BOND RETURN PREDICTABILITY: AN INVESTIGATION FOR THE EUROPEAN MARKET

Florinda C. C. Campos Silva*
fsilva@eeg.uminho.pt

Maria Ceu Cortez*
mccortez@eeg.uminho.pt

Manuel J. Rocha Armada*
rarmada@eeg.uminho.pt

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Universidade do Minho
Escola de Economia e Gestão
4710-057 Braga
Portugal
Phone: 351 253 604550
Fax: 351 253 676375

* Ph.D. Student (Assistant Lecturer), Associate Professor and Full Professor of Finance, respectively, at the University of Minho. The authors express their appreciation for the financial support from FCT, POCTI as well as from the European Communitarian Fund FEDER.
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Abstract

The predictability of security returns has received considerable attention in the finance literature. Notwithstanding, the predictability of bond returns, in particular outside the US, has been far less explored. In this paper we analyse the ability of several predetermined information variables in predicting bond returns in the European market. We test if variables, commonly used for that matter in the context of other markets (such as inverse relative wealth, term spread**,** real bond yield and a January dummy) are also useful predictors of European bond returns. Due to some particularities of the sample period of analysis, characterised by the EMU convergence, we also make another contribution by including the yield spread in relation to German bonds. Furthermore, our research is also innovative by considering different bond maturities: 1-3, 3-5 and 5 or more years to maturity.

The results indicate that variables like the term spread, IRW and a January dummy give useful information in order to predict bond returns for different maturities. The other two variables add little in terms of explanatory power. Surprisingly, the DM yield spread does not seem to have any predictive ability for the countries expected to participate in the EMU. However, a puzzling result was obtained: this variable appears to be significant for the UK market!

Additionally, we find that investors, using simple trading strategies that exploit this information, may obtain higher returns. This outperformance is observed for different maturities, being more evident for long-term Government bonds.

These findings may have important implications on other related issues such as market efficiency, asset pricing and portfolio performance evaluation.

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1. Introduction

The predictability of the return on financial assets is a question that has been largely debated amongst academics and practitioners. This predictability may be interpreted as evidence of rational variation of expected returns or as market inefficiency or even as a combination of the two. Assuming rationality, predictability should reflect the time-varying expected risk premium. Why does the expected risk premium change? Intuitive reasons tell us that it changes with economic conditions. The economic explanation is that the level of risk aversion changes along with the economic cycle, being higher in situations of recession (thus higher the expected risk premium) and lower in situations of expansion (thus lower the expected risk premium). Evidence that time variation in expected returns is related to business conditions and is common to stocks and bonds suggests that predictability "is real and rational" (Fama, 1991, p. 1577)[1] and consistent with intertemporal asset pricing models.

In fact, several studies found that variables like dividend yield, default premium, term premium and short-term interest rates have forecasting ability and are indeed related to the current and future health of the economy (e.g.: Estrella and Mishkin (1998), Chen (1991) and Harvey (1989)).

Contrasting with the stock market, which has been extensively studied, the bond market, in particular outside the US, is far less explored and bond return predictability is a topic clearly in need of more research.

[1] For the defensors of irrational behaviour these are not convincing arguments. The fact that time variation is common to stocks and bonds may just mean that non rational anomalies are correlated across assets and markets both at the domestic and international level. Also, its relation to business conditions may just be a signal that common anomalies in different markets are related to business conditions.

Thus, the objective of this paper is to investigate, in relation to the European bond market, the predictive ability of a set of predetermined information variables. We test if variables that are commonly used in the context of other markets, such as the inverse relative wealth, a term spread, a real bond yield and a January dummy, are also useful predictors of European bond returns. Given the particular sample period of analysis, characterised by EMU convergence, we contribute by also including the yield spread in relation to German bonds. Furthermore, our research is innovative by considering different bond maturities: 1-3, 3-5 and 5 or more years to maturity. With a new data set, we think that the problem of data mining is somewhat overcome. Furthermore, we restrict the information variables to variables we can justify based on economic reasoning instead of using a more exhaustive statistical search (for the latter see for example Pesaran and Timmermann (1995)).

No doubt, evidence obtained on the predictability of bond returns in the European market might have implications not only on our understanding of market efficiency but also in relation to other related issues in Finance, such as asset pricing and bond portfolio performance evaluation (e.g.: Silva, Cortez and Armada (2003)).

This paper is organised as follows. In the next section we review the literature on the predictability of security returns. In section three, we describe and present the motivations for the selected information variables. In section four we present the data. In section five we analyse the ability of those variables in predicting bond returns in the European market. This analysis is complemented, in section six, by examining the implications of strategies that exploit their predictive ability. Finally, in the last section, we present the main conclusions of this research.

2. Predictability of Security Returns

The few studies on bond market predictability include Keim and Stambaugh (1986), Fama and French (1989) and Chang and Huang (1990), all on the US market. The first two studies found the presence of common predictability in both US stock and bond markets. This implies that variables found to be useful in predicting stock returns should also be useful in predicting bond returns. In particular, Keim and Stambaugh (1986) conclude that, for many stocks and bonds, the expected risk premiums seem to change throughout time in a way that is, at least, partially explained by variables that reflect asset price levels. The variables used were: the spread between yields on medium and long-term high risk bonds (BAA) and the risk-free rate, minus the logarithm of the ratio between the real value of the stock market index and its historical average over the preceding 45 years (a detrended stock price level) and minus the stock's average price in the quintile of the companies quoted in NYSE with lower value (a small firm risk premium). They also found evidence of a January effect in the regression coefficients of these variables.

Chang and Huang (1990) also documented evidence of predictability in the US corporate bond market. Following Keim and Stambaugh (1986), they investigated the predictability of corporate bonds using the spread between yields on BAA-rated bonds and the risk-free rate plus a dummy variable for the month of January, as well as four additional variables, as in Campbell (1987). These additional variables, related to the shape of the term structure of interest rates, are the one-month bill yield, the spread between the two-month and one-month yield, the spread between the six-month and one-month yield and one lag of the excess return on the two-month over one-month bills. The results indicated that corporate bond returns are predictable using all these variables. The forecasting power is higher than that reported by Campbell (using only variables related to the term structure). Among all the variables, the lagged excess return on two-month over one-month bills and the yield spread on BAA-rated bonds were the most important. Furthermore, the January dummy variable appeared as highly significant for low-grade bonds.

Fama and French (1989) investigated the ability of the dividend yield, a default spread and a term spread as forecasting variables. Their results show that expected returns on corporate bonds and stocks move together. The dividend yield, commonly used to forecast stock returns, also exhibited some power in predicting bond returns and the default spread and term spread variables, commonly used to forecast bond returns, also predicted stock returns. The dividend yield and the default spread seem to vary with long-term business conditions (persistently weak or persistently strong), while the term spread seems to vary with short-term business cycles (business-cycle peaks or business-cycle troughs). The same conclusion was found by Chen (1991). All three variables predicted that expected returns are lower when market conditions are good and higher when conditions are bad. According to Fama and French (1989), this opposite variation can be explained either by two possible reasons: "when business conditions are poor, income is low and expected returns on bonds and stocks must be high to induce substitution from consumption to investment. When times are good and income is high, the market clears at lower levels of expected returns. It is also possible, however, that variation in expected returns with business conditions is due to variation in the risks of bonds and stocks" (Fama and French, 1989, p. 48).

Bond return predictability outside the US is clearly less explored. Ilmanen (1995) is one of the few exceptions. He studied the predictable variation in international Government bond returns[2] using four variables: the inverse relative wealth (the ratio of

[2] Six countries were analysed: US, Canada, Japan, Germany, UK and France. These markets represented, at that time, more than 80 percent of the world bond markets.

past wealth to current wealth, where wealth is measured by a stock index), a bond beta (measured relatively to a stock index), a real bond yield and a term spread[3]. The first two variables are proposed as proxies for time-varying risk aversion and time-varying risk and the others as alternative proxies for the overall expected bond risk premium. Ilmanen considers both local or country specific variables and Global or GNP-weighted averages of the local variables[4]. His main conclusions were that the reward for bearing interest rate risk (the bond risk premium) is small, on average, but it varies significantly over time, and that world variables are better predictors of bond excess returns. The world inverse relative yield, the world term spread and the world real yield are positively related to future bond excess returns in all countries. The inverse relative wealth appears to be an important source of time variation in expected returns. Furthermore, the forecasting ability of these variables is statistical and economically significant in most of the countries, both in-sample and out-of-sample, and dynamic trading strategies that exploit this predictability earn annual mean excess returns between 3 to 8 percent.

Other studies on the predictability of bond returns outside the US include Yamada (1999), on the Japanese Government bond market, and Deaves (1997), on the Canadian Government bond market. The first author uses the four variables suggested by Ilmanen (1997) – a term spread, a real bond yield, the inverse relative wealth and a momentum variable. Together, these four variables capture 15 percent of the monthly variation in bond excess returns for the period 1985 to 1998[5]. The second author also uses the

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[3] In another paper Ilmanen (1996) studies the predictability of Government bond returns using the same variables except the bond beta and for only four of those countries: US, Japan, Germany and UK. Considering only the US market, Ilmanen (1997) besides these three variables – a term spread, a real bond yield and the inverse relative wealth – included one more variable, a momentum variable, that tries to capture large trending moves in the bond market.

[4] Assuming that markets are integrated, the market price of risk is better described by worldwide economic conditions rather than by local economic conditions.

[5] For the US market, these four variables, for the period 1965-1995, captured 10 percent of the monthly variation in bond excess returns.

inverse relative wealth as defined in Ilmanen (1995, 1996, 1997) plus a term spread, a current short-term rate (proxied by the three-month bill rate), and three alternative forms of volatility (past twenty-quarter moving windows of the standard deviation of the three-month bill rate, M1 growth and real GDP growth). The term spread and the inverse relative wealth arise as the most important variables in predicting excess returns on the Canadian Government bond market.

More recently, Miffre and Clare (2000) and Barr and Priestley (2001), focusing on Conditional Asset Pricing, assume a set of local and world instruments as predictors of bond returns in an international context, however without previous analysis of their forecasting ability.

As some researchers claim to have found empirical evidence that stock and bond returns are predictable, others raise questions about the power of the results. In most cases, empirical studies on predictability of returns are affected by important problems. First of all, there is the problem of data mining. The information variables are usually selected based on previous studies and tested frequently by using the same type of data and the same time period. Hence what we find may not be true predictability but something that "could simply be an artifact of the sample" (Ferson, Sarkissian and Simin, 2000). Several other studies have addressed this problem (e.g.: Lo and MacKinlay (1990)).

Other problems are mainly statistical problems resulting from the methodology that usually is used: regression analysis. One is the "spurious regression" problem investigated by Ferson, Sarkissian and Simin (2000). Many of the variables used behave as persistent, or highly autocorrelated and, as shown in their study, spurious regression relations may be found between the levels of trending time series that are indeed independent.

The small sample bias due to dependent stochastic regressors is another problem (e.g.: Nelson and Kim (1993) and Stambaugh (1999)). The standard assumption that the error term is uncorrelated with the regressors may not hold. What happens is that the shocks to the predetermined variables used as regressors are correlated with shocks to returns (the dependent variable) and, as the predetermined variables are persistent (autocorrelated), the past error terms are correlated with the regressors.

3. European Bond Returns: potential explanatory variables

In this paper, we test variables that previous studies have shown to be useful in predicting bond returns and which we can justify based on economic reasons. We will next present the arguments behind the choice for each one of the variables.

Inverse Relative Wealth

This variable, suggested by Ilmanen (1995) as a proxy for time-varying risk aversion, can be as important as time-varying risk in explaining the time variation of the risk premium. The argument is that relative risk aversion (RRA) is negatively related to relative wealth and that such variation can explain the observed countercycle pattern in expected returns, as found in Fama and French (1989) and Chen (1991). Investors are more risk averse when their wealth is low relative to their past wealth. The higher risk aversion implies that they demand larger compensation for holding risky assets like stocks and long-term bonds.

This variable is motivated by the utility function:

$$U(W) = \frac{(W-\omega)^{1-\gamma}}{1-\gamma} \quad [1]$$

where W is wealth, ω is subsistence wealth and γ is a positive constant. Assuming a positive subsistence wealth, this function implies a RRA level that is decreasing in wealth:

$$RRA = \frac{-WU_{ww}}{U_w} = \frac{\gamma}{1-\frac{\omega}{W}} \quad [2]$$

In the above utility function the subsistence level is fixed and the RRA varies inversely with absolute wealth. However, it is more plausible to have the subsistence level varying over time and RRA varying inversely with relative wealth. To capture the variation in RRA and following Ilmanen (1995), we use the ratio of exponentially weighted average of past real wealth to current real wealth as an instrument to predict bond risk premium. A significant positive relation should exist between this variable and expected bond excess returns. This variable is similar to the detrended stock market level variable used by Keim and Stambaugh (1986).

Term Spread and Real Bond Yield

These two variables are used as proxies for the overall expected bond risk premium, as also suggested in Ilmanen (1995). As mentioned in the previous section, other studies use the term spread (a measure of the slope of the term structure) as a predictor for the expected bond excess returns.

As showed in Campbell and Ammer (1993), the continuously compounded yield of a n-period nominal discount bond results from a sum of three terms: the n-period average of expected inflation rates, the n-period average of expected real rates of a one-period nominal bond and the n-period average of expected bond risk premium. Therefore, the bond yield contains information about expected bond risk premium but also about expected inflation and expected short-term real rates, so it is a noisy proxy for expectations of all these events. If we subtract the expected short rates from the bond yield, we should obtain a better proxy for the expected bond risk premium. This is what motivates the use of the term spread and the real bond yield.

The term spread is the difference between the yield of a n-period bond and the yield of a one-period bond (a short-term nominal rate) and the real bond yield is the difference between the yield of a n-period bond and the expected inflation rate over the remaining life of the bond. Neither of these two variables are a perfect proxy for the expected bond risk premium, since both contain information about it and about expected nominal or real rates. As it is not clear which of the variables is a less noisy proxy, we will use both in our empirical analysis.

<u>Yield spread in relation to German bonds</u>

During the 90s Germany was the European country with the lowest levels of inflation and interest rates, and this has made the German market a reference market. Furthermore, with the process of the integration into the monetary union, the yield spread on benchmark German bonds was used as a benchmark for the other European countries. As our sample period is a particular period of convergence towards the European Monetary Union (EMU), the argument in favour of the inclusion of this variable is straightforward.

<u>A dummy variable for the month of January</u>

The January or turn-of-the-year effect is defined in the finance literature as a positive risk-adjusted premium for holding a security in the month of January. It is frequently viewed as an anomaly in the financial markets and it has been ascertained not only in stock returns but also in long-term Government and corporate bonds returns (Smith (2002), Maxwell (1998), Chang and Huang (1990), among others)[6].

On the other hand, Keim and Stambaugh (1986) conclude that seasonality must be a consideration of any study dealing with changing expectations. The information variables they use to predict bond and stock returns show a January seasonality, which might suggest an increased risk around the turn of the year. A similar conclusion was found in Fama and French (1993). These authors found that the January seasonality in the returns on stocks and corporate bonds seem to be largely explained by the corresponding seasonality in the risk factors. In order to explore this possibility we also consider a dummy variable for the month of January.

4. The Data

We analyse monthly continuously compounded excess returns for the period of February 1994 to December 2000, in relation to six European countries: Portugal, Spain, Italy, France, Germany and UK. These countries represented, in 2000, around 78 percent of the European Government bond primary market and around 70 percent of the European bond secondary market transactions[7].

To measure bond market returns we use the SalomonSmithBarney World Government Bond Index for each country[8], in local currency. While stock return predictability is usually analised in terms of US dollars, in the case of bond returns it is more appropriate to use local-currency returns since the volatility of exchange rates is

[6] Several theories have attempted to explain the January effect: tax-loss selling, seasonal buying and selling patterns, individual investor seasonal demand and window-dressing (see for example Maxwell, (1998)).
[7] See "The Euro Bond Market", European Central Bank, July 2001, 2000 Annual Report of CMVM (the Portuguese equivalent to the Securities Exchange Commission) and FIBV (Fédération Internationale des Bourses de Valeurs) statistics 2000.
[8] We only consider the Government bond sector since in the European market the corporate bond sector is not yet a liquid market. Another limitation results from the fact that we only have corporate bond indices available for the European region globally and not for each individual country.

substantially higher than that of interest rates. The use of dollar-adjusted (or other currency) bond returns might induce more evidence on the predictability of exchange rates than of bond returns. The SalomonSmithBarney World Government Bond Index includes Sovereign debt denominated in the domestic currency with a required minimum size outstanding that varies by market[9]. We analyse three different maturity subsectors (1-3 years to maturity, 3-5 years to maturity and 5 or more years to maturity) and also the broad index for all maturities. As far as we are aware of, this is the first study to consider the predictive ability for different maturities. For the risk-free rate we use the 3-month Interbank offered rate (IBOR). All these data are obtained from Datastream.

As predetermined information variables we consider the term spread, a real bond yield and the inverse relative wealth, as in Ilmanen (1995), plus the yield spread in relation to German bonds (DM yield spread) and a dummy variable for the month of January, as described in the previous section.

The inverse relative wealth (IRW) is used as a proxy for time-varying risk aversion and, similarly to Ilmanen (1995), we define this variable as the “exponentially weighted average of past real wealth to current real wealth”. As a proxy for aggregate wealth we use a stock index for each country. Although stock markets only represent a small part of the world wealth, they probably represent their most volatile segment and are positively correlated with other segments of wealth. We use the MSCI stock indices for each country (also obtained from Datastream) deflated by the Consumer Price Index (CPI)[10]. The CPI data was obtained from the International Monetary Fund. We have

[9] This market capitalization index was introduced in 1986 and calculated with respect to the reference date of January 1985. The composition has changed considerably since its introduction (see Salomon Smith Barney Global Index Catalog – 2001 Edition, February 2001).

[10] This variable, as already pointed out, is similar to the detrended stock market level variable, calculated as minus the logarithm of the ratio of the real Standard & Poor’s Composite Index to its previous long-run

taken into account a delay of about two or three weeks in order to consider only publicly available information. Thus, this variable was calculated as follows:

$$IRW_t = \frac{\text{ewa } W_{t-1}}{W_t} = \frac{(W_{t-1} + coef * W_{t-2} + coef^2 * W_{t-3} + ...) * (1 - coef)}{W_t} \qquad [3]$$

where:

ewa W_{t-1} = the exponentially weighted average of real stock market levels up to time t-1;

W_t = the real level of the stock market at time t;

coef = smoothing coefficient.

We use a 36-month window and a smoothing coefficient of 0.9 as in Ilmanen (1995). However, we have considered other possibilities (a 60-month and a 83-month window and a smoothing coefficient of 0.8) and the results were quite similar.

As we mentioned previously, the term spread is the difference between the yield of a long-term bond and the yield of a short-term bond (a short-term nominal rate) and the real bond yield is the difference between the long-term bond yield and the expected inflation rate over the remaining life of the bond. As proxy for the long-term bond yield we consider the yield on a 10-year Government bond (or approximately), information that we obtained from the Central Banks[11]. It might have been preferable to also use a Government bond rate as the short-term rate. However, for the majority of the countries we do not have a liquid Treasury bill market. For the countries for which we could not

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level (45 years), as used by Keim and Stambaugh (1986). Additional tests were conducted using this variable instead of the IRW and the results were similar.

[11] For Portugal we use the yield on Treasury bonds with remaining maturity between 108 and 126 months; as to Spain the yield on a 10-year Government bond; for Italy the yield on the 10-year BTP (Buoni Poliennali del Tesoro); for France the ”taux de l`emprunt phare a 10 ans”; for Germany the yield on listed Federal securities with a residual maturity of 9-10 years (only bonds eligible as underlying instruments for futures contracts are included); finally, as to the UK the yield on a 10-year bond.

obtain that rate we use the 3-month Interbank offered rate[12]. The inflation rate is the year-on-year inflation rate. Once again we have taken into account a delay on the publication of CPI[13]. Both variables are expressed in annual rates.

Considering that our sample period is a particular period characterised by the convergence towards the Euro, the DM yield spread is also included. This variable is measured by the difference between the yield on the domestic 10-year Government bond (or approximately) and the yield on the equivalent German bond. In order to explore the possibility of an increased risk around the turn of the year we also consider a dummy variable for the month of January. The variable takes a value of 1 if the next month is the month of January and 0 otherwise.

In Panel A of Table 1, we present, for each country, the summary statistics for bond market excess returns for the period February 1994 to December 2000. The average monthly excess returns are low and vary between 0.018 (the SBWGBI 1-3 for the UK market) and 0.368 percent (the SBWGBI all maturities for the Portuguese Market). Only for Portugal and for the German 1-3 maturity subsector, we reject the null hypothesis of a mean equal to zero at the 5% level. We can observe that, for all countries, market excess returns increase with maturity.

[Insert Table 1 about here]

Italy is the country with the highest standard deviation and, in general, also with the higher excess returns. The UK presents the smallest excess returns, although not the smallest standard deviation. The maturity subsector of 5 or more years presents the

[12] This was the case for Portugal, Italy, UK and Germany. For France, we use the "taux de référence des bons de trésor à 3 mois" from the Bank of France, and for Spain the rate on 34 to 94 days Treasury bill secondary market from the Bank of Spain.

[13] The inflation rate of January is used to calculate the real bond yield for the month of February and this will be used to predict bond excess returns for the month of March.

higher variability and also the higher mean excess returns. The Jarque-Bera normality test indicates that, with few exceptions, bond market excess returns are normally distributed.

In Panel B and C of Table 1 we have the cross-countries correlations and for each country the correlations between the maturity subsectors. We can observe relatively high cross-countries correlations, ranging between 0.29 and 0.94. As expected, the correlations are lowest between each of the Latin countries and the UK. The correlations seem to increase with the maturity. For all countries, the correlations between the several maturity subsectors are very high, ranging between 0.73 and 1. This may indicate that bond returns for different maturities might be predicted by the same information variables..

Table 2 reports the summary statistics for the information variables. All the variables have high first-order autocorrelation. We test the stationarity of these variables using the Augmented Dickey-Fuller test[14] and conclude that in most of the cases we cannot reject the null hypothesis of a unit root.

[Insert Table 2 about here]

In order to reduce the problem of spurious regression, a problem that may be found when persistent regressors are used, we follow the suggestion of Ferson, Sarkissian and Simin (2000) and use the variables subtracted by the 12-month moving average. This simple form of stochastic detrending does not require any parameter

[14] It is important to check whether the series are stationary or not before using them in a regression as standard inference procedures do not apply to regressions that contain integrated regressors. The formal method to test that is the Unit Root Test. We follow the Augmented Dickey-Fuller test. The null hypothesis is that the series is I(1) and the alternative hypothesis is that the series is stationary or I(0). We reject the null hypothesis of the series being I(1) in favour of the alternative hypothesis of a I(0) series if the test statistic is a larger negative value than the critical value.

estimation, so it is an appealing alternative to using time series models or time trends to deal with near nonstationarity[15].

Another issue that can be raised is related with the scale of these variables. The proper scale is not specified by theory but it can affect the results. Usually, the solution is to use mean zero variables (see Bernhardt and Jung (1979)), a procedure that we also follow.

We analyse the correlation between the variables (excluding the dummy) both for the level variables and the stochastically detrended and mean zero variables. In the first case we find relatively high correlations, namely between the term spread and real bond yield and between real bond yield and DM spread. When we consider the stochastically detrended and mean zero variables we find lower correlations. The exception is the correlation between term spread and real bond yield with relatively high values (the lowest is for France with 0.47 and for all others it is superior to 0.64)[16].

5. Empirical Results

The standard approach to assess predictability is through linear regression analysis. Excess returns over a given time period are regressed on a set of variables that are known by investors at the beginning of the period. We run simple and multiple regressions of the monthly continuously compounded bond excess returns on the information variables, lagged 1 month, for each country.

Table 3 presents the results of these regressions. The slope coefficients, t-statistics, the in-sample adjusted coefficient of determination (R^2adj.) and the joint significance of all the regressors are reported. The table is divided into panel A, B, C and D. Panel A presents the results for the SalomonSmithBarney WGBI 1-3 years to maturity, panel B presents the results

[15] This stochastic detrending procedure is equivalent to a triangular weighted average of changes in the variable, so it is stationary even if there is a unit root in the variable (see Campbell (1996)).
[16] Although not reported, the tables with these correlations are available from the authors, upon request.

for the SalomonSmithBarney WGBI 3-5 years to maturity, panel C presents the results for the SalomonSmithBarney WGBI 5 or more years to maturity and finally panel D presents the results for the SalomonSmithBarney WGBI all maturities. In each panel we report the results for the simple regressions, for the multiple regressions considering all the information variables, for the multiple regressions with all variables excluding the real bond yield variable and for the multiple regressions excluding the real bond yield variable and also the DM spread.

[Insert Table 3 about here]

We also evaluate the predictive ability through out-of-sample analysis[17]. This was carried out as described next. The period of February 1994 to December 1997 (a total of 47 monthly observations) was used to estimate the coefficients for the information variables. These estimates are then used to forecast bond market excess returns for January 1998. We then run a new regression using all the observations till January 1998. The new coefficients estimates are used to forecast bond market excess returns for February 1998 and so forth till December 2000. Finally, the realised excess returns over the period January 1998 to December 2000 are regressed on the forecasted excess returns (a total of 36 observations). The R^2(adj.) of this out-of-sample regression is also reported in Table 3.

In relation to the simple regressions, the variable term spread appears as highly significant both in sample and out-of-sample. Considering all the indices, it explains between 0.4 and 14.6 percent in-sample and between 1.1 and 13.8 percent out-of-sample. For the other variables we find little evidence of predictive ability.

[17] We have also analysed the predictability in subperiods. We divided the overall period in two subperiods (February 1994 to December 1997 and January 1998 to December 2000). For both subperiods we found similar evidence on the predictive ability of the variables.

In the multiple regressions the term spread is also the most significant variable. In the case of the first multiple regression (which includes all the variables) that power is not so high due, probably, to the high correlation between the term spread and the real bond yield. When we consider the regression without the real bond yield, the R^2(adj.) decreases slightly, from between 0.6 and 24.2 percent to between 0.9 and 17.2 percent. However, the explanatory power out-of-sample is higher, ranging from 0.5 and 26.9 percent (comparatively to the –2.8 and 17.2 percent of the regression including all the variables). Excluding both the real bond yield and the DM spread variables leads to similar results: the R^2(adj.) varies between 2.0 and 16.1 percent in-sample and between 2.6 and 22.5 percent out-of-sample.

Contrary to what is usually found for the US market, the coefficient of the term spread is negative[18]. This result can be explained by the fact that this variable also captures information on the expected inflation rate. Expectations about inflation rate are positively correlated with general economic activity and therefore negatively correlated with expected returns. In fact, during the period of analysis we have a positive mean for the term spread, which might signal expectations of higher inflation.

Although not being as significant as found by Ilmanen (1995), the IRW is significant for the UK market (for all the indices) and also for other markets for the subsectors of 1-3 and 3-5 years to maturity. Its coefficient is positive, as should be expected. We also find that the dummy for the month of January is somewhat significant for all the markets except for the UK market. It seems that expected bond market returns are higher in January. Surprisingly, the DM yield spread does not seem to have any predictive ability for the countries expected to participate in the EMU. A puzzling result, is that, however this variable appears significant for the UK market!

[18] In a study of the Japanese market Cai, Chan and Yamada (1997) also found a negative sign for the term spread variable.

In general, the evidence of predictability is slightly higher for the shorter maturity indices (1-3 and 3-5 years to maturity) both in-sample and out-of-sample. Comparing the results of the three multiple regressions, the predictability out-of-sample is always higher for the one that includes the term spread, IRW and the January dummy. We test for the joint significance of the variables. At the 5% level we reject the null hypothesis that the variables are jointly equal to zero, for all markets except the Portuguese market.

6. Investment Implications of Bond Return Predictability

In the previous section we found evidence that some information variables are useful as predictors of bond market excess returns. These findings should be relevant for investors. The important question is to know if investment strategies that exploit this return predictability produce economically significant profits.

In order to answer this question, similarly to Ilmanen (1995, 1996, 1997) we implement and analyse the historical performance of such dynamic investment strategies and compare their historical returns to the returns of passive strategies that have a constant portfolio composition regardless of the economic conditions. The objective is to show that variables like term spread, IRW and others could have been used to enhance returns.

As passive strategy we consider the strategy that involves always holding the market (stay in bonds). Another alternative strategy could involve staying in cash and hence obtaining a zero excess return (because this strategy is equivalent to rolling over the one-month risk-free rate).

Instead, the dynamic strategy involves holding one unit of the bond (market) if its predicted premium is positive and none of the bond if its predicted premium is negative. This position is rebalanced monthly. As it is based on the sign of the predicted excess bond return and not in its magnitude, this strategy involves a low frequency of trading and no short-selling is allowed[19]. We consider both in-sample and out-of-sample estimates of bond predicted excess returns (or risk premiums).

In-sample estimation assumes that investors know in advance the statistical relation between the predetermined information variables and subsequent bond excess returns. The estimates are the fitted values from the regressions of bond market excess returns on term spread, IRW and the January dummy for the whole sample period. This approach might exaggerate the potential profitability of the dynamic strategy.

A more reasonable approach is to forecast the next month's bond excess return using only available historical data and to update the forecast each month using new data[20]. We define our initial sample as the period February 1994 to December 1997. Thus, the estimates are one-step ahead forecasts based on rolling regressions that begin in January 1998 and use all the available historical information since February 1994.

In Figure 1 we compare the annualised mean excess returns for the passive trading strategy with that of the dynamic strategy considering the in-sample estimation for the period February 1994 to December 2000[21]. Only with the exception of the Portuguese market (the all maturities index), with a very weak underperformance of about 0.035 percent, the excess return of the dynamic strategy is superior to that of the static strategy. The outperformance varies between 0.18 (for the German 1-3 maturity subsector) and 3.57 percent (for the Spanish 5+ maturity subsector). The longer maturity subsector has the higher outperformance.

[Insert Figure 1 about here]

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[19] Another alternative would be a scaled strategy in which the size of the position in the bond market depends on the magnitude of the predicted excess return. This is a more transaction-intensive strategy and it assumes that Government bonds may be shorted with the full use of proceeds and consequently, the results would be less reliable (see Ilmanen (1995)).

[20] Similarly to what we have done to calculate the out-of-sample R^2(adj.) presented in Table 3.

[21] As the passive strategy involves always holding the market the reported mean are equal to annualise the monthly values of Table 1.

To evaluate if this outperformance is consistent over the sample period we also examined the cumulative performance of both strategies[22]. The relative performance of the dynamic strategy over the cash market increases gradually through most of the sample period. Most of the outperformance of the dynamic strategy relative to bonds happened during the year of 1994 as it avoided bonds during a bear market.

The inferences for the risk-adjusted performance are even more favourable to the dynamic strategy, as shown in Table 4. The risk is measured by volatility, shortfall frequency and frequency of "being wrong". The volatility (measured by the standard deviation of returns) of the dynamic strategy is, as should be (since it has, at most, the same level of volatility as bonds, and the rest of the time it is invested in cash) lower than that of the spassive strategy. Contrary to what we found for the passive strategy,[23] the t-test for the monthly returns of the dynamic strategy allows us to reject the hypothesis of a mean equal to zero in almost all the cases. Thus, the Sharpe ratio is clearly higher.

[Insert Table 4 about here]

We can see that the dynamic strategy had some success in avoiding negative returns. The shortfall probability, defined as the frequency of negative realised excess returns, ranges between 16 and 25 percent while the corresponding values for the static strategy ranges between 29 and 45 percent. Investors following such a dynamic strategy avoid the bond market for several months and earn zero.

If investors possess information on the variables and trade accordingly, the predicted bond excess returns leads to a right decision with a frequency between 57

[22] The graphics are not reported in this paper. They are available from the authors, upon request.
[23] See again Table 1.

(Italy 1-3 years to maturity) and 72 percent (for Portugal and Spain all maturities). For most of the countries, this frequency is superior to 60 percent.

Although the results seem to indicate some outperformance of a dynamic strategy, it is important to question what happens if transactions costs are taken into account. In Table 5 we report the number of times that the dynamic strategy switches between the bond and cash markets during the period. We can observe that this simple investment strategy implies only a few transactions: about one or two times a year. So, transaction costs do not seem to have a significant impact on the performance of the dynamic strategy.

[Insert Table 5 about here]

As we mentioned previously we also conduct an out-of-sample analysis for the period January 1998 to December 2000. The results are reported in Table 6. One can observe that they are not much different from those of the in-sample analysis. However, the difference between the two strategies is not so large as the considered short period is characterised by low bond market returns.

[Insert Table 6 about here]

7. Conclusions

In this paper we have analysed the usefulness of several information variables in predicting European bond market returns. We started by pointing out the motivations for the selected variables and then examined their predictive ability. The statistical problems of data mining and especially spurious regression received particular attention.

The results indicate that variables like term spread, IRW and a January dummy give useful information to predict bond returns for different maturities. We have also considered other variables but, besides having some problems with correlations, they seem to add little in terms of explanatory power. Surprisingly, the DM yield spread does not seem to have predictive ability for the countries expected to participate in the EMU. A puzzling result, is that, however this variable appears significant for the UK market!

Investors using simple trading strategies, by exploiting this information, may have been able to obtain higher returns. Outperformance was observed for all the maturities subsectors, being more evident for long-term Government bonds. Consequently, this might also have important implications on issues such as market efficiency, asset pricing and portfolio performance evaluation. When we evaluate the performance of bond funds we should then take these implications into account. Indeed, recent research on conditional performance evaluation shows that portfolio managers can also enhance their returns by exploiting information contained on some public variables.

Table 1– Summary Statistics on Bond Market Excess Returns for the period February 1994 to December 2000

This table presents, in Panel A, the average monthly continuously compounded excess returns in local currency, expressed in percent per month, for the three maturity subsectors of the SalomonSmithBarney WGBI (1-3 years, 3-5 years and 5 or more years) and for the broad all maturities index, for each country. Also, it reports the standard deviation of these returns, the first-order autocorrelation, the T-test for the hypothesis of the mean=0 and the Jarque-Bera statistic, with the probability in parenthesis. Panel B and Panel C present, respectively, the cross-country correlations for each maturity subsector and for each country the correlation between the several maturity subsectors.

	Portugal	Spain	Italy	France	Germany	UK
PANEL A - Market Indices Statistics						
SBWGBI 1-3						
Mean		0.092	0.077	0.068	0.094	0.018
StD		0.575	0.611	0.392	0.399	0.463
AC1		0.070	0.115	0.147	0.141	0.061
T-test Mean=0		1.46	1.15	1.59	2.14	0.36
Jarque-Bera		22.555	2.641	0.069	0.776	6.108
		(0.000)	(0.267)	(0.966)	(0.679)	(0.047)
SBWGBI 3-5						
Mean		0.171	0.182	0.124	0.158	0.037
StD		1.102	1.150	0.818	0.790	0.894
AC1		0.133	0.185	0.179	0.147	0.141
T-test Mean=0		1.42	1.44	1.38	1.82	0.38
Jarque-Bera		21.591	0.407	2.106	1.126	3.943
		(0.000)	(0.816)	(0.349)	(0.570)	(0.139)
SBWGBI 5+						
Mean		0.286	0.304	0.203	0.234	0.164
StD		1.832	1.951	1.590	1.331	1.860
AC1		0.181	0.194	0.138	0.142	0.057
T-test Mean=0		1.42	1.42	1.16	1.60	0.80
Jarque-Bera		3.710	0.061	3.327	4.691	7.262
		(0.156)	(0.970)	(0.189)	(0.096)	(0.026)
SBWGBI all						
Mean	0.368	0.203	0.192	0.162	0.176	0.122
StD	0.910	1.224	1.191	1.155	0.930	1.504
AC1	0.282	0.179	0.183	0.149	0.119	0.080
T-test Mean=0	3.43	1.51	1.47	1.28	1.72	0.74
Jarque-Bera	2.067	5.982	0.099	3.109	3.580	8.181
	(0.356)	(0.050)	(0.952)	(0.211)	(0.167)	(0.017)

Note: In the case of Portugal, the period is restricted from January 1995 to December 2000 since the SalomonSmithBarney WGBI for Portugal starts only in 30/12/1994. Also, we only have the all maturities index.

Table 1 – Summary Statistics on Bond Market Excess Returns for the period February 1994 to December 2000 (cont.)

PANEL B - Cross-Country Correlations

SBWGBI 1-3						
Spain		1				
Italy		0.82	1			
France		0.75	0.70	1		
Germany		0.59	0.46	0.77	1	
UK		0.31	0.29	0.45	0.53	1
SBWGBI 3-5						
Spain		1				
Italy		0.85	1			
France		0.80	0.73	1		
Germany		0.71	0.60	0.89	1	
UK		0.51	0.47	0.63	0.66	1
SBWGBI 5+						
Spain		1				
Italy		0.85	1			
France		0.81	0.71	1		
Germany		0.76	0.66	0.92	1	
UK		0.67	0.61	0.75	0.75	1
SBWGBI all						
Portugal	1					
Spain	0.94	1				
Italy	0.85	0.89	1			
France	0.78	0.75	0.73	1		
Germany	0.72	0.70	0.64	0.91	1	
UK	0.56	0.61	0.61	0.70	0.73	1

PANEL C - Subsector Maturities Correlations

	SBWGBI 1-3	SBWGBI 3-5	SBWGBI 5+	SBWGBI all
Spain				
SBWGBI 1-3	1			
SBWGBI 3-5	0.97	1		
SBWGBI 5+	0.87	0.95	1	
SBWGBI all	0.93	0.98	0.99	1
Italy				
SBWGBI 1-3	1			
SBWGBI 3-5	0.97	1		
SBWGBI 5+	0.89	0.96	1	
SBWGBI all	0.94	0.98	0.99	1
France				
SBWGBI 1-3	1			
SBWGBI 3-5	0.94	1		
SBWGBI 5+	0.79	0.92	1	
SBWGBI all	0.84	0.95	1.00	1
Germany				
SBWGBI 1-3	1			
SBWGBI 3-5	0.95	1		
SBWGBI 5+	0.76	0.90	1	
SBWGBI all	0.87	0.97	0.97	1
UK				
SBWGBI 1-3	1			
SBWGBI 3-5	0.94	1		
SBWGBI 5+	0.73	0.89	1	
SBWGBI all	0.78	0.92	1.00	1

Note: Due to the restricted sample for Portugal, the cross-countries correlations for the all maturities indices, in panel

Table 2 – Summary Statistics on the Predetermined Information Variables

In this table we report the mean, standard deviation and the first-order autocorrelation for each of the information variables for the period January 1994 to November 2000. The Term Spread is the difference between the yield on a long-term government bond and a short-term bond rate (or the 3-month interbank offered rate). The Real Bond Yield is the difference between the yield on the long-term government bond and the inflation rate. The DM spread is the difference between the yield on a domestic long-term government bond and the yield on an equivalent German bond. These three variables are in annual rates. IRW (inverse relative wealth) is the ratio between the exponentially weighted average of past real wealth and current wealth.

	Portugal	Spain	Italy	France	Germany	UK
Information Variables						
Term Spread						
Mean	1.148	1.626	0.997	1.617	1.804	0.359
StD	0.616	0.930	1.027	0.850	0.859	1.601
AC1	0.890	0.877	0.942	0.850	0.904	0.974
Real Bond Yield						
Mean	4.088	4.160	4.682	4.546	4.086	4.010
StD	2.037	1.658	1.825	0.905	0.745	1.525
AC1	0.948	0.955	0.961	0.924	0.799	0.960
IRW						
Mean	0.904	0.875	0.892	0.883	0.883	0.923
StD	0.130	0.113	0.109	0.099	0.085	0.056
AC1	0.902	0.849	0.838	0.869	0.798	0.742
DM spread						
Mean	1.461	1.666	2.058	0.197		1.048
StD	1.671	1.646	1.979	0.274		0.586
AC1	0.972	0.987	0.984	0.924		0.923

Note: For Portugal, the predetermined information variables are restricted to the period December 1994 to November 2000.

Table 3 - Regressions of Bond Market Excess Return on Lagged Information Variables

The dependent variable is the monthly continuously compounded excess returns on each country SalomonSmithBarney WGBI for the three maturity subsectors and for the broad all maturities index. Panel A refers to the WGBI 1-3 years to maturity, Panel B to the WGBI 3-5 years to maturity, Panel C to the WGBI 5 or more years to maturity and Panel D to the WGBI all maturities. Each panel presents the results for the simple regressions, for the multiple regressions including all the variables and for the multiple regressions excluding, respectively, the Real Bond Yield variable and both the Real Bond Yield and the DM spread variables. Term Spread, Real Bond Yield, IRW and DM spread as defined in Table 2. All these variables are stochastically detrended (by subtracting a 12-month moving average) and mean zero variables. Jd is the dummy for the month of January. The coefficients and the t-statistics for each of the variables are presented (standard errors are heteroskedasticity and autocorrelation adjusted following Newey and West (1987)). R^2(adj) is the in-sample adjusted coefficient of determination, expressed in percent. "Joint significance" is the probability for the chi-square statistic of the Wald test for the restriction that all variables have a coefficient equal to zero. Out-of-sample is the R^2(adj) for the regression of the realised excess returns over the period January 1998 to December 2000 on the forecasted excess returns (rolling one-step ahead forecasts).

Variables	Spain	Italy	France	Germany	Uk
PANEL A - WGBI 1-3 years					
Term Spread					
coef	-0.192	-0.141	-0.095	-0.064	-0.129
t-stat	-3.927 ***	-1.852 *	-2.503 **	-1.312	-2.982 ***
R^2(adj)	12.0%	3.2%	4.9%	0.4%	5.5%
Out-of-sample	6.3%	1.1%	11.6%	5.6%	5.8%
Real Bond Yield					
coef	-0.061	-0.039	-0.129	0.006	-0.058
t-stat	-0.751	-0.693	-2.211 **	0.085	-1.158
R^2(adj)	-0.2%	-0.7%	4.7%	-1.2%	0.4%
Out-of-sample	3.6%	-0.1%	10.8%	-1.6%	4.6%
IRW					
coef	-0.106	0.909	0.747	1.034	1.112
t-stat	-0.170	1.515	1.780 *	2.624 **	1.163
R^2(adj)	-1.2%	0.6%	0.8%	3.0%	0.4%
Out-of-sample	4.1%	-2.3%	7.8%	2.1%	-1.2%
DM spread					
coef	-0.081	0.013	-0.101		0.126
t-stat	-0.777	0.155	-0.621		0.745
R^2(adj)	-0.2%	-1.2%	-0.9%		-0.5%
Out-of-sample	-2.9%	-2.3%	-2.8%		-2.9%

*** Statistically significant at 1% ** Statistically significant at 5% * Statistically significant at 10%

Table 3 - (cont.)

Term Spread					
coef	-0.364	-0.269	-0.061	-0.183	-0.359
t-stat	-4.991 ***	-2.575 **	-1.202	-1.563	-2.365 **
Real Bond Yield					
coef	0.294	0.091	-0.126	0.158	0.133
t-stat	2.777 ***	0.977	-1.127	1.170	1.096
IRW					
coef	2.356	2.071	1.490	0.674	1.808
t-stat	2.880 ***	2.651 ***	2.701 ***	1.208	2.593 **
DM spread					
coef	-0.367	-0.106	-0.114		0.447
t-stat	-2.392 **	-0.871	-0.310		2.341 **
Jd					
coef	0.274	0.269	0.365	0.289	0.188
t-stat	3.574 ***	1.298	2.861 ***	2.809 ***	2.194 **
R^2(adj)	20.0%	6.1%	14.1%	6.6%	16.4%
Out-of-sample	9.2%	-2.3%	15.9%	7.1%	7.5%
Joint Significance	0.000	0.021	0.000	0.002	0.000
Term Spread					
coef	-0.232	-0.199	-0.105		-0.233
t-stat	-3.723 ***	-2.745 ***	-2.663 ***		-3.937 ***
IRW					
coef	1.593	1.910	1.522		1.887
t-stat	2.097 **	2.602 **	2.864 ***		2.663 ***
DM spread					
coef	-0.090	-0.041	-0.400		0.412
t-stat	-0.794	-0.420	-1.708 *		2.283 **
Jd					
coef	0.265	0.257	0.374		0.225
t-stat	3.075 ***	1.300	2.566 **		2.962 ***
R^2(adj)	13.5%	6.3%	13.5%		14.7%
Out-of-sample	12.5%	1.9%	14.8%		19.1%
Joint Significance	0.000	0.007	0.000		0.000
Term Spread					
coef	-0.237	-0.203	-0.101	-0.055	-0.164
t-stat	-4.103 ***	-2.772 ***	-2.476 **	-1.128	-3.495 ***
IRW					
coef	1.159	1.666	0.854	1.071	2.151
t-stat	1.672 *	3.041 ***	2.019 **	2.545 **	2.965 ***
Jd					
coef	0.264	0.259	0.352	0.292	0.201
t-stat	2.901 ***	1.341	2.351 **	2.948 ***	2.240 **
R^2(adj)	13.8%	7.2%	10.7%	5.7%	9.8%
Out-of-sample	14.0%	2.6%	15.2%	10.1%	12.6%
Joint Significance	0.000	0.002	0.003	0.001	0.000

*** Statistically significant at 1% ** Statistically significant at 5% * Statistically significant at 10%

Table 3 - (cont.)

Variables	Spain	Italy	France	Germany	Uk
PANEL B - WGBI 3-5 years					
Term Spread					
coef	-0.403	-0.324	-0.246	-0.222	-0.269
t-stat	-4.260 ***	-2.444 **	-3.108 ***	-2.269 **	-3.185 ***
R^2(adj)	14.6%	5.4%	8.3%	3.9%	6.6%
Out-of-sample	9.2%	6.7%	13.8%	11.5%	13.4%
Real Bond Yield					
coef	-0.086	-0.081	-0.257	-0.092	-0.096
t-stat	-0.514	-0.779	-2.261 **	-0.736	-1.004
R^2(adj)	-0.7%	-0.5%	4.2%	-0.4%	0.0%
Out-of-sample	0.4%	0.3%	10.0%	-1.5%	-2.9%
IRW					
coef	-0.364	1.334	1.304	1.630	2.754
t-stat	-0.304	1.060	1.475	2.058 **	1.557
R^2(adj)	-1.1%	-0.1%	0.2%	1.4%	1.4%
Out-of-sample	4.8%	-2.9%	0.1%	-1.4%	3.4%
DM spread					
coef	-0.113	-0.021	-0.210		0.213
t-stat	-0.526	-0.125	-0.537		0.771
R^2(adj)	-0.7%	-1.2%	-0.9%		-0.6%
Out-of-sample	-2.9%	-2.9%	-2.1%		-2.5%
Term Spread					
coef	-0.773	-0.630	-0.225	-0.437	-0.829
t-stat	-5.391 ***	-2.950 ***	-2.168 **	-1.681 *	-2.924 ***
Real Bond Yield					
coef	0.643	0.271	-0.117	0.284	0.361
t-stat	3.088 ***	1.389	-0.489	1.015	1.583
IRW					
coef	4.217	4.042	2.829	0.929	4.235
t-stat	2.738 ***	2.446 **	2.364 **	0.830	3.113 ***
DM spread					
coef	-0.674	-0.295	-0.513		0.866
t-stat	-2.303 **	-1.222	-0.605		2.693 ***
Jd					
coef	0.457	0.580	0.708	0.547	0.208
t-stat	2.621 **	1.766 *	2.788 ***	2.505 **	0.891
R^2(adj)	24.2%	9.9%	14.3%	7.7%	21.7%
Out-of-sample	9.3%	-2.0%	13.2%	8.6%	13.2%
Joint Significance	0.000	0.021	0.000	0.008	0.000
Term Spread					
coef	-0.485	-0.423	-0.266		-0.484
t-stat	-3.816 ***	-3.220 ***	-3.385 ***		-4.563 ***
IRW					
coef	2.545	3.565	2.859		4.450
t-stat	1.754 *	2.284 **	2.461 **		3.248 ***
DM spread					
coef	-0.066	-0.104	-0.778		0.772
t-stat	-0.285	-0.515	-1.498		2.525 **
Jd					
coef	0.437	0.546	0.717		0.308
t-stat	2.134 **	1.844 *	2.643 ***		1.626
R^2(adj)	15.2%	8.4%	15.0%		17.2%
Out-of-sample	12.9%	2.8%	12.8%		26.9%
Joint Significance	0.000	0.008	0.000		0.000
Term Spread					
coef	-0.489	-0.434	-0.258	-0.207	-0.356
t-stat	-4.072 ***	-3.284 ***	-3.045 ***	-2.145 **	-4.245 ***
IRW					
coef	2.225	2.953	1.558	1.642	4.945
t-stat	1.528	2.587 **	1.836 *	1.977 *	3.564 ***
Jd					
coef	0.437	0.551	0.674	0.553	0.264
t-stat	2.111 **	1.893 *	2.322 **	2.662 **	1.284
R^2(adj)	16.2%	9.2%	12.7%	7.2%	12.6%
Out-of-sample	14.0%	4.6%	14.4%	9.7%	22.5%
Joint Significance	0.000	0.002	0.003	0.002	0.000

*** Statistically significant at 1% ** Statistically significant at 5% * Statistically significant at 10%

Table 3- (cont.)

Variables	Spain	Italy	France	Germany	UK
PANEL C - WGBI 5+ years					
Term Spread					
coef	-0.655	-0.631	-0.466	-0.434	-0.441
t-stat	-4.195 ***	-2.997 ***	-2.860 ***	-2.719 **	-2.861 ***
R^2(adj)	13.9%	7.4%	7.8%	5.7%	3.6%
Out-of-sample	6.2%	8.4%	12.3%	8.8%	3.2%
Real Bond Yield					
coef	-0.103	-0.174	-0.387	-0.256	-0.048
t-stat	-0.374	-0.972	-1.718 *	-1.492	-0.283
R^2(adj)	-0.9%	-0.1%	2.0%	2.9%	-1.2%
Out-of-sample	-2.6%	1.1%	6.6%	0.7%	8.2%
IRW					
coef	-1.441	0.444	1.445	1.587	5.189
t-stat	-0.785	0.191	0.916	1.052	1.564
R^2(adj)	-0.7%	-1.2%	-0.8%	-0.3%	1.0%
Out-of-sample	-2.6%	1.1%	6.6%	0.7%	8.2%
DM spread					
coef	-0.206	-0.133	-0.181		0.291
t-stat	-0.570	-0.454	-0.238		0.547
R^2(adj)	-0.6%	-0.9%	-1.2%		-1.0%
Out-of-sample	-2.9%	-2.8%	-1.5%		0.4%
Term Spread					
coef	-1.263	-1.140	-0.471	-0.755	-1.710
t-stat	-5.145 ***	-3.101 ***	-2.443 **	-1.684 *	-3.199 ***
Real Bond Yield					
coef	1.141	0.521	-0.062	0.417	0.955
t-stat	3.141 ***	1.569	-0.133	0.909	2.209 **
IRW					
coef	5.635	5.005	3.376	0.510	7.486
t-stat	2.077 **	1.664	1.339	0.249	2.269 **
DM spread					
coef	-1.103	-0.507	-0.747		1.397
t-stat	-2.194 **	-1.276	-0.427		2.433 **
Jd					
coef	0.680	1.041	1.179	0.868	-0.088
t-stat	1.833 *	2.269 **	2.903 ***	2.200 **	-0.154
R^2(adj)	23.0%	10.1%	8.7%	7.1%	16.5%
Out-of-sample	2.7%	-2.8%	5.3%	2.7%	3.3%
Joint Significance	0.000	0.011	0.002	0.014	0.003
Term Spread					
coef	-0.753	-0.740	-0.492		-0.796
t-stat	-3.460 ***	-3.373 ***	-3.082 ***		-3.626 ***
IRW					
coef	2.671	4.087	3.392		8.054
t-stat	1.052	1.421	1.375		2.439 **
DM spread					
coef	-0.025	-0.140	-0.887		1.148
t-stat	-0.061	-0.399	-0.829		2.188 **
Jd					
coef	0.645	0.977	1.183		0.177
t-stat	1.535	2.461 **	2.880 ***		0.399
R^2(adj)	12.7%	7.9%	9.8%		8.7%
Out-of-sample	3.8%	0.5%	5.3%		8.5%
Joint Significance	0.000	0.005	0.001		0.003
Term Spread					
coef	-0.754	-0.756	-0.482	-0.417	-0.605
t-stat	-3.628 ***	-3.409 ***	-2.897 ***	-2.711 ***	-3.595 ***
IRW					
coef	2.549	3.262	1.909	1.557	8.790
t-stat	1.031	1.522	1.102	0.953	2.652 **
Jd					
coef	0.645	0.983	1.134	0.877	0.111
t-stat	1.536	2.482 **	2.586 **	2.328 **	0.261
R^2(adj)	13.8%	8.8%	9.8%	7.0%	6.9%
Out-of-sample	4.3%	2.9%	9.0%	2.6%	6.9%
Joint Significance	0.000	0.002	0.006	0.004	0.002

*** Statistically significant at 1% ** Statistically significant at 5% * Statistically significant at 10%

Table 3 - (cont.)

Variables	Portugal	Spain	Italy	France	Germany	UK
PANEL D - WGBI all maturities						
Term Spread						
coef	-0.254	-0.438	-0.354	-0.342	-0.275	-0.376
t-stat	-1.408	-4.246 ***	-2.609 **	-2.919 ***	-2.435 **	-3.011 ***
R^2(adj)	3.4%	14.0%	6.1%	7.9%	4.4%	4.2%
Out-of-Sample	10.7%	7.5%	7.6%	12.9%	10.6%	4.7%
Real Bond Yield						
coef	0.083	-0.091	-0.095	-0.302	-0.135	-0.053
t-stat	-2.085 **	-0.509	-0.897	-1.844 *	-1.017	-0.383
R^2(adj)	4.1%	-0.7%	-0.3%	2.5%	0.0%	-1.1%
Out-of-Sample	2.8%	-1.7%	0.6%	7.7%	0.0%	6.1%
IRW						
coef	-0.869	-0.722	0.690	1.231	1.459	4.340
t-stat	-0.740	-0.580	0.510	1.159	1.480	1.586
R^2(adj)	-0.5%	-0.9%	-1.0%	-0.6%	0.3%	1.1%
Out-of-Sample	0.1%	1.8%	-2.0%	-2.9%	-2.9%	-1.4%
DM spread						
coef	-0.245	-0.154	-0.053	-0.167		0.258
t-stat	-1.497	-0.657	-0.311	-0.304		0.587
R^2(adj)	1.8%	-0.4%	-1.1%	-1.1%		-0.9%
Out-of-Sample	-2.2%	-2.9%	-2.9%	-2.0%		-0.4%
Term Spread						
coef	-0.080	-0.843	-0.654	-0.336	-0.527	-1.416
t-stat	-0.301	-5.302 ***	-3.271 ***	-2.362 **	-1.715 *	-3.127 ***
Real Bond Yield						
coef	-0.132	0.737	0.271	-0.077	0.329	0.772
t-stat	-0.852	3.157 ***	1.389	-0.228	1.020	2.116 **
IRW						
coef	-0.548	4.321	3.360	2.809	0.635	6.312
t-stat	-0.381	2.415 **	1.817 *	1.532	0.464	2.430 **
DM spread						
coef	-0.012	-0.777	-0.289	-0.573		1.199
t-stat	-0.053	-2.317 **	-1.204	-0.454		2.513 **
Jd						
coef	0.370	0.509	0.626	0.919	0.632	-0.005
t-stat	1.396	2.144 **	2.006 **	2.992 ***	2.404 **	-0.012
R^2(adj)	0.6%	23.2%	8.8%	10.1%	7.1%	18.0%
Out-of-sample	5.8%	5.1%	-2.8%	7.0%	5.4%	4.7%
Joint Significance	0.207	0.000	0.026	0.001	0.018	0.001
Term Spread						
coef	-0.210	-0.513	-0.434	-0.363		-0.679
t-stat	-1.073	-3.646 ***	-3.156 ***	-3.150 ***		-3.767 ***
IRW						
coef	0.010	2.406	2.853	2.829		6.771
t-stat	0.008	1.441	1.716 *	1.581		2.591 **
DM spread						
coef	-0.112	-0.080	-0.087	-0.749		0.998
t-stat	-0.489	-0.301	-0.418	-0.968		2.273 **
Jd						
coef	0.353	0.486	0.590	0.925		0.209
t-stat	1.247	1.854 *	2.128 **	2.923 ***		0.597
R^2(adj)	0.9%	13.7%	7.2%	11.2%		10.2%
Out-of-sample	6.3%	6.5%	0.8%	6.9%		11.3%
Joint Significance	0.480	0.000	0.013	0.000		0.001
Term Spread						
coef	-0.247	-0.517	-0.443	-0.354	-0.261	-0.513
t-stat	-1.455	-3.897 ***	-3.199 ***	-2.943 ***	-2.377 **	-3.763 ***
IRW						
coef	-0.309	2.019	2.344	1.577	1.461	7.410
t-stat	-0.349	1.281	1.898 *	1.260	1.376	2.804 **
Jd						
coef	0.368	0.486	0.595	0.883	0.639	0.152
t-stat	1.296	1.829 *	2.171 **	2.610 **	2.559 **	0.446
R^2(adj)	2.0%	14.6%	8.2%	10.7%	6.6%	8.0%
Out-of-sample	7.8%	7.3%	2.9%	10.6%	5.3%	9.3%
Joint Significance	0.369	0.000	0.004	0.004	0.004	0.001

*** Statistically significant at 1% ** Statistically significant at 5% * Statistically significant at 10%

Figure 1- Annualised mean of bond excess returns (in percentage) over the period February 1994 to December 2000: passive versus dynamic strategy

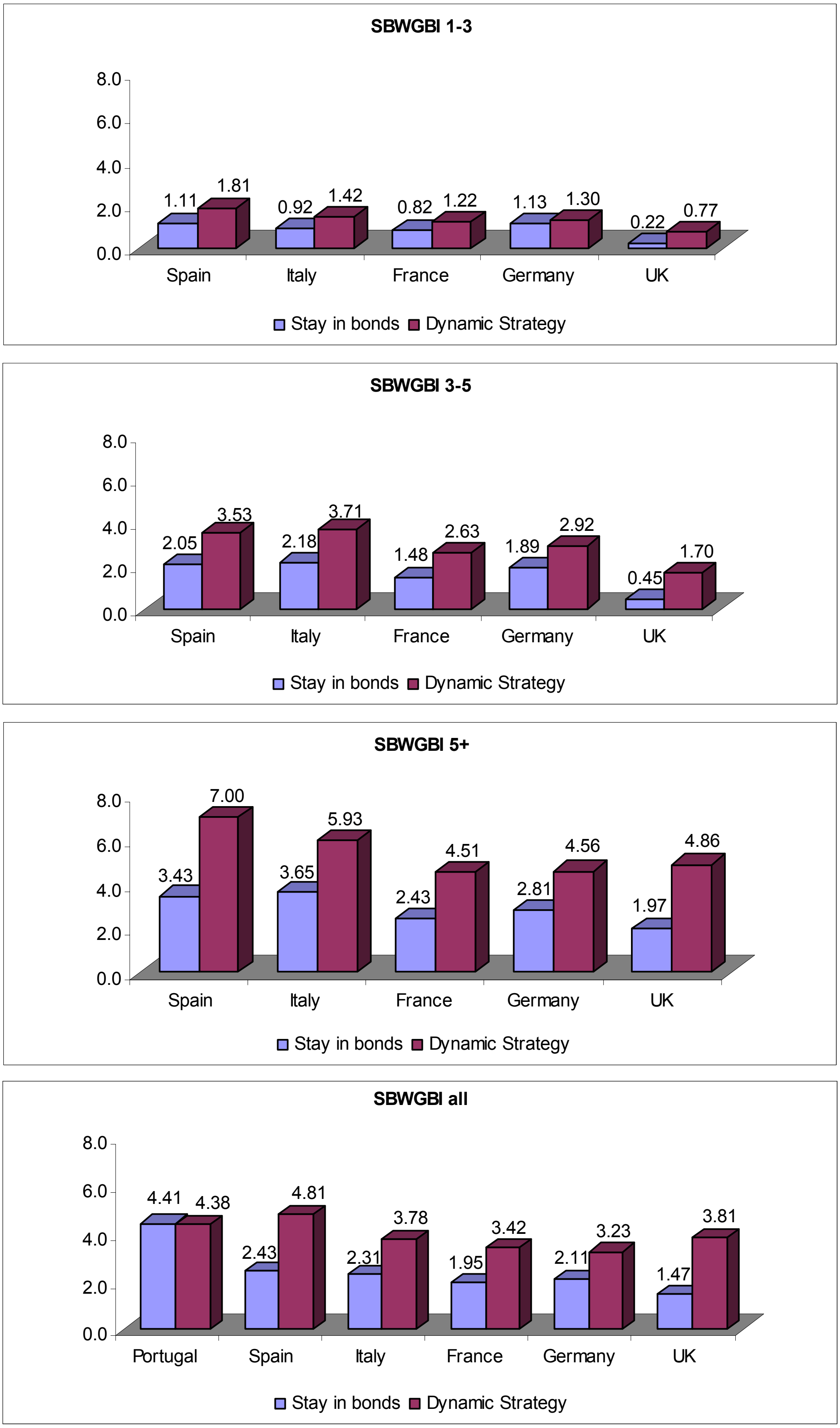

Table 4 - Performance of Passive and Dynamic Bond Trading Strategies (in-sample) for the period February 1994 to December 2000

This table compares the in-sample performance of a passive and a dynamic bond investment strategy for each country and for each maturity subsector. Panel A reports the results of the passive strategy while Panel B presents the results of the dynamic strategy. The passive strategy involves always staying in bonds. The dynamic strategy involves buying one unit of the bond (market) if its predicted premium is positive and none of the bond if its predicted premium is negative. The expected bond risk premium is the fitted value from the regressions of realised bond market excess returns on term spread, IRW and the January dummy for the whole sample period. The table reports the annualised mean (in percentage) and standard deviation of the excess returns for each trading strategy, the T-test for the hypothesis of the monthly mean=0 (for the dynamic strategy), the annualised Sharpe ratio (the ratio of the mean and standard deviation), the shortfall frequency (observed frequency of negative excess returns) and, for the dynamic strategy, the frequency of forecasts with correct sign (observed frequency of predicting positive bond risk premiums when the realised premium is positive plus observed frequency of predicting negative bond risk premiums when the realised premium is negative).

	Portugal	Spain	Italy	France	Germany	UK
Panel A - Static Strategy						
SBWGBI 1-3						
Mean		1.107	0.924	0.820	1.127	0.217
Standard Deviation		1.993	2.116	1.359	1.383	1.603
Sharpe Ratio		0.555	0.437	0.604	0.815	0.136
Shortfall frequency		0.42	0.41	0.45	0.39	0.45
SBWGBI 3-5						
Mean		2.053	2.181	1.483	1.890	0.446
Standard Deviation		3.816	3.984	2.832	2.735	3.097
Sharpe Ratio		0.538	0.547	0.523	0.691	0.144
Shortfall frequency		0.37	0.39	0.43	0.41	0.39
SBWGBI 5+						
Mean		3.433	3.649	2.435	2.812	1.967
Standard Deviation		6.346	6.757	5.506	4.612	6.445
Sharpe Ratio		0.541	0.540	0.442	0.610	0.305
Shortfall frequency		0.40	0.43	0.40	0.37	0.39
SBWGBI all						
Mean	4.411	2.435	2.306	1.945	2.110	1.469
Standard Deviation	3.153	4.240	4.124	4.001	3.223	5.212
Sharpe Ratio	1.399	0.574	0.559	0.486	0.655	0.282
Shortfall frequency	0.29	0.40	0.41	0.40	0.37	0.40

Table 4 - Performance of Passive and Dynamic Bond Trading Strategies for the period February 1994 to December 2000 (cont.)

	Portugal	Spain	Italy	France	Germany	UK
Panel B - Dynamic Strategy						
SBWGBI 1-3						
Mean		1.806	1.420	1.217	1.304	0.765
Standard Deviation		1.339	1.596	1.057	1.277	1.093
T-test mean=0		3.55	2.34	3.03	2.69	1.84
Sharpe Ratio		1.349	0.889	1.151	1.021	0.700
Shortfall Frequency		0.22	0.20	0.23	0.30	0.17
Frequency of forecasts with correct sign		0.66	0.57	0.60	0.63	0.61
SBWGBI 3-5						
Mean		3.528	3.712	2.627	2.915	1.700
Standard Deviation		2.471	3.199	1.985	2.209	1.992
T-test mean=0		3.76	3.05	3.48	3.47	2.24
Sharpe Ratio		1.428	1.160	1.323	1.320	0.853
Shortfall Frequency		0.19	0.17	0.22	0.22	0.16
Frequency of forecasts with correct sign		0.65	0.66	0.61	0.69	0.60
SBWGBI 5+						
Mean		7.000	5.933	4.513	4.563	4.858
Standard Deviation		4.603	5.555	3.513	3.540	4.481
T-test mean=0		4.00	2.81	3.38	3.39	2.85
Sharpe Ratio		1.521	1.068	1.285	1.289	1.084
Shortfall Frequency		0.20	0.24	0.17	0.18	0.20
Frequency of forecasts with correct sign		0.71	0.63	0.67	0.71	0.60
SBWGBI all						
Mean	4.376	4.814	3.776	3.415	3.228	3.811
Standard Deviation	3.107	3.045	3.387	2.607	2.548	3.593
T-test mean=0	3.45	4.16	2.93	3.45	3.33	2.79
Sharpe Ratio	1.408	1.581	1.115	1.310	1.267	1.061
Shortfall Frequency	0.25	0.19	0.22	0.17	0.19	0.22
Frequency of forecasts with correct sign	0.72	0.72	0.65	0.67	0.71	0.58

Note: In the case of Portugal the period is restricted to January 1995 to December 2000 as explained previously.

Table 5 – Number of Transactions for the Dynamic Strategy over the period February 1994 to December 2000.

	SBWGBI 1-3	SBWGBI 3-5	SBWGBI 5+	SBWGBI all
Portugal				5
Spain	10	9	9	10
Italy	15	17	13	12
France	9	10	8	8
Germany	11	9	6	7
UK	12	14	12	14

Table 6 - Performance of Passive and Dynamic Bond Trading Strategies (out-of-sample) for the period January 1998 to December 2000

This table compares the out-of-sample performance of a passive and a dynamic bond investment strategy for each country and for each maturity subsector. Panel A reports the results of the passive strategy while Panel B presents the results of the dynamic strategy. The passive strategy involves always staying in bonds. The dynamic strategy involves buying one unit of the bond (market) if its predicted premium is positive and none of the bond if its predicted premium is negative. The expected bond risk premium is the fitted value from the rolling regressions of realised bond market excess returns on term spread, IRW and the January dummy (rolling one-step ahead forecasts) that begin in January 1998 and uses all the available historical information since February 1994. The table reports the annualised mean (in percentage) and standard deviation of the excess returns for each trading strategy, the T-test for the hypothesis of the monthly mean=0, the annualised Sharpe ratio (the ratio of the mean and standard deviation), the shortfall frequency (observed frequency of negative excess returns) and, for the dynamic strategy, the frequency of forecasts with correct sign (observed frequency of predicting positive bond risk premiums when the realised premium is positive plus observed frequency of predicting negative bond risk premiums when the realised premium is negative).

	Portugal	Spain	Italy	France	Germany	UK
Panel A - Static Strategy						
SBWGBI 1-3						
Mean		0.403	0.391	0.403	0.491	0.195
Standard Deviation		1.181	1.173	1.118	1.163	1.445
T-test mean=0		0.59	0.58	0.62	0.73	0.23
Sharpe Ratio		0.341	0.333	0.360	0.422	0.135
Shortfall frequency		0.50	0.42	0.44	0.42	0.47
SBWGBI 3-5						
Mean		1.141	0.802	1.071	1.190	0.423
Standard Deviation		2.289	2.342	2.453	2.469	2.732
T-test mean=0		0.86	0.59	0.76	0.84	0.27
Sharpe Ratio		0.499	0.343	0.437	0.482	0.155
Shortfall frequency		0.39	0.39	0.44	0.44	0.42
SBWGBI 5+						
Mean		2.053	1.593	2.223	2.230	2.648
Standard Deviation		4.367	4.373	4.492	4.704	5.826
T-test mean=0		0.81	0.63	0.86	0.82	0.79
Sharpe Ratio		0.470	0.364	0.495	0.474	0.454
Shortfall frequency		0.39	0.47	0.39	0.39	0.42
SBWGBI all						
Mean	0.939	1.326	1.071	1.606	1.454	2.058
Standard Deviation	3.014	3.039	2.723	3.338	2.999	4.642
T-test mean=0	0.54	0.76	0.68	0.83	0.84	0.77
Sharpe Ratio	0.312	0.436	0.393	0.481	0.485	0.443
Shortfall frequency	0.39	0.39	0.42	0.39	0.39	0.42

Table 6 - Performance of Passive and Dynamic Bond Trading Strategies (out-of-sample) for the period January 1998 to December 2000 (cont.)

	Portugal	Spain	Italy	France	Germany	UK
Panel B - Dynamic Strategy						
SBWGBI 1-3						
Mean		1.045	0.497	0.403	0.423	0.953
Standard Deviation		0.961	0.884	1.033	1.159	1.148
T-test mean=0		1.88	0.97	1.35	0.63	1.44
Sharpe Ratio		1.088	0.561	0.390	0.365	0.830
Shortfall Frequency		0.31	0.25	0.31	0.42	0.19
Frequency of forecasts with correct sign		0.67	0.47	0.67	0.53	0.72
SBWGBI 3-5						
Mean		2.393	1.282	1.589	1.514	2.115
Standard Deviation		1.768	1.597	2.234	2.315	2.026
T-test mean=0		2.34	1.39	1.23	1.13	1.81
Sharpe Ratio		1.353	0.803	0.711	0.654	1.044
Shortfall Frequency		0.19	0.19	0.33	0.33	0.19
Frequency of forecasts with correct sign		0.75	0.58	0.56	0.61	0.69
SBWGBI 5+						
Mean		3.808	2.507	3.812	2.729	4.135
Standard Deviation		3.440	3.223	3.638	4.249	4.944
T-test mean=0		1.92	1.35	1.81	1.11	1.45
Sharpe Ratio		1.107	0.778	1.048	0.642	0.836
Shortfall Frequency		0.19	0.25	0.22	0.25	0.28
Frequency of forecasts with correct sign		0.75	0.58	0.69	0.67	0.61
SBWGBI all						
Mean	0.939	2.744	1.648	2.155	1.894	4.297
Standard Deviation	3.014	2.350	1.984	3.041	2.723	3.545
T-test mean=0	0.54	2.02	1.44	1.23	1.20	2.10
Sharpe Ratio	0.312	1.168	0.831	0.709	0.696	1.212
Shortfall Frequency	0.39	0.19	0.22	0.25	0.25	0.25
Frequency of forecasts with correct sign	0.61	0.75	0.58	0.67	0.67	0.64

Note: In the case of Portugal, the expected bond risk premium is the fitted value from the rolling regressions of realised bond market excess returns on term spread, IRW and the January dummy (rolling one-step ahead forecasts) that begin in January 1998 and uses all the available historical information since January 1995.

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