-i} + \sum_{j=q1}^{q2} b_j x_{t-j} + \delta_x c_1 ecm_{t-1} + \nu_t \qquad [2]$$

where $q1 \geq 1$, $q2 \leq 12$, and δ_x is equal to 1 if there is cointegration between the fundamental and the indicator, and 0 otherwise. Notice that the same number of lags $-p-$ for the dependent variable is included in equations [1] and [2].

3. We re-run equations [1] and [2] for shorter subsamples ending at T-23, T-22,..., then we make 1-, 4-, 8- and 12-quarter ahead predictions, and compute and compare mean squared forecasting errors. Our forecast series contain, in general, 23, 20, 16 and 12 data points, respectively. However, in order to preserve enough degrees of freedom, the number of forecasts has had to be reduced in those cases in which the indicator series does not cover the whole period.[3]

2.2 Financial indicators considered

In this paper, we analyse the informational content of 26 financial indicators, grouped in six different categories: domestic public debt yields, domestic public debt yield spreads, domestic-foreign interest rate differentials vis-à-vis Germany and the US, credit quality spreads, exchange rates and stock prices. For comparative purposes, two standard monetary aggregates are also included: a narrow one -M2- and a broad one -ALP2-. These financial indicators are fairly standard in the related literature.

As commented in the Introduction, the intuition behind the use of financial

[3] See Appendix A for details regarding sample periods.

indicators in this context is that forward-looking agents, when forming the expectations that determine financial prices, consider a wide information set. This information set includes not only the past course of fundamentals but also other pieces of information, such as monetary policy actions and their expected effects, for example. It is precisely because of these *additional* pieces of information that financial indicators may have an *additional* information content compared to the own macroeconomic fundamentals. The following paragraphs are not intended to provide a sound theoretical basis for the potential predictive power of each of the indicators considered. Such an analysis is beyond the scope of this paper.[4] On the contrary, these paragraphs are aimed at providing some insight into the potential predictive power of the chosen indicators.

In the first place, according to the Fisher relationship, domestic public debt yields can be decomposed into three unobservable components: the real interest rate, the expected rate of inflation over the life of the bond and the risk premia. To the extent that changes in yields reflect changes in the first component, they should be negatively correlated with future output growth. Similarly, changes in yields due to changes in the expected rate of inflation should, under reasonable assumptions, be positively correlated with future inflation.

The above-mentioned Fisher relationship can also explain why public debt yield spreads, defined as the difference between long yields and short yields, may contain significant information about future inflation. Regarding output, there are at least two possible explanations of the potential predictive power of the public debt yield spreads. The first is related to monetary policy. Thus, for example, a tightening of monetary policy, which will be followed by a fall in output growth, usually has a greater effect on short-term rates than on long-term rates, flattening the yield curve. Alternatively, if agents are expecting a low growth, and they expect a Phillips curve relationship to hold, then inflation and interest rates would be expected to drop and the yield curve to flatten or even to invert. Notice also that, under the expectations hypothesis of the term structure of interest rates, yield spreads should also be good predictors of future short yields.

Regarding the foreign-domestic interest rate differentials, if uncovered interest rate

[4] Woodford (1994), Davis and Fagan (1996), Estrella (1997) and Smets and Tsatsaronis (1997) provide a good basis for such a theoretical exercise.

parity holds, these reflect the expected changes in the exchange rates. If purchasing power parity is expected to hold, then expected exchange rate changes should be mirrored in expected inflation differentials. Thus, a wider differential may imply worse relative prospects for inflation in the home country. Moreover, both expected exchange rate changes and current exchange rates may have direct effects on output growth and, through this channel, on future inflation.

There are also two possible explanations for the potential predictive power of the credit quality spread, defined as the spread between the yield of a private asset and a public asset of the same maturity. Firstly, since that spread should reflect mainly the greater default risk of the private asset, its changes could reflect changes in the perceived default risk, which should be negatively correlated with prospects of output growth. Secondly, Bernanke and other authors underline the relationship between the credit quality spread and monetary policy. According to these authors, in a context of imperfect sustitutability between assets, a monetary policy tightening induces a decline in the supply of bank loans. This means higher bank lending rates and higher rates on sustitutes for bank loans, such as private bonds and commercial paper, i.e., a widening of the spreads between those rates and public debt yields. The predictive power regarding inflation could be based on a short-term relationship between output and inflation.

Finally, the use of stock prices can be justified as follows: since dividend growth will be related to output growth, stock prices can contain information about future output insofar as they reflect market expectations of future dividends.

3. DO FINANCIAL INDICATORS FORECAST INFLATION, OUTPUT OR SHORT-TERM INTEREST RATES?

Regarding data, quarterly year-on-year CPI inflation, year-on-year GDP growth and 3-month domestic interest rates covering the period from 1978:I to 1997:I are the three macrofundamentals we consider. Details on the financial indicators considered are provided in Appendix A.

The main results of applying the process described in Section 2.1 to our data set are reported in Tables 1 to 3. Each table refers to one macrofundamental and shows which lags of the indicator are significant in the regression covering the whole period available, the number of observations in each equation, the ratio of the root of the mean in-sample squared error to that of the univariate model, and the mean squared error ratios corresponding to 1-, 4-, 8- and 12-quarters-ahead-out-of-sample forecasts. Two different values are provided for the last three ratios. First (upper values), ratios have been computed using the ex-post observed values of the indicator to make out-of-sample predictions. Second (lower values), out-of-sample values of the indicator have been forecast from an univariate equation containing 4 lags. The idea is that the actual predictive power of the indicator should be somewhere between both ratios, because the univariate-based forecast of the indicator could be improved by a more general equation or model, but such an improvement would be limited by perfect foresight.

Table 1 shows that only one term structure indicator is not significant in the equation for the inflation rate. According to the in-sample analysis, improvements vary between the 36% mean squared error reduction when the 5-year domestic yield (R5Y) is used and the 4% reduction corresponding to the 3-year domestic yield (R3Y). This result is similar to that found in most of the related papers for other countries. Out-of-sample results, however, are less favourable and, in general, ratios tend to be above 1. In 2 out of 8 cases the 1-quarter-ahead ratio is above 1. The best 1-quarter-ahead indicator is the 5-year yield (R5Y), which provides a ratio of .72. Results, however, are poorer for higher horizons. There are only three term structure indicators that offer ratios below 1 for four and eight quarters ahead projections and one regarding 12 quarters ahead. Only the 3-year to 1-month spread (S3_1) is able to overcome the univariate approach at any horizon, although the lowest ratio it provides is .89. Unfortunately, there are no sufficient data to test the out-of-sample performance of the more promising indicator according to the in-sample analysis: the 5-year domestic yield (R5Y).

Financial indicators based on the term structure offer by far the best results. Half of the domestic-foreign differentials are non-significant and those which are significant fail to improve the simple univariate results. Credit quality indicators tend to be significant but, when it is possible to make out-of-sample forecasts, these are outperformed by the univariate model. Similar results are obtained when using exchange rate and stock exchange indicators. It should be noted, however, that monetary aggregates do not provide better results, and have a poorer performance than the term structure indicators.

Overall, results in Table 1 raise some doubts about the usefulness of financial indicators as inflation predictors in Spain, at least for horizons between 1 and 12 quarters.[5] Are results similar regarding short-term interest rates and output?.

According to Table 2, results are even worse regarding the 3-month interest rate. Although most indicators (18 out of 20) are significant in the regressions covering the whole period, when their out-of-sample performance is analysed they fail to provide ratios below 1. No indicator is able systematically to overcome the univariate model to any horizon. Only three indicators provide ratios below 1 for 1-quarter-ahead forecasts. This number falls to one for 4-quarter-ahead forecasts and to zero in the other two cases. Especially striking is the inability of long-term yields to provide good forecasts.

Finally, Table 3 shows that many financial indicators are even non-significant in the regressions involving output (11 out of 26). Nevertheless, the 3-year domestic yield (R3Y) provides good results regarding the longest horizon and clearly outperforms the univariate model: the ratio for 12-quarter-ahead errors is .72 when the ex-post observed indicator is used and .68 when it is forecast with the univariate model. Similarly, the stock exchange indicator provides ratios below 1 for all horizons considered, varying between .75 and .95.

All in all, the results in Tables 1 to 3 are rather negative regarding the ability of financial prices to forecast inflation, output or short-term interest rates. They seem to work, at least in most cases, when in-sample criteria are used but fail to do so out of the sample. This result is only partially at odds with other results in the literature which point to a higher informational content of financial indicators, because most of them are based solely on in-sample analysis.

Should we conclude that financial prices are not useful as indicators of future fundamentals in Spain? Before reaching such a conclusion, several aspects deserve more attention. Obviously, there are problems with the extension of some data series. But these problems can hardly be overcome unless we wait for about another 10 years.

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[5] Slightly better results were obtained using an alternative price index (IPSEBENE by its Spanish name) which drops from the CPI the most volatile components.

In our view, there are two more promising ways of gaining greater insight into the potential usefulness of financial prices. The first involves asking about their usefulness as 'qualitative' predictors. The idea is quite simple: maybe financial prices cannot anticipate the inflation rate prevailing, say, 2 years ahead, but they can forecast whether prices are going to experience any unusual acceleration by that time. The second asks about the usefulness of financial prices as expectation indicators. We know that if expectations are rational and there are no information problems, expectations and ex-post values must differ only because of a standard white-noise term and, therefore, a good predictor will also be a good expectation indicator and viceversa. But in other perhaps more realistic circumstances, even rational agents may be subject to important errors when predicting, for example, inflation and, therefore, indicators failing to forecast inflation might nevertheless be good inflation expectation indicators. In the next two sections we deal with these two issues.

4. ARE FINANCIAL PRICES USEFUL AS QUALITATIVE INDICATORS?

Before concluding that financial prices do not contain any relevant information on future macroeconomic performance, we would find it worthwhile to explore whether they are able to anticipate 'events' although they are not able to ancitipate their 'magnitude'. If financial agents are forward-looking but tend to focus on general trends more than on eventual changes, financial prices would be better predictors of trend shifts than of precise point values.[6] This idea is behind the recent work by Estrella and Mishkin (1996) showing that the slope of the yield curve helps to predict recessions in the US.

Exploring this possibility in detail is beyond the scope of this paper. Instead, we provide an initial approach for evaluating to what extent a deeper analysis might be worthwhile. Thus, we undertake a Probit analysis in which the qualitative dependent variables are 'inflation upturns', 'output slowdowns' and 'monetary policy tightenings'. Each of them has been built rather simply, following the procedure in Ball (1994). First, for inflation, output and the 3-month interest rate maxima (minima) are recorded as those observations that are higher (lower) than the three

[6] The fact that better quantitative results are obtained when a less volatile price index is used -see footnote 6- may be interpreted as providing some support for this view.

prior and the three subsequent observations.[7] Second, whenever two consecutive maxima (minima) are computed, the higher (lower) is chosen. Moreover, if there are two critical values separated by less than three quarters, the second one is eliminated. Finally, the dependent variable corresponding to inflation and the interest rate are given the value of 1 whenever the corresponding series are moving from a minimum to a maximum. For output, values of 1 are given when it moves from a maximum to a minimum, thus reflecting a slowdown in output. Chart 1 shows the three variables.

As to the Probit estimates and the performance criteria, they can be summarised in the following steps:

1. We first estimate a Probit model in which only (quantitative) lags of the fundamental are included. As before, this pseudo-univariate model will be our benchmark.

2. For those indicators that appeared as in-sample significant in the quantitative analysis, we add as many lags as suggested by the quantitative analysis.[8] The pseudo-R^2s suggested by Estrella (1995) and the mean probabilities corresponding to 1s and 0s are then compared. This is the equivalent of the in-sample quantitative analysis.

3. Both Probits are re-estimated for shorter samples and 23 1-quarter-ahead forecasts are made and compared according to the pseudo-R^2.

Tables 4 to 6 show the results of this procedure, which are rather promising. Regarding inflation, and in contrast to Table 1, most financial indicators that are significant in the in-sample analysis also have out-of-sample ratios below 1, what reflects a clear improvement over the univariate model. The higher increases in the

[7] Regarding inflation, the less volatile index IPSEBENE has been used instead of CPI as an additional filter to eliminate noisy changes. Regarding output, the more classical approach of 'three consecutive quarters of negative growth' has also been tried but it provided too few observations.

[8] In order to reduce the number of variables in the Probit model we consider a single variable built as an average of the different lagged values. Notice that the whole exercise is rather restrictive, which explains why this can be considered only as an initial approach.

pseudo-R^2 of out-of-sample forecast with respect to that of the univariate model correspond to the indicators based on the term structure: 3-year and 5-year yields (R3Y and R5Y) show ratios of .47 and .23, respectively; 5-year to 1-month (S5_1), 5-year to 1-year (S5_12) and 1-year to 1-month (S12_1) spreads also have low ratios (.27, .40 and .55, respectively). Thus, financial indicators seem to do a better job forecasting inflation upturns than forecasting inflation itself.

The same result applies to output slowdowns. According to Table 5, about half of the 9 significant indicators provide out-of-sample pseudo-R^2 ratios below 1. Again, the best results are provided by the yield slope indicators, the spread between 3 years and 1 month (S3_1) giving the lowest ratio: .90.

Similar results are also found for the 3-month interest rate. In this case, 5 out of 9 significant indicators are able to make out-of-sample forecasts better than those of the pure univariate model. It should be noticed again than the term structure appears as the more useful source of information. 1-year (R1Y) and 3-year (R3Y) yields are able clearly to overcome the univariate model, providing ratios of .74 and .64, respectively.

All in all, results in these last three tables are more promising than those of the quantitative analysis[9] and point to the yield curve as a leading indicator of trend shifts in inflation, output and short-term interest rates.

5. MAY FINANCIAL PRICES BE USEFUL AS EXPECTATION INDICATORS?

Up to now, we have focused on the capacity of financial prices to predict the future behaviour of some relevant macroeconomic variables. Nevertheless, even if they were bad predictors for those variables they might prove useful as indicators for agents' expectations. Obviously, it could be argued that rationality plus perfect information make this analysis redundant because expected and ex-post values may only differ because of a white-noise term. However, this rational-expectation-perfect-information framework is clearly at odds with what seems to be one of the main worries of most

[9] Particularly because, as commented, this can only be seen as a preliminary approach.

central bankers: the degree of credibility of the policies implemented. Naturally, credibility is a relevant issue only in a context of imperfect information.

There are a number of papers in the literature showing how rational agents may be subject to important and rather persistent expectation errors. Most have focused on inflation. For example, some authors have found that, due to imperfect information, inflation rates can be successfully characterised by switching-regime models à la Hamilton, not only in high-inflation countries like Argentina, Israel or Mexico (see Kaminsky and Leiderman, 1996) but also in countries whose inflation rates are relatively low and stable like the US (Evans and Lewis, 1995) or Canada (Bank of Canada, 1996). These switching-regime models produce inflation expectation errors which have zero mean *ex-ante* but, *ex-post*, can show a non-zero mean over relatively protracted periods. Similarly, according to King (1996), if agents do not immediately learn about central bank behaviour, disinflationary processes will probably be characterised by inflation targets (and, therefore, by actual inflation) below agents' inflation expectations. Lasting inflation expectation errors are also predicted by models à la Backus-Driffill (1985) where central bankers face credibility problems and need time to build their anti-inflationary reputation.

Differences between targeted values or planned monetary policy actions and expectations may imply additional costs to reach the targets or to implement the desired policy. Thus, for example, regarding inflation, discrepancies between targets and expectations, based on a credibility or information problem, may increase the costs of a disinflationary policy. Similarly, monetary authorities may provide clearer monetary policy signals if they know the interest rates agents are expecting. Thus, in these circumstances, agents' expectations are another valuable piece of information that financial prices could provide. In this section, we survey a number of recent papers on this issue written at the Research Department of the Banco de España.

The main problem in assessing the informational content of financial indicators in this respect is that agents' expectations are non-observable. Surveys, when available, rarely provide enough information. The approach, hence, has to be different. In particular, more room has to be made to economic theory, and arguably results are model-dependent.

Our research in this area has been twofold. On the one hand, we have tried to retrieve inflation expectations from the nominal interest rates according to the Fisher equation. On the other hand, expectations on future short-term interest rates have been obtained according to the relationship between short- and long-term interest rates. As it is well known, however, an analysis of the informational content of financial prices on expected output cannot be based on similar non-arbitrage or equilibrium relationships.

The Fisher relationship states that riskless nominal interest rates are equal to the sum of three components: a riskless real rate to the same maturity, the expected inflation at that horizon and an inflation risk premium. If we do not believe there are arbitrage opportunities in Spanish financial markets, inflation expectations at different horizons could be obtained provided we have data on the nominal zero-coupon bond yield curve, the real zero-coupon bond yield curve and the inflation risk premia to different maturities.

The nominal zero-coupon yield curve is regularly estimated at the Banco de España following the Nelson and Siegel (1987) and Svensson (1994) methodology. This method provides a smooth continuous nominal zero-coupon yield curve, and according to Núñez (1995) offers better results than other alternative methods available in the literature.

In Ayuso (1996), *ex-ante* real rates are estimated for the Spanish economy in a CCAPM framework. Notice that *ex-post* real interest rates are not good substitutes for *ex-ante* interest rates in this case for, at least, two reasons. For one thing, because according to the Fisher relationship that would imply that the average inflation risk premium is zero. For another, because *ex-post* real interest rates are only observable after the inflation rate has been observed, thus dispelling any usefulness they may have as an indicator of inflation expectations. Therefore, *ex-ante* real interest rates have to be estimated.

The approach in Ayuso (1996) can be briefly summarised as follows. According to the equilibrium relationships implied by the CCAPM for returns expressed in real terms, it can be shown that the riskless zero-coupon *ex-ante* real interest rate to a given horizon k must be equal to the inverse of the expected marginal rate of substitution between current and k-period-ahead consumption. If agents have isoelastic preferences and consumption and returns are jointly lognormal, the marginal rate of substitution depends on two parameters that characterise agents' time preference and risk aversion, respectively, and the (log) rate of consumption growth.

The time preference and the relative risk aversion parameters are estimated following Hansen and Singleton (1982): without imposing lognormality, first-order conditions for different investment strategies maturing between 1 month and 12 months in the future are obtained. In particular, for each maturity, several combinations of 1-month to 12-month zero-coupon bonds are considered. This set of first-order conditions is then used to estimate, by GMM, the above-mentioned parameters. On the other hand, expected consumption growth at different horizons are obtained from an AR-ARCH model for consumption growth. Table 7 shows the basic statistics thus obtained for the 1-, 3-, 5- and 10-year *ex-ante* real interest rates. As can be seen, they seem to be rather stable and the real yield curve is nearly flat. It should be said, however, that the level of the real yield curve is not estimated with high precision.

Turning now to inflation risk premia, in Alonso and Ayuso (1996) such an estimate is undertaken also in a CCAPM framework assuming both lognormality and isoelastic preferences. Under these assumptions, it is easy to show that for any horizon k the inflation premium can be expressed as the product of two factors: the agents' relative risk aversion coefficient, and the conditional covariance between k-period-ahead (log) prices and consumption. They estimate 1-, 3- and 5-year-ahead conditional covariances between Spanish price and consumption data from a bivariate GARCH model and calculate inflation premia for different available estimates of the Spanish relative risk aversion coefficient. Table 8 shows the basic statistics of the inflation premia when the maximum estimate of relative risk aversion (7.22) is considered. This can be seen as an upper bound for the actual inflation premia. According to this table, inflation premia can also be considered relatively low and stable even for maturities up to 5 years.

Thus, regarding the informational content of the term structure on inflations expectations, the results commented above suggest that -since the level of the real yield curve is estimated with low precision- the most efficient way to exploit the informational content of long-term nominal interest rates is by looking at changes in their levels. Given that inflation premia and *ex-ante* real rates are rather stable, changes in long-term zero-coupon interest rates should mainly reflect changes in agents' inflation expectations.

As to the possibility of extracting information on short-term interest rate expectations from long-term interest rates, it is well-known that long-term rates can be expressed as an average of future expected short-term rates plus a term risk premium. Term premia for equations containing expectations on 1-month and 1-year interest rates to different horizons have been estimated in Restoy (1995), using the methodology proposed by Backus and Zin (1994) to explain the shape of a yield curve.

The starting point of this methodology is a non-arbitrage argument: if there are no arbitrage opportunities, all expected returns must be equal provided they are discounted using the proper discount factor. Assuming that the discount factor follows an ARMA process, it is easily shown that the parameters of this process completely characterise the current interest rates, the implicit forward rates and the term premia. Thus, term premia can be computed provided an estimate of these ARMA parameters. The discount factor, however, is non-observable and this precludes the direct estimation of its univariate model. But the ARMA parameters can be retrieved, exploiting the fact that they also determine the sample moments of current and forward interest rates.

This retrieval process is what Backus and Zin (1994) call a 'reverse engineering process': given an autoregressive order and a moving average order, the relationship between the ARMA parameters of the process followed by the discount factor and the sample moments in the time series of the spot and forward interest rates can be used to estimate the former from the latter. Different AR and MA orders give rise to a different set of parameters and GMM provides a natural way of, first, estimating them, and second, choosing the model that best fits the data.

Table 9 presents the average term premium estimates obtained in Restoy (1995), together with the mean values of the 1-month and the 1-year forward rates. According to the estimates in the table, term premia included in Spanish nominal interest rates can be considered moderate or low, and therefore, 1-month and 1-year forward curves -which are obtained from the zero-coupon nominal yield curve- can be seen as mainly reflecting the expected paths for 1-month and 1-year interest rates.

6. CONCLUSIONS AND POLICY IMPLICATIONS

In this paper we have analysed the informational content of different financial prices on three macroeconomic variables of clear interest for the Banco de España in the design and implementation of its monetary strategy: the inflation rate -i.e. the direct target of current Spanish monetary policy; a short-term interest rate -i.e., its operational target; and output, because even a central bank with direct final inflation targets should worry about output deviations from a reference level.

We have looked at 26 financial prices covering the term structure, foreign-domestic differentials, credit quality, exchange rates and stock exchange indicators and have checked, first, their capacity to forecast quantitatively the three above-mentioned macrofundamentals; second, their usefulness as 'qualitative' predictors to anticipate inflation upturns, output slowdowns and monetary policy tightenings; and, finally, their usefulness as inflation and interest rate expectation indicators. In some sense, and guided by the results, we have moved from a very demanding to a less demanding analysis.

Although most of the financial indicators considered are found to be significant when they are included in the regression to explain the behaviour of inflation, output or the interest rate, they fail to outperform a simple univariate model when their out-of-sample performance up to three years is analysed.

Given this result, we have explored the possibility of using those financial indicators as 'qualitative' rather than as 'quantitative' indicators. As an initial approach, we have estimated several Probit models to forecast inflation upturns, output slowdowns and monetary policy tightenings. The results of this approach are clearly promising and seem to merit a further analysis that is beyond the scope of this paper. In any case, they point to the yield curve as the main potentially useful source of information.

Finally, we have also explored whether financial prices may be considered as good expectation indicators, irrespective of their ability as quantitative or qualitative predictors. The rationale for this analysis is based on agents' inability to perceive clearly what central banks really do. In this framework, they could make errors that are far from the usual zero-mean assumption. Although the approach relies on the acceptance of several prior assumptions, the available evidence points to an important informational content of yields on zero-coupon bonds on both expected inflation and expected short-term interest rates.

Taken together, these results may have important implications for the use of financial indicators in the current Spanish monetary policy framework. As none of the financial indicators considered seems to hold a stable empirical relationship with any of the fundamentals, this discards the possibility of using them as nominal anchors for monetary policy decisions in the same way that monetary aggregates were used in the past. Nevertheless, they can be useful both as 'qualitative' indicators to complement the quantitative information provided by other non-financial indicators, and as expectation indicators signalling potential credibility problems and potential misunderstandings of monetary policy actions. In this respect, indicators derived from the zero-coupon yield curve (interest rate levels and spreads) emerge as the most informative financial prices.

TABLE 1. THE PREDICTIVE POWER ON INFLATION (CPI): Linear Model

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
R1M	68	13.13	2-6[f]	0.93	0.99	1.00	0.99	1.10
		(0.04)				0.98	0.93	0.99
R12M	62	9.94	1-3[f]	0.95	1.00	1.07	1.05	1.10
		(0.04)				1.04	0.95	1.01
R3Y	63	5.46	--[f]	0.96	0.99	1.01	0.98	0.98
		(0.02)				1.06	0.98	1.03
R5Y	42	104.3	1-12[f]	0.64	0.72	--	--	--
		(0.00)				--	--	--
S5_1	43	41.12	6-12	0.70	1.28	1.21	--	--
		(0.00)				1.21	--	--
S3_1	61	35.64	6-11	0.86	0.89	0.89	0.95	0.94
		(0.00)				0.89	0.99	1.04
S12_1	61	22.15	2-10	0.89	0.98	0.93	1.00	1.03
		(0.01)				0.92	1.04	1.06
S5_12	43	21.41	9-12	0.80	0.89	1.04	1.22	--
		(0.00)				1.04	1.22	--
S3_12	63	6.47	1-5	--	--	--	--	--
		(0.26)				--	--	--
S12MG	59	27.10	1-12	0.91	1.08	1.16	1.03	0.97
		(0.01)				1.00	1.02	0.86
S3YG	60	14.04	1-12	--	--	--	--	--
		(0.30)				--	--	--
S5YG[g]	43	19.32	1-12	--	--	--	--	--
		(0.08)				--	--	--
S12MU	61	7.55	10-10	0.94	0.96	1.08	0.99	1.02
		(0.01)				1.08	0.99	1.06
S3YU	62	4.91	10-10	0.96	0.99	1.11	0.99	1.15
		(0.03)				1.11	0.99	1.17
S5YU	43	12.85	1-12	--	--	--	--	--
		(0.38)				--	--	--

TABLE 1. Cont.

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
SCP3M	31	55.59	3-8	0.68	--	--	--	--
		(0.00)				--	--	--
SCP12M	31	15.17	1-6	0.83	--	--	--	--
		(0.02)				--	--	--
SP5Y	45	4.05	3-6	--	--	--	--	--
		(0.40)				--	--	--
SCL3M	51	8.53	1-12	--	--	--	--	--
		(0.74)				--	--	--
SL3Y	64	13.48	6-8	0.93	1.17	1.10	1.18	1.02
		(0.00)				1.10	0.96	0.97
SL5Y	46	17.91	5-9	0.85	1.51	1.69	1.99	2.39
		(0.00)				1.69	1.91	1.10
ESPDEM	64	19.96	2-12	0.91	1.13	1.22	1.20	1.36
		(0.05)				1.27	0.98	0.96
ESPUSD	65	13.56	6-11	0.92	1.13	1.25	1.42	1.34
		(0.03)				1.25	1.28	0.89
NEER	64	21.75	2-12	0.88	1.23	1.51	1.77	1.97
		(0.03)				1.52	1.23	1.01
REER	64	21.25	1-12	0.88	1.39	1.84	2.09	2.18
		(0.05)				1.76	1.37	1.24
SP	66	18.19	3-10	0.89	1.15	1.19	1.25	1.28
		(0.02)				1.21	1.29	1.20

M2	65	16.62	5-11[f]	0.93	1.28	1.25	1.45	1.46
		(0.03)				1.24	1.38	1.32
ALP2	68	12.12	4-8[f]	0.94	1.02	1.20	1.22	1.09
		(0.06)				1.23	1.07	1.02

Notes:

(a) See Appendix A for indicator definitions.

(b) Wald test robust to heteroscedasticity of the joint significance of the lagged terms of the indicator variable included in each equation. When cointegration exists, the null hypothesis also includes a zero value for the coefficient of the error correction term. The test has a $\chi^2(m)$ distribution, where m is the number of restrictions. p-value in parenthesis.

(c) Lagged terms of the indicator variable included in each equation.

(d) Ratio of one-quarter ahead RMSE, within sample, between the equation with indicator and the univariate equation. This ratio must always be smaller than one.

(e) Ratios of 1-, 4-, 8- and 12-quarters-ahead RMSE, out of sample, between the equation with indicator and the univariate equation. A value greater than one means worse forecast performance of the model with indicator than the univariate model. In general, in order to predict more than one quarter ahead, we need forecasts of the indicator itself. For each indicator, the first row is that resulting when actual values of the indicator are used for the forecasts and the second row is that resulting when AR(4) univariate predictions of the indicator are used. Results are presented only when at least 8 forecasts can be made.

(f) The model with indicator includes an error correction term, resulting from the cointegration between the levels of the dependent variable and the indicator.

(g) For this indicator, a trend is included in the equations, because only deviations of the indicator from a trend can be considered stationary.

TABLE 2. THE PREDICTIVE POWER ON 3-MONTH INTEREST RATES: Linear Model

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
R12M	61	10.45	9-9[f]	0.92	1.08	1.33	1.42	1.54
		(0.01)				1.22	1.13	0.93
R3Y	59	27.74	7-12[f]	0.90	1.39	1.48	1.79	3.20
		(0.00)				1.41	1.60	1.63
R5Y	42	15.18	1-12[f]	--	--	--	--	--
		(0.30)				--	--	--
S12MG	61	25.31	1-10	0.83	1.37	1.51	1.64	2.31
		(0.00)				1.21	1.31	1.45
S3YG	60	10.22	9-12	0.93	1.04	1.14	1.20	1.91
		(0.04)				1.14	1.20	1.54
S5YG[g]	45	8.09	9-10	0.87	0.91	0.97	1.24	1.33
		(0.02)				0.97	1.24	1.21
S12MU	59	41.92	2-12	0.76	1.27	1.25	1.33	2.35
		(0.00)				1.30	1.23	1.26
S3YU	60	38.58	6-12	0.88	1.26	1.14	1.26	2.12
		(0.00)				1.14	1.37	1.79
S5YU	46	10.45	6-9	0.89	0.99	1.05	1.29	1.40
		(0.03)				1.05	1.42	1.14
SCP3M	34	19.15	1-5	0.90	1.17	--	--	--
		(0.00)				--	--	--
SCP12M	32	35.89	1-7	0.75	--	--	--	--
		(0.00)				--	--	--
SP5Y	42	16.89	4-11	0.87	0.97	1.96	--	--
		(0.03)				1.96	--	--

TABLE 2. Cont.

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
SCL3M	52	28.36	3-12	0.83	1.50	1.87	3.88	3.89
		(0.00)				1.48	1.61	1.29
SL3Y	63	11.90	6-9	0.93	1.06	1.12	1.15	1.31
		(0.02)				1.12	1.10	1.09
SL5Y	43	18.37	3-12	0.86	1.46	1.97	--	--
		(0.05)				2.10	--	--
ESPDEM	65	33.39	1-12	0.83	1.58	1.48	1.70	2.43
		(0.00)				1.33	1.24	1.28
ESPUSD	65	13.99	1-12	--	--	--	--	--
		(0.30)				--	--	--
NEER	67	17.19	6-10	0.92	1.17	1.06	1.15	1.46
		(0.00)				1.06	1.17	1.19
REER	69	18.32	1-8	0.90	1.44	1.48	1.69	2.27
		(0.02)				1.28	1.23	0.91
SP	68	19.73	1-9	0.95	1.23	1.19	1.22	1.61
		(0.02)				1.24	1.25	1.40

M2	72	12.52	2-2	0.94	1.00	0.91	0.61	0.94
		(0.00)				0.83	1.04	1.01
ALP2	65	16.13	1-12	--	--	--	--	--
		(0.19)				--	--	--

Notes: see notes on Table 1.

TABLE 3. THE PREDICTIVE POWER ON OUTPUT: Linear Model

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
R1M	67	22.64	4-10	0.87	1.08	1.04	1.06	0.82
		(0.00)				1.04	1.09	1.07
R12M	57	51.34	2-10	0.80	1.09	0.99	0.81	0.74
		(0.00)				1.01	0.91	1.03
R3Y	57	30.14	1-11	0.85	1.14	1.05	0.85	0.72
		(0.00)				1.07	0.90	0.68
R5Y	41	53.52	1-10	0.76	1.36	--	--	--
		(0.00)				--	--	--
S5_1	43	15.17	1-12	--	--	--	--	--
		(0.23)				--	--	--
S3_1	61	29.83	2-11	0.87	1.16	1.27	1.60	3.44
		(0.00)				1.26	1.52	3.85
S12_1	64	23.35	1-7	0.92	1.13	1.27	1.68	4.92
		(0.00)				1.26	1.56	5.17
S5_12	43	11.25	1-12	--	--	--	--	--
		(0.51)				--	--	--
S3_12	59	18.54	1-12	--	--	--	--	--
		(0.10)				--	--	--
S12MG	59	12.44	1-12	--	--	--	--	--
		(0.41)				--	--	--
S3YG	60	11.72	1-12	--	--	--	--	--
		(0.47)				--	--	--
S5YG[g]	43	57.00	4-12	0.66	1.12	1.31	--	--
		(0.00)				1.31	--	--
S12MU	65	5.47	2-2	0.96	1.07	1.14	1.47	4.49
		(0.02)				1.17	1.60	4.81
S3YU	63	31.37	2-9	0.85	1.08	1.08	1.25	2.14
		(0.00)				1.14	1.43	2.52
S5YU	45	33.14	6-10	0.83	0.91	0.93	0.86	--
		(0.00)				0.93	0.88	--

TABLE 3. Cont.

IND[a]	NOBS.	SIGNIF.[b]	LAGS[c]	IN-SAMPLE RATIO[d]	OUT-OF-SAMPLE RATIOS[e]			
					RMSE1	RMSE4	RMSE8	RMSE12
SCP3M	31	16.17	2-8	0.86	--	--	--	--
		(0.02)				--	--	--
SCP12M	31	7.83	1-8	--	--	--	--	--
		(0.45)				--	--	--
SP5Y	43	25.30	1-10	0.83	1.62	1.73	--	--
		(0.00)				1.66	--	--
SCL3M	52	21.98	1-12	0.89	1.17	1.25	1.39	--
		(0.04)				1.22	1.23	--
SL3Y	60	17.13	1-12	--	--	--	--	--
		(0.14)				--	--	--
SL5Y	43	16.13	1-12	--	--	--	--	--
		(0.19)				--	--	--
ESPDEM	65	25.65	3-12	0.87	1.09	1.14	1.36	2.57
		(0.00)				1.13	1.25	1.81
ESPUSD	65	14.94	1-12	--	--	--	--	--
		(0.24)				--	--	--
NEER	65	8.69	4-12	--	--	--	--	--
		(0.47)				--	--	--
REER	65	15.97	1-12	--	--	--	--	--
		(0.19)				--	--	--
SP	71	13.46	1-1	0.92	0.90	0.80	0.75	0.95
		(0.00)				0.86	0.91	0.92
M2R	65	20.54	3-12	0.90	1.35	1.22	1.33	3.55
		(0.02)				1.24	1.43	2.88
ALP2R	71	6.08	1-3	0.96	0.96	0.84	0.71	1.05
		(0.11)				0.88	0.85	0.96

Notes: see notes on Table 1.

TABLE 4. THE PREDICTIVE POWER ON INFLATION (IPSEBENE): Probit Model

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			$P\text{-}R^{2}$[c]	Y=1[d]	Y=0[e]	$P\text{-}R^{2}$[f]
R12M[g]	68	6.40 (0.01)	.51	.77	.92	1.61
R3Y[g]	69	12.00 (0.00)	.33	.66	.82	.76
R5Y[g]	42	15.05 (0.00)	.31	.64	.70	.23
S5_1	45	13.88 (0.00)	.30	.67	.72	.27
S3_1	62	0.02 (0.90)	--	--	--	--
S12_1	46	5.33 (0.02)	.60	.81	.92	.55
S5_12	61	7.31 (0.01)	.44	.80	.86	.40
S3_12	59	0.01 (0.91)	--	--	--	--
S5YG	45	2.97 (0.08)	.66	.90	.95	3.33
S3YU	68	0.04 (0.85)	--	--	--	--
S5YU	50	3.95 (0.05)	.65	.86	.92	.52
SCP3M	31	2.12 (0.15)	.70	.90	.91	.72
SCP12M	37	3.28 (0.07)	.75	.92	.89	(-)
SP5Y	51	0.58 (0.44)	--	--	--	--

TABLE 4. Cont.

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			P-R2[c]	Y=1[d]	Y=0[e]	P-R2[f]
SL3Y	61	16.80 (0.00)	.30	.62	.74	(-)
SL5Y	46	7.00 (0.01)	.45	.81	.88	.58
ESPDEM	73	0.84 (0.36)	--	--	--	--
ESPUSD	65	7.62 (0.01)	.50	.72	.88	(-)
NEER	70	0.11 (0.75)	--	--	--	--
REER	64	1.26 (0.25)	.85	.96	.99	.73
SP	74	0.31 (0.58)	--	--	--	--
M2[g]	64	18.86 (0.00)	.28	.57	.70	--
ALP2[g]	68	4.83 (0.09)	.63	.83	.92	--

Notes:

(a) See Appendix A for indicator definitions.

(b) Likelihood ratio test of the joint significance of the lagged terms of the indicator variable included in each equation plus the error correction term if this exists. The test has a $\chi^2(m)$ distribution, where m is the number of restrictions. p-values in brackets.

(c) Ratio of pseudo-R^2, within sample, between the univariate equation and the equation with indicator. Within sample this ratio must always be lower than one.

(d) Ratio of the mean value of the fitted probability when Y is actually one in the univariate model and the model with indicator. A value lower than one implies that, on average, the model with indicator has a greater probability of being right when Y is equal to one.

(e) Ratio of the mean value of the fitted probability when Y is actually zero in the model with indicator and the univariate model. A value lower than one implies that, on average, the model with indicator has a greater probability of being right when Y is equal to zero.

(f) The same as (c) for out-of-sample errors. The lower the ratio, the higher the informational content of the indicator. (-) denotes a negative ratio.

(g) The model with indicator includes an error correction term, resulting from the cointegration between the levels of the dependent variable and the indicator.

TABLE 5. THE PREDICTIVE POWER ON OUTPUT: Probit Model

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			P-R2[c]	Y=1[d]	Y=0[e]	P-R2[f]
R1M	67	4.58 (0.03)	.94	.97	.83	.93
R12M	57	4.73 (0.03)	.92	.97	.81	1.07
R3Y	57	11.33 (0.00)	.85	.93	.58	4.35
R5Y	41	1.47 (0.23)	--	--	--	--
S3_1	61	9.37 (0.00)	.88	.93	.72	.90
S12_1	64	6.49 (0.01)	.92	.96	.79	.98
S5YG	43	0.23 (0.63)	--	--	--	--
S12MU	69	1.59 (0.20)	.97	.98	.96	.98
S3YU	63	0.45 (0.50)	--	--	--	--
S5YU	45	12.04 (0.00)	.85	.91	.38	(-)
SP5Y	43	0.39 (0.53)	--	--	--	--
SCL3M	52	0.45 (0.50)	--	--	--	--
ESPDEM	65	1.51 (0.22)	--	--	--	--
NEER	65	2.28 (0.13)	.97	.98	.94	.93

TABLE 5. Cont.

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			$P\text{-}R^{2}$[c]	Y=1[d]	Y=0[e]	$P\text{-}R^{2}$[f]
SP	75	7.72 (0.01)	.91	.97	.82	1.01
M2R	65	2.25 (0.13)	.97	.98	.92	.98
ALP2R	74	0.84 (0.36)	--	--	--	--

Notes: see notes on Table 4.

TABLE 6. THE PREDICTIVE POWER ON 3-MONTH INTERES RATES: Probit Model

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			P-R2[c]	Y=1[d]	Y=0[e]	P-R2[f]
R12M[g]	61	8.70 (0.01)	.56	.89	.87	.74
R3Y[g]	59	5.58 (0.06)	.68	.92	.92	.64
S12MG	61	0.53 (0.47)	--	--	--	--
S3YG	60	2.69 (0.10)	.80	.96	.94	.81
S5YG	45	6.45 (0.04)	.58	.89	.83	5.26
S12MU	59	0.02 (0.90)	--	--	--	--
S3YU	60	1.29 (0.26)	.89	.97	.98	.94
S5YU	46	2.26 (0.13)	.82	.95	.94	.97
SCP3M	34	2.96 (0.09)	.83	.93	.90	2.86
SCP12M	32	1.17 (0.28)	--	--	--	--
SP5Y	42	4.08 (0.04)	.69	.92	.89	(-)
SCL3M	52	0.43 (0.51)	--	--	--	--
SL3Y	63	0.92 (0.34)	--	--	--	--
SL5Y	43	0.22 (0.64)	--	--	--	--

TABLE 6. Cont.

IND[a]	NOBS.	SIGNIF.[b]	IN-SAMPLE RATIOS			OUT-SAMPLE RATIO
			P-R^2[c]	Y=1[d]	Y=0[e]	P-R^2[f]
ESPDEM	65	0.10 (0.75)	--	--	--	--
NEER	67	0.03 (0.86)	--	--	--	--
REER	69	0.35 (0.56)	--	--	--	--
SP	68	4.01 (0.05)	.68	.93	.92	3.33
M2	75	6.28 (0.01)	.32	.89	.92	.50

Notes: see notes on Table 4.

TABLE 7. BASIC STATISTICS OF *EX-ANTE* REAL INTEREST RATES

Maturity	Minimum	Maximum	Average	Standard deviation
1 year	3.92	5.67	4.88	0.28
3 years	4.42	5.21	4.85	0.13
5 years	4.57	5.06	4.84	0.08
10 years	4.70	4.94	4.83	0.04

NOTES:
- Taken from Ayuso (1996).
- Rates measured in annual percentage points (log approximations).
- Data are monthly and cover the period 1985:2-1994:12.

TABLE 8. BASIC STATISTICS OF INFLATION PREMIA

Inflation premium at	Minimum	Maximum	Average	Standard deviation
1 year	0.02	0.04	0.03	0.004
3 years	0.09	0.20	0.11	0.029
5 years	0.18	0.39	0.23	0.052

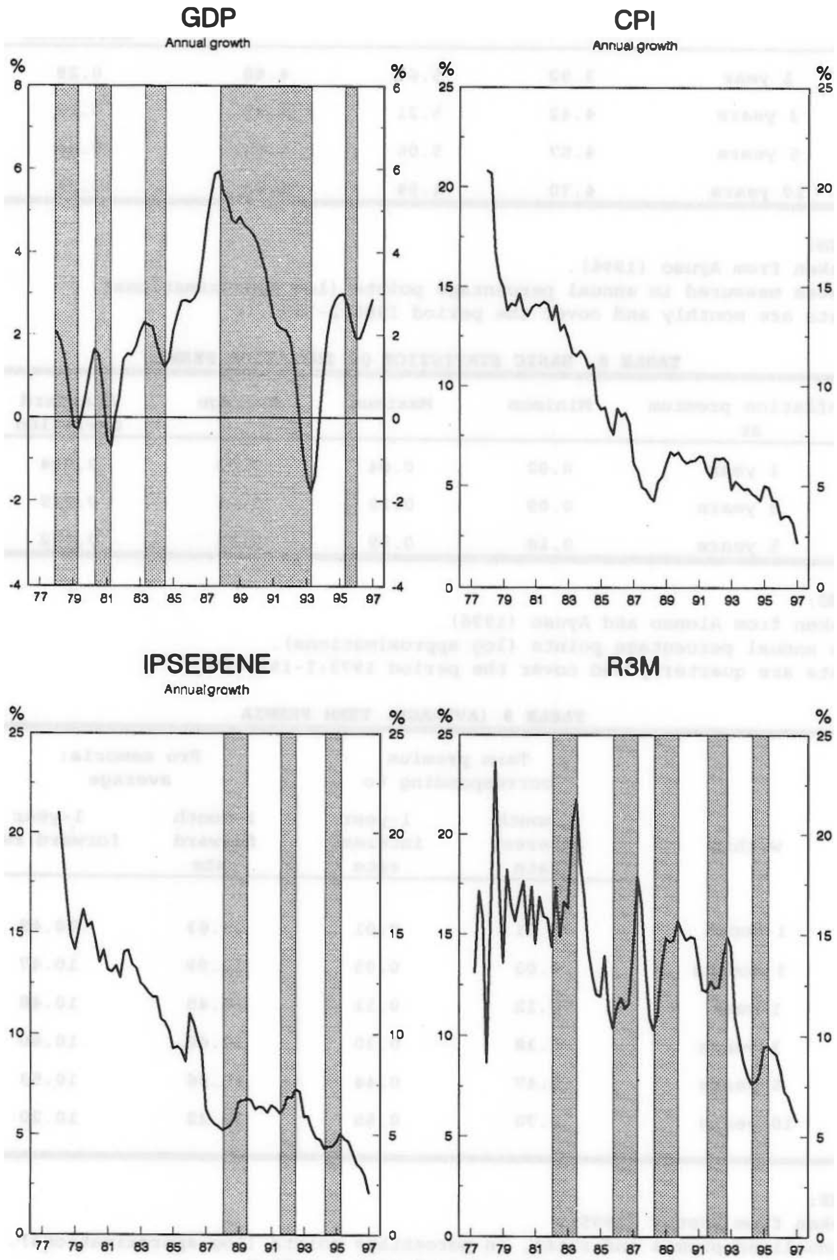
NOTES:
- Taken from Alonso and Ayuso (1996).
- In annual percentage points (log approximations).
- Data are quarterly and cover the period 1973:I-1995:IV.

TABLE 9 (AVERAGE) TERM PREMIA

	Term premium corresponding to		Pro memoria: average	
within	1-month interest rate	1-year interest rate	1-month forward rate	1-year forward rate
1 month	0.01	0.01	10.63	10.49
3 months	0.03	0.03	10.89	10.47
1 year	0.12	0.11	10.45	10.48
3 years	0.38	0.30	10.60	10.60
5 years	0.47	0.44	10.56	10.53
10 years	0.70	0.55	10.22	10.20

NOTES:
- Taken from Restoy (1995).
- Annualised premia and rates, in percentage points (log approximations).
- Data are monthly and cover the period 1991:1-1995:7.

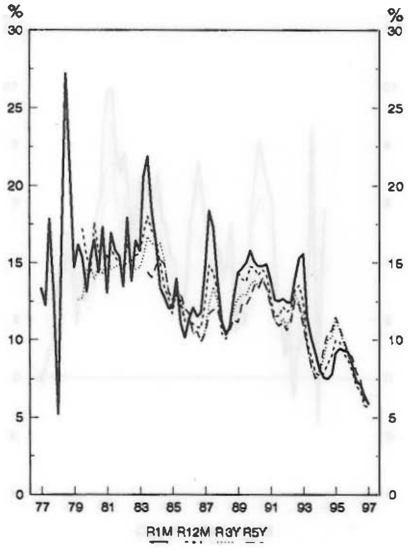
CHART 1. MACROECONOMIC VARIABLES (a)



(a) Grey areas correspond to dates where the 'qualitative' version of the variable is equal to one. See the main text for details.

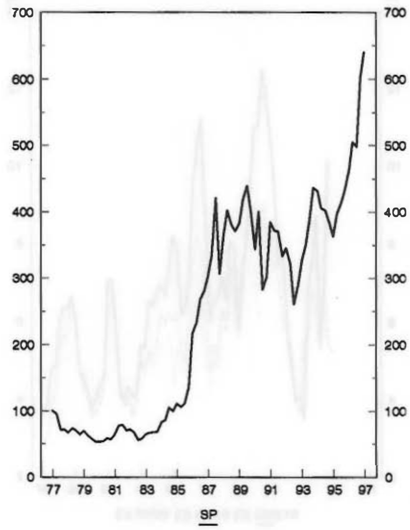
CHART 2. INDICATORS

RISKLESS INTEREST RATES



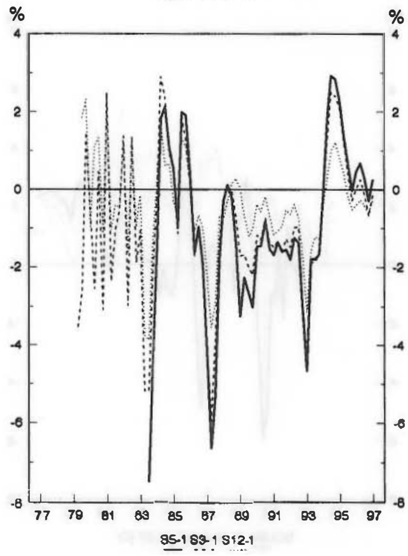
STOCK PRICES

Index (1977 I = 100)



TERM-STRUCTURE SPREADS

Against 1-month



TERM-STRUCTURE SPREADS

Against 12-month

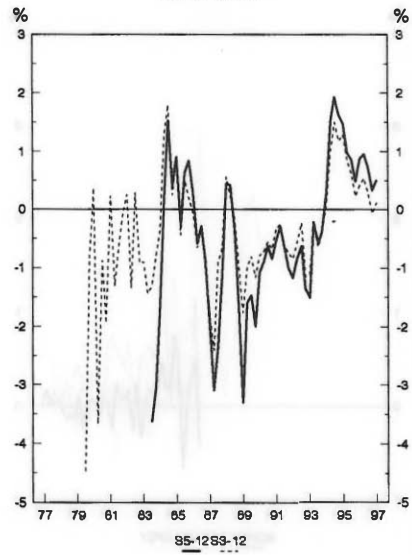
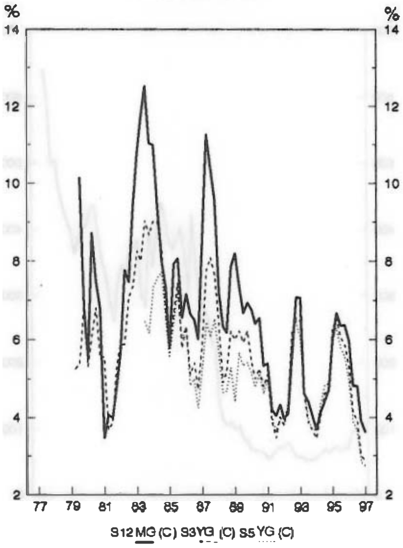
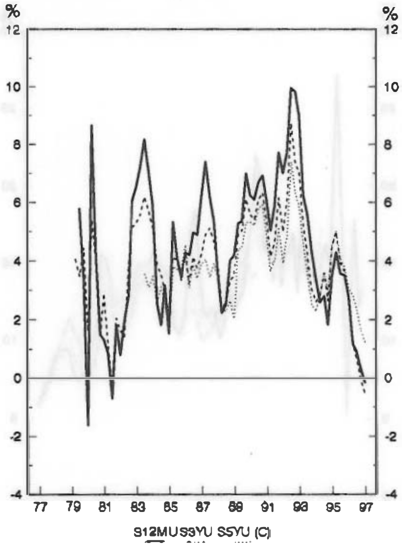


CHART 2. INDICATORS (Cont.)

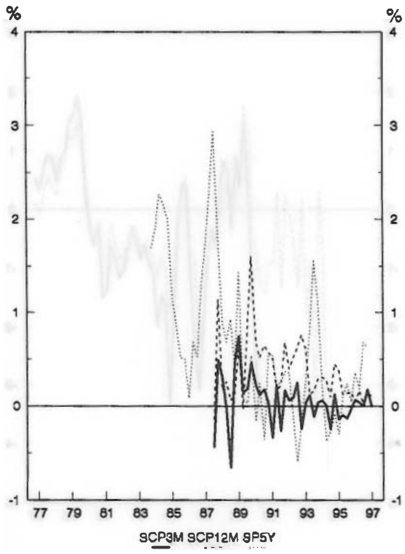
FOREIGN SPREADS
Against Germany



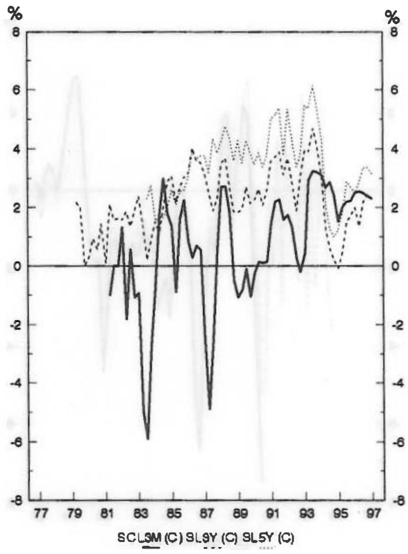
FOREIGN SPREADS
Against USA



PRIVATE-PUBLIC SPREADS

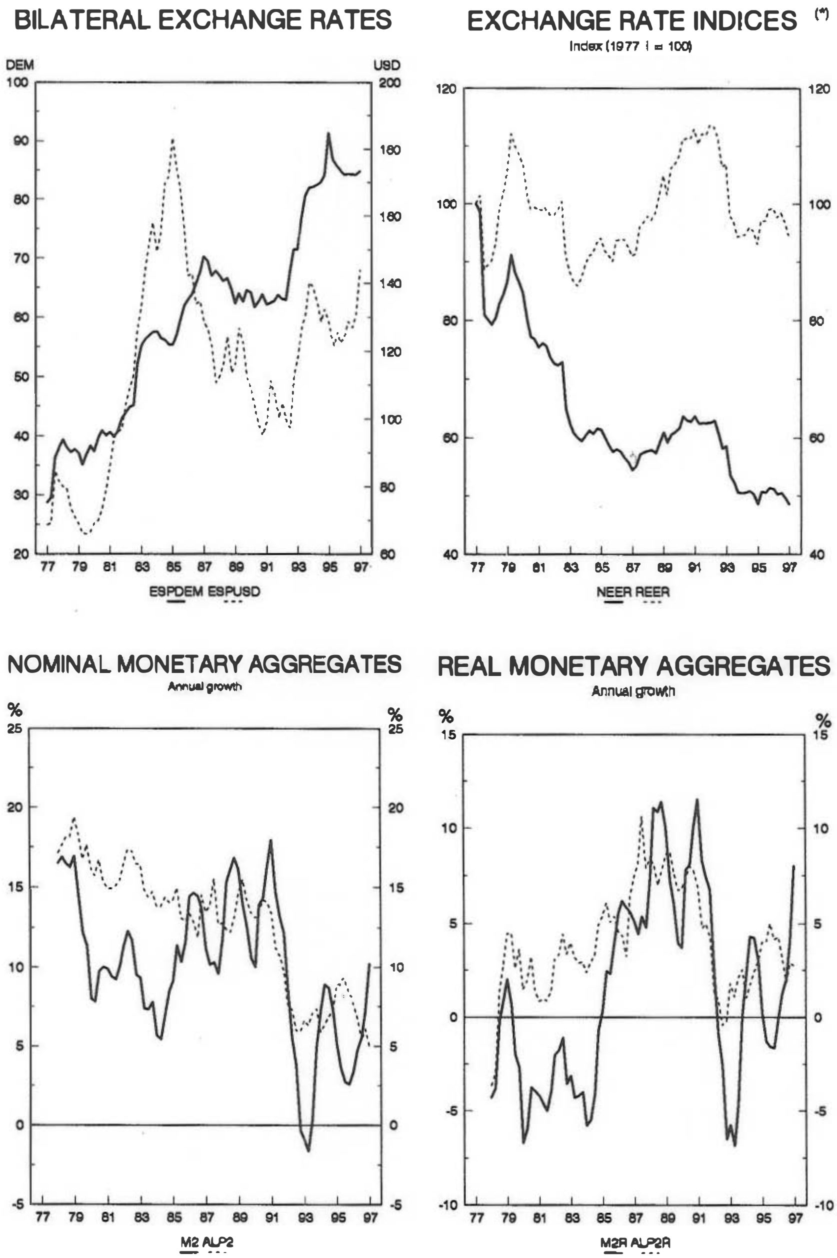


CREDIT SPREADS



(C) Corrected series.

CHART 2. INDICATORS (Cont.)



(*) A decline in the indices denotes a depreciation.

APPENDIX A. DATA DESCRIPTION

Due to the late development of a full range of liquid and competitive financial markets, the availability of data on asset prices in the Spanish economy is very limited. As a consequence, the selection and construction of variables for this work has been influenced by the need to have information for a period long enough to make reliable estimations of information content. That means that, in some cases, the variables used are only an approximation to the theoretical variable of interest.

In this appendix we describe the variables used in this work[10]. Unless otherwise indicated the source is the Banco de España and the quarterly series are built as the monthly averages of the daily data corresponding to the last month of each quarter. Most series cover the period from the first quarter of 1977 to the first quarter of 1997, but some of them do not cover the whole period.

Macroeconomic variables:

GDP: Real Gross Domestic Product. Source: National Institute of Statistics (INE). Quarterly series in origin.

CPI: Consumer Price Index. This is a re-elaboration -made at the Banco de España- of the Index produced by the National Institute of Statistics (INE) to homogenise the methodology of calculation for the whole period. Monthly in origin.

IPSEBENE: Consumer Price Index corrected by the elimination of its more volatile components: energy and non-processed foods. As before, we use the series re-elaborated at the Banco de España. Monthly in origin.

R3M: 3-month interbank interest rate.

[10] All them are shown in Charts 1 and 2.

Domestic riskless interest rates:

R1M: 1-month interbank interest rate.

R12M: 12-month interbank interest rate.

R3Y: 3-year central government bond yield. Until 1988, average yield on outright spot transactions with bonds at between 2 and 4 years on the Madrid Stock Exchange. Thereafter, average yield on outright spot transactions between market members with 3-year bonds on the public debt Book-Entry Market.

R5Y: 5-year central government bond yield. Until 1991, average yield on bonds at over 4 years. Thereafter, average yield on 5-year bonds. Data from outright spot transactions between market members on the public debt Book-Entry Market since 1988 and from the Madrid Stock Exchange before then.

Term-structure spreads:

S5_1: 5-year minus 1-month (R5Y-R1M).

S3_1: 3-year minus 1-month (R3Y-R1M).

S12_1: 12-month minus 1-month (R12M-R1M).

S5_12: 5-year minus 1-year (R5Y-R12M).

S3_12: 3-year minus 1-year (R3Y-R12M).

Domestic-Foreign spreads:

S12MG: 12-month interbank interest rate in Spain (R12M) minus 12-month interbank interest rate in Germany. Domestic markets.

S3YG: 3-year government bond yield in Spain (R3Y) minus 3-year government bond yield in Germany.

S5YG: 5-year government bond yield in Spain (R5Y) minus 5-year government bond yield in Germany.

S12MU: 12-month interbank interest rate in Spain (R12M) minus 12-month interbank interest rate in the United States. Domestic markets.

S3YU: 3-year government bond yield in Spain (R3Y) minus 3-year government bond yield in the United States.

S5YU: 5-year government bond yield in Spain (R5Y) minus 5-year government bond yield in the United States.

Credit quality spreads:

a) Private-public spreads:

SCP3M: 3-month commercial paper interest rate minus 3-month Treasury bill interest rate. In both cases, interest rates correspond to primary auction markets. Only auctions of the major issuers are considered. These are semi-public companies, but they are the only ones that conduct auctions regularly.

SCP12M: 12-month commercial paper interest rate minus 12-month Treasury bill interest rate. Comments on the previous variable also apply here.

SP5Y: Corporate bond yield minus 5-year government bond yield. Average yields in secondary markets. Corporate bonds correspond to electric companies and have horizons of about 2 years.

b) Credit spreads:

SCL3M: Average interest rate of banks and savings banks on commercial discount up to 3 months minus 3-month interbank interest rate (R3M).

SL3Y: Average interest rate of banks and savings banks on credit accounts at 1 to 3 years minus 3-year government bond yield (R3Y).

SL5Y: Average interest rate of banks and savings banks on loans at 3 years or over minus 5-year government bond yield (R5Y).

Exchange rates:

ESPDEM: Spot price of the D-Mark in pesetas per unit.

ESPUSD: Spot price of the US dollar in pesetas per unit.

NEER: Index of the nominal effective exchange rate of the peseta against developed countries.

REER: Index of the real effective exchange rate of the peseta against developed countries.

Stock prices:

SP: Madrid Stock Exchange General Index, end-of-month data. Source: Madrid Stock Exchange.

Monetary Aggregates:

M2: Narrow measure of money in nominal terms.

ALP2: Broad measure of money in nominal terms. The original series is adjusted for a change in level at the beginning of 1992, due to the exchange of Treasury notes for especial public debt.

M2R: M2 deflated by CPI.

ALP2R: ALP2 deflated by CPI.

APPENDIX B. UNIT ROOT TEST AND DATA TRANSFORMATIONS

We make several transformations on the original data. First, all interest rates, and consequently all spreads, are expressed in continous time. Second, the rest of the series are expressed in logarithms. Finally, all series are duly transformed to include only stationary series in the equations. This last step requires the analysis of the order of integration of the different variables considered, as well as the possible existence of cointegration relationships between some of them.

Most variables considered have been frequently used in empirical work. Thus, there is widespread evidence about their univariate and bivariate stochastic properties. Consequently, we shall not repeat here the analysis of those variables, but concentrate on those less frequently analysed.

Summarising previous evidence, we know that both price indices (CPI and IPSEBENE) are seasonal I(2) variables, so a $\Delta\,\Delta_4$ transformation in logarithms ensures stationarity (see, for example, Matea and Regil, 1996). GDP is a borderline case between I(1) and I(2), depending on the particular sample period considered. In this work, we considered GDP as I(1). Although, by construction, GDP should be a nonseasonal variable, there is some evidence of seasonality in it. So, we use a Δ_4 of the log of GDP as the stationary transformation.

As regards interbank and public debt interest rates, Alonso et al.(1997) have shown that they are I(1) variables, that they are cointegrated with the annual growth of both price indices and that spreads between them are stationary.

Likewise, the different exchange rates considered are I(1) variables. This result also applies to the real effective exchange rate index, which implies the non-existence of cointegration between the nominal effective exchange rate and consumer prices (see Pérez-Jurado and Vega, 1993).

Finally, nominal monetary aggregates are I(2) but real monetary aggregates are I(1) and all of them have seasonal components. That is, the growth rate of nominal monetary aggregates and inflation are cointegrated (see, for example, Ayuso and Vega, 1994).

Regarding the remaining indicators considered in this work (domestic-foreign, private-public and credit spreads), we present here some evidence about their stochastic properties. Initial tests showed the existence of a unit root in some of these spreads. But the low power of these test against the alternative of stationarity with some structural break is well known. In fact, the Spanish economy, and its financial system in particular, has experienced significant changes over the sample period considered.

A quick look at the series suggests specific dates at which a change in the mean occurs for several related series. Hence, we observe a change in the mean of the credit spreads around 1984:4, probably reflecting the passing from a context of legally fixed banking rates to one of market-determined rates[11]. Similarly, the recent convergence of Spanish interest rates towards the German ones can be represented as a change in the mean of Spanish-German spreads around 1991:1. We eliminate these changes in mean from the original series, using univariate models to estimate the corrected series. More statistically than theoretically grounded is the correction in the spread between Spain and USA 5-year rates of a change in mean in 1996:2.

Table B.1 shows Phillips-Perron unit root tests[12] for foreign, private-public and credit spreads. When needed, the corrected serie is used. With a few exceptions, the existence of a unit root can be rejected for all series, at least at the 10% significance level. When not significant, the statistics are very close to the 10% critical value (in the model with trend for the case of the 5-year spread with Germany).

---

[11] The liberalization of interest rates on bank assets begins in 1977 and is completed in 1981. Interest rates on bank liabilities are not fully liberalised until 1987.

[12] For details about the calculation and interpretation of the tests, see Perron (1988).

TABLE B.1. UNIT ROOT TESTS: I(1) AGAINST I(0)

	Model with trend			
	S12MG(c)	S3YG(c)	S5YG(c)	S12MU
$t_{\tilde{\alpha}}$	-3.30*	-3.21*	-3.06	-2.48
ϕ_3	5.54*	5.51	4.87	6.36*
ϕ_2	3.80	3.71	3.41	4.25*
	S3YU	S5YU(c)	SCP3M	SCP12M
$t_{\tilde{\alpha}}$	-2.00	-2.54	-7.15***	-5.67***
ϕ_3	4.06	3.54	26.49***	16.80***
ϕ_2	2.74	2.40	17.69***	11.21***
	SP5Y	SCL3M(c)	SL3Y(c)	SL5Y(c)
$t_{\tilde{\alpha}}$	-2.88	-3.71**	-3.20*	-2.46
ϕ_3	4.75	6.98**	5.21	3.20
ϕ_2	3.22	4.69*	3.47	2.14
	Model without trend			
	S12MG(c)	S3YG(c)	S5YG(c)	S12MU
t_{α^*}	-2.97**	-2.54	-2.02	-3.74***
ϕ_1	4.60*	3.31	2.33	7.17***
	S3YU	S5YU(c)	SCP3M	SCP12M
t_{α^*}	-2.95**	-2.67*	-6.35***	-5.10***
ϕ_1	4.51*	3.68	20.74***	13.34***
	SP5Y	SCL3M(c)	SL3Y(c)	SL5Y(c)
t_{α^*}	-2.66*	-3.11**	-3.03**	-2.54
ϕ_1	3.68	4.97**	4.64*	3.29

Notes:

1. A (c) indicates that the corrected series has been used.
2. *, ** and *** indicates significance at the 10%, 5% and 1% levels, respectively.
3. Both models contain a constant and 4 lags of the corresponding spread.
4. t_α is a test of the mull hypothesis of existence of a unit root in the corresponding model.

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