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Short-term market timing using the Bond-Equity Yield Ratio

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ABSTRACT

The Bond-Equity Yield Ratio (BEYR) has recently become a popular relative pricing tool favored by market practitioners. In this paper we compare the short-term profitability of a naive strategy based on the extreme values of the BEYR to the short-term profitability of a more sophisticated strategy relying on regime switches. Although the latter seems to perform better than the former, there is no overwhelming international evidence that these dynamic strategies deliver significantly higher risk-adjusted returns than the buy-and-hold portfolios. In addition, the profitability of these active strategies does not appear to be significantly different when the equity yield, instead of the BEYR, is used as criterion to time the market.

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1. Introduction

Although the efficient market hypothesis is widely regarded as a cornerstone of modern finance, the search for market-beating returns is very much alive and still looks like the search for the Holy Grail of empirical finance.[1] A very large number of studies have indeed focused on whether financial variables can predict stock returns. Among the suggested variables or ratios, there are the consumption-wealth ratio (Lettau and Ludvigson, 2001), the equity share in total new equity and debt issues (Baker and Wurgler, 2000), Tobin's q (Robertson and Wright, 2005; Smithers and Wright, 2000), the dividend-payout ratio (Lamont, 1998), the book-to-market ratio (Kothari and Shanken, 1997; Pontiff and Schall, 1998), term and default spreads on bonds (Campbell, 1987; Fama and French, 1989), short-term interest rates (Ang and Bekaert, 2004; Campbell, 1987), and the well-scrutinized equity yield (i.e. the dividend yield or the earnings yield).[2]

Predictive regression models are often used to assess the extent of return predictability. In these models, real (excess) stock returns over various horizons are regressed on a variable thought to potentially explain future movements in stock prices. However, these models are often characterized by some econometric pitfalls that plague many papers: data mining problems, non-robustness of test statistics or incorrect inferences in small samples are causes of concern which cast doubt on the empirical evidence of stock return predictability (Giot and Petitjean, 2006). In addition, statistical evidence of predictability using in-sample predictive regressions does not necessarily imply economic significance based on out-of-sample forecasts (Rapach and Wohar, 2006a).

In this paper we avoid these econometric pitfalls and investigate whether short-term market timing strategies can lead to superior risk-adjusted returns in a different framework. In contrast to the 'regression approach', the strategies are driven by the regime switches and extreme values of a predictive variable. The criterion (i.e. predictive variable) used to time the market on a short-term basis is the Bond-Equity Yield Ratio (BEYR), which is defined as the ratio

[1] After being wiped out in one of the many stock market crashes of his era, Isaac Newton already wrote in 1768: "I can calculate the motions of the heavenly bodies but not the movements of the stock market".

[2] Key papers on the equity yield include Basu (1977, 1983), Campbell and Shiller (1989, 1988, 1998, 2001), Fama and French (1988, 1989, 1992), Hodrick (1992), Jaffe, Keim, and Westerfield (1989), Rozeff (1984), and Shiller (1989).

of the bond market yield to the stock market yield.[3] In our framework, the bond market yield is the yield-to-maturity on long-term government bonds, while the stock market yield is the equity yield of the most representative stock index. The two most widely used proxies for the equity yield are the dividend yield (D/P) and the earnings yield (E/P).

According to the extant literature on the BEYR, this ratio is assumed to wander around a long-run equilibrium level, deviations from which are taken to signal that equity prices are at an unsustainable level (Brooks and Persand, 2001). If the BEYR becomes high relative to its long-run level, equities are in the danger zone, i.e. they are viewed as being expensive relative to bonds. The expectation, then, is that for given levels of bond yields, equity yields must rise, which will occur via a fall in equity prices. Similarly, if the BEYR is well below its long-run level, bonds are in the danger zone or stocks are unduly cheap. Thus, in its crudest form, the trading rule based on the BEYR would say the following: 'if the BEYR is low, buy equities and sell bonds; if the BEYR is high, sell equities and buy bonds.' To determine the thresholds of the danger zones, we use extreme historical values and regime switches. The use of extreme values is justified on the ground that prices can display short-run and, at times, seemingly persistent deviations from their long-run equilibrium values. This question has been at the heart of a debate in financial economics ever since Shiller's (1981) seminal study. For instance, Summers (1986) suggests that irrational fads in investor sentiment create sustained deviations of stock prices from intrinsic valuations and that rational investors might not be able to arbitrage away the mispricing because of noise trader risk. More recently, Shiller (2000) argues that the 1990's hike in prices and valuation ratios was fueled by investors' irrational exuberance.[4]

In practice, strategies based on extreme values consist in comparing the current level of the variable (the BEYR in our case) to the extreme values extracted from its historical distribution. These extreme values determine the thresholds for the danger zone, which in turn determine when buys and sells are made. In the extant literature, such extreme values are of-

[3]This ratio is better known as the Gilt-Equity Yield Ratio (GEYR) in the UK. Berge and Ziemba (2006) call it the Bond Stock Earnings Yield Differential (BSEYD). The so-called 'Fed model' is a straightforward variant of the BEYR.

[4]For example, US valuation ratios rose spectacularly during the course of the 1990's. The S&P composite P/E ratio hit an all-time peak of 44.2 in December 1999 that was more than double its long term historical mean level.

ten determined in an arbitrary way. For example, Berge and Ziemba (2006) test 44 'different' strategies (combinations of exit and entry threshold levels). In this paper, we follow Black's (1986) estimation according to which the stock market moves 10% of the time far away from its fundamental value and set the threshold at the 90th percentile of the unconditional distribution of the BEYR. The first trading rule is thus the following: when the current value of the BEYR is higher (lower) than the 90th percentile of the its unconditional distribution, we shift funds out of stocks (bonds) into bonds (stocks).

Besides extreme values, regime switches are also often used to model valuation ratios. This is justified on the grounds that valuation ratios may move around constant (and possibly time-varying) long-run equilibrium levels (Ackert and Hunter, 1999; Madsen and Milas, 2005). For instance, Coakley and Fuertes (2006) employs a non-linear, two-regime framework that allows for different behavior over phases of the stock market cycle. Persistence in the ratios implies prolonged price deviations from fundamentals, stemming from short run continuation fueled by investor sentiment during bull or bear markets. Brooks and Persand (2001) also provides statistical and empirical motivations for the use of a two-regime switching model (corresponding to low and high values of the BEYR). They document that the BEYR displays time-varying variance and that its unconditional distribution exhibits significant bumps in one of the tails.

Regime-switching strategies often rely on the Markov switching methodology that *endogenously* determines the threshold at which the ratio (the BEYR here) enters its high regime (i.e. the danger zone for equities). As such, this methodology alleviates concern of data mining. Probability forecasts of being in the high regime during the next period are also delivered by the model. Our second trading rule is thus the following: we shift funds out of stocks (bonds) into bonds (stocks) when this probability is forecasted to be greater (lower) than 50%. To the best of our knowledge, there has been no attempt to compare strategies based on extreme values to those based on regime switches. Furthermore, this paper compares the profitability of the strategies when the equity yield, instead of the BEYR, is used as the criterion to switch between equities and bonds.

Using more than 30 years of monthly data for four countries (Belgium, Netherlands, United Kingdom and United States), our empirical analysis can be summarized as follows.

First, there is no overriding international evidence that the active strategies deliver significantly higher risk-adjusted returns than the buy-and-hold strategies. Second, the regime-switching strategy seems to generate higher risk-adjusted returns than the extreme value strategy. Their performances are nevertheless highly correlated and they don't differ much. Third, the profitability of the active strategies does not seem to significantly depend on the criterion used to time the market (i.e. the equity yield or the BEYR).

The rest of the paper is structured as follows. Section 2 discusses the empirical relevance of the BEYR. In Section 3, we detail the market-timing strategies and explain how the out-of-sample predictions are evaluated from the trading perspective. We present the dataset in Section 4. We discuss the empirical results in Section 5 and conclude in Section 6.

2. The BEYR as a relevant empirical tool

The BEYR is defined as the ratio of the long-term government bond market yield to the stock market yield. In the extant literature, the bond and stock market yields are respectively approximated by the yield-to-maturity on long-term government bonds (R) and by the equity yield of the most representative stock market index. The two most widely used proxies for the equity yield are the dividend yield (D/P) and the earnings yield (E/P). To reflect the importance of both dividends and earnings, we consider two versions of the BEYR ratio. In the first case, the BEYR ratio is defined as: $ln(BEYR_1) = ln(R) - ln(D) + ln(P)$, or $beyr_1 = r - d + p$. In the alternative specification, we have $beyr_2 = r - e + p$.

The BEYR is derived from the Gilt-Equity Yield Ratio (GEYR) that has been keenly studied by academics in the UK, in particular by Mills (1991, 1993, 1998). It is defined as the ratio of the coupon yield on nonredeemable government bonds to the dividend yield on equities. It has been suggested that the current value of the GEYR might be a useful tool for investment managers or market analysts in determining whether to invest in equities or whether to invest in gilts (Clare, Thomas, and Wickens, 1994; Levin and Wright, 1998; and Harris and Sanchez-Valle, 2000a and 2000b). Thus the GEYR is purported to contain information useful for determining the likely direction of future equity market trends.

The so-called ‘Fed Model’ is the most popular application of the the rationale underlying the GEYR.[5] Widely popularized in the United States by market practitioners and finance journals, the Fed model states that the 10-year government bond yield should be inversely related to the expected earnings yield of the S&P500 index. In the Fed model, the equity yield is proxied by the anticipated earnings yield. In practice, the Fed model suggests asset allocation decisions based on the perceived degree of over and underpricing of the S&P500 with respect to its fair value.

While the theoretical justifications for the comparison of the respective bond and equity yields are disputable (see Asness, 2003; Durré and Giot, 2006; Giot and Petitjean, 2006b), this approach has been quite successful as an empirical description of past stock prices (Lander, Orphanides, and Douvogiannis, 1997; Campbell and Vuolteenaho, 2004). Most importantly, it is a market timing strategy much favored by practitioners.[6] The pure ‘mechanical’ relationship implied by this approach is indeed appealing for intuitive reasons. First, market participants constantly arbitrage the stock and bond markets. From a trading perspective, a ‘substitution effect’ between stocks and bonds is in play and such an effect is shaped by the relationship between equity and bond yields. Second, market participants do take advantage of low interest rates to buy stocks on margin through ‘carry trade’ operations. Stock markets indirectly benefit from a low-rate environment as portfolio managers incur low borrowing costs when buying shares. When interest rates rise, these portfolio managers sell their shares to put a cap on their rising borrowing costs.

3. Market-timing strategies: definition and evaluation

In this paper, the basic trading rule consists in shifting funds out of stocks and into long-term government bonds when the BEYR is ‘high’, i.e. when the equity yield is abnormally smaller

[5]Recent modifications of the Fed model include the “Stock Valuation Models #2” (SVM-2) introduced by Yardeni (2003). See Asness (2003), Thomas (2005), and Durré and Giot (2006) for a discussion of the Fed model.

[6]As an illustration, the Wall Street Journal on Monday June 6, 2005, ran a story in its Money and Investing column ‘Equities shrug off gloom’, quoting a practitioner as saying: ‘To see a market that is this cheap compared to interest rates, you have to go back 30 to 40 years. Theres never been a better moment to buy equities compared to bonds and thats a very strong support to the market.

than the prevailing bond yield. Correspondingly, we shift funds out of long-term government bonds and into stocks when the BEYR is ‘low’, i.e. when the equity yield is considered to be abnormally larger than the prevailing bond yield. Note that this can be a somewhat loose comparison, which is shaped by the trading strategy in use. In the subsequent empirical study, we follow two active strategies to allocate capital between stocks and long-term bonds. The first strategy is based on regime switches while the second is based on extreme values.

3.1. The regime-switching strategy

Following Brooks and Persand (2001), we use the regime-switching methodology to model the BEYR. This methodology is particularly appropriate as the assumptions of normality, constant mean and variance in the *unconditional* distribution are not relied upon.[7]

In the class of models that let regimes be determined by unobservable variables, the Markov switching (MS) model advocated by Hamilton (1989) is the most popular. In such a model, the regime occurring at time t cannot be observed as it is determined by an unobservable first-order Markov process s_t. This implies that the current regime s_t only depends on the past regime s_{t-1}. Focusing on the two-regime case, the transition probabilities are defined by:

$$P(s_t = 1|s_{t-1} = 1) = p_{11}, \tag{1}$$

$$P(s_t = 2|s_{t-1} = 1) = p_{12}, \tag{2}$$

$$P(s_t = 1|s_{t-1} = 2) = p_{21}, \tag{3}$$

$$P(s_t = 2|s_{t-1} = 2) = p_{22}. \tag{4}$$

Also of interest are the unconditional probabilities that the process is in each of the regimes. These are given by:

$$P(s_t = 1) = \frac{1 - p_{22}}{2 - p_{11} - p_{22}}, \tag{5}$$

$$P(s_t = 2) = \frac{1 - p_{11}}{2 - p_{11} - p_{22}}. \tag{6}$$

[7] Brooks and Persand (2001) indicate that the Markov switching approach is not a model in the usual context of the word; it is rather a ‘filter’ since it splits the data into two subsamples with corresponding probability estimates.

Considering the 2-regime MS model with an AR(p) specification in both regimes, the density of y_t conditional on the regime s_t and the history Ω_{t-1} is:

$$f(y_t|s_t = j, \Omega_{t-1}; \theta) = \frac{1}{\sqrt{2\pi\sigma}} exp[\frac{-(y_t - \phi_j^{'} x_t)^2}{2\sigma^2}] \tag{7}$$

with mean$= \phi_{0,s_t} + \phi_{1,s_t} y_{t-1} + ... + \phi_{p,s_t} y_{t-p}$, variance$= \sigma^2$, $x_t = (1, y_{t-1}, ..., y_{t-p})'$, $\phi_j = (\phi_{0,j}, \phi_{1,j}, ..., \phi_{p,j})'$ for $j = 1,2$, and the parameter vector $\theta = (\phi_1^{'}, \phi_2^{'}, p_{11}, p_{22}, \sigma^2)'$. These assumptions are far less restrictive and more likely to be valid than the assumption of an unconditional Gaussian distribution for all the data (Maitland-Smith and Brooks, 1999).

The selected MS model in this paper follows the MSIAH specification with regime dependent intercept and heteroscedasticity, as defined in the Krolzig's (1997) MSVAR Ox package. A rolling estimation procedure is carried out to ensure that the probability estimates only incorporate information that was available at the time to which the probability refers. More precisely, we use the first half of the data sample to get the initial estimation of the model; we then compute the forecasted probability of being in the high regime of the BEYR (i.e. in the danger zone for equities); the estimation of the model is rolled forward one month by excluding the oldest observation and replacing it by the last observed value; a new set of estimated model parameters and forecasts are obtained; the estimation of the model is rolled forward one month again. The process goes on until the end of the sample is reached. The trading rule involves buying (selling) bonds and selling (buying) equities when the probability of being in the high regime is forecast to be greater (smaller) than 0.5.[8]

Secondly, as the long-term bond yield may not bear on the long-term stock market valuation, higher trading performance may be achieved by using the equity yield (i.e. D/P or E/P), instead of the BEYR, as market timing criterion. The same aforementioned methodology is applied.

[8]Since higher degree of certainty about the forecasted regime may lead to higher trading profitability, two alternative trading rules have been followed. First, the 0.9 forecasted probability value has been used instead of the 0.5 value. Second, we have built a dynamic portfolio that is invested in the risk-free rate (resp. bonds/ stocks) when the forecasted probability lies between 0.25 and 0.75 (resp. below 0.25/ above 0.75). There appears to be no significant difference between these strategies.

3.2. The 'extreme value' strategy

As indicated in the introduction, we also consider an alternative setting where extreme values of the BEYR could provide useful information for timing the market. This strategy is meant to identify the months when the stock market looks so pricey that investors may be better off avoid it. When the BEYR is above an appropriately defined threshold, it is interpreted as a signal according to which market downturns are likely to be witnessed in the next month. Extremely high values of the BEYR may indeed signal a higher probability of imminent market downturns (Shen, 2003; Berge and Ziemba, 2006).

We use the 90th percentile of the historical range of the BEYR to define the threshold of the 'extremely high BEYR', and interpret it as predicting a market downturn in the next month. When the current value of the BEYR goes above (below) the 90th percentile, we sell stocks (long-term bonds) and buy long-term bonds (stocks). The choice of the 90th percentile as the threshold implicitly assumes that the stock market moves 10% of the time far away from its fundamental value. This is consistent with Black's (1986) estimation. Secondly, we also investigate which of the BEYR and the equity yield (i.e. without taking into account the long-term government bond yield) generates the highest short-term trading performance.

3.3. Evaluation of the strategies

We divide the total sample of observations into two equal in-sample and out-of-sample portions. The returns for all out-of-sample months are computed for the two active strategies; the characteristics of the active strategies (total wealth, raw and risk-adjusted returns) are compared with those of the buy-and-hold equities and buy-and-hold long-term bonds strategies. Returns are calculated as continuously compounded percentage return on a stock index and on a long-term government bond portfolio.

Risk adjustment is essential when evaluating the usefulness of active strategies, as these spend time out of the market and may exhibit less volatile returns than buy-and-hold portfolios (Kho, 1996; Brown, Goetzmann, and Kumar, 1998; Dowd, 2000). We therefore compute the Sharpe ratio, defined as:

$$S_i = \frac{R_i - RFR}{SD_i} \tag{8}$$

where S_i denotes the Sharpe ratio for strategy i, R_i denotes the average return to strategy i over the period, RFR denotes the average value of a risk-free proxy over the period, and SD_i denotes the standard deviation of returns to strategy i.

Transaction costs are evaluated following Sutcliffe (1997) estimates. As the active strategies can be easily replicated using the corresponding T-bond and stock market futures contracts, we consider transaction costs on the futures markets. According to Sutcliffe (1997), an appropriate round-trip figure for the FTSE-100 futures is 0.116% (of the purchase and sale values). This figure is made up of bid/ask spread (0.083%) and commissions (0.033%). [9] To keep things simple, we assume identical costs for the two (stock and T-bond) future markets.

4. The dataset

The empirical part of this work focuses on four countries: Belgium, Netherlands, United Kingdom and United States. As far as stock prices, earnings and long-term interest rates are concerned, reliable data has been available for this group of 4 countries since the early seventies. Therefore, the sample period of our analysis ranges from January 1973 to January 2004, yielding a total of 373 monthly observations.

We use the indexes supplied by Thomson Financial Datastream (TFD) to facilitate the comparison between countries. The stock indices are the TFD global equity indices whose constituents cover at least 75% to 80% of the total market capitalization of each country. The dividend yield and the price-earnings ratio (which gives the earnings yield) of the global equity indices are also provided by TFD. The bond yields are the TFD long-term government bond yields, which have been available since 1957 for the major markets. Finally, we use the TFD total return indices on 10-year government bonds to track the performance of long-term bonds.

[9] Futures trading costs are not easy to gauge, but Goyal and Welch (2006) argue that a typical contract for a notional amount of \$ 250,000 may cost around \$10-\$30. A 20% movement in the underlying indexabout the annual volatilitywould correspond to \$50,000, which would come to around 5 bp for a single transaction.

For each country, we plot the time path of the BEYR ratios and its constituents in Figures I to IV. The BEYR ratios display large up and down swings and are large on an absolute basis at local stock market peaks. For example, the US stock market bubble seems to materialize in less than a year, from the late 1998 to the mid 1999. In the early 2000, the US BEYR series reach their all time high, far above their previous 1987 peaks. With the benefit of hindsight, the US equity market looked incredibly overpriced in 2000, the more so if we look at the ratio of the bond yield to dividend yield. Interestingly, the UK BEYR series are poorly correlated with the US BEYR series and did not appear to be 'overpriced' in 2000 (at least compared to 1987).[10] The Dutch BEYR series exhibit the same kind of behavior as the US series. These two countries appear to be the most correlated within the sample. For Belgium, equities in 1987 appeared to be more overpriced (relative to the bond market) than in the early 2000.

According to the Bera-Jarque normality test statistics, we reject the hypothesis of normality for all BEYR series except for the bond-earnings yield ratio in the US (Table I). Moreover, the BEYR series are autocorrelated as the Ljung box Q^* statistic rejects the null of no autocorrelation in all cases. Engle's LM test for autoregressive conditional heteroscedasticity indicates that the BEYR variances are time-varying. Brooks and Persand (2001) note that these statistical results motivate the use of a model featuring time-varying components (for the mean and/or the variance). The unconditional distribution of the BEYR series confirm that the BEYR is far from being normally distributed: the BEYR series often display significant bumps in their tails, which suggests distinct regimes. This motivates the use of a two-regime switching model, tailored to take into account the low and high BEYR regimes.

5. Empirical analysis

The performance of the active strategies along with the strategies of buy-and-hold equities and buy-and-hold 10-year bonds are given in Tables II to V.

In the US, all market timing strategies based on the BEYR deliver higher Sharpe ratios than the two passive strategies (Table II). Among the two active strategies, the regime-switching

[10]The correlation matrices of the BEYR are not reported to save space. They are available from the authors upon request.

strategy (RSS) performs best as it delivers the highest Sharpe ratios. In terms of raw returns, the BEYR with earnings is the only market timing criterion for which active strategies deliver higher average returns than the two passive portfolios. As such, the BEYR with earnings seems to be a superior market timing criterion than the BEYR with dividends. Although the use of the earnings yield in the extreme value strategy leads to the highest average returns, the BEYR seems to be a superior market timing criterion than the equity yield, both in terms of raw and risk-adjusted returns. In summary, the best market timing criterion and strategy in the US seem to be the BEYR with earnings and the regime-switching strategy, respectively. The success of the BEYR with earnings as the market timing criterion may explain the wide popularity of the 'Fed model' in the US.

In the UK, the Sharpe ratio is lower for the buy-and-hold equity portfolio than for the buy-and-hold long-term bond portfolio (Table III).[11] Although most active strategies provide higher (raw and risk-adjusted) returns than the buy-and-hold equity portfolios, they do not outperform the buy-and-hold bond portfolio on a risk-adjusted basis. The performance of the active strategies does not seem to depend on the criterion used to time the market, although the earnings yield appears to do a slightly better job. The regime-switching strategy beats the extreme value strategy on a risk-adjusted basis in all cases.

Regarding the BEYR in the Netherlands, market timing strategies underperform the passive benchmark portfolios (Table IV). The performance is even worse when the equity yield is used as the criterion to time the market. Overall, the BEYR with dividends is the least worst market timing criterion and the extreme value strategy is less disappointing than the regime-switching strategy.

In Belgium (as in the UK), the Sharpe ratio is lower for the buy-and-hold equity portfolio than for the buy-and-hold long-term bond portfolio (Table V). While no market timing strategy delivers lower risk-adjusted returns than the buy-and-hold equity portfolio, no single active strategy provides higher Sharpe ratios than the buy-and-hold bond portfolio. Nevertheless, the BEYR appears to be a superior market timing criterion than the equity yield. When the

[11] This never happens in Brooks and Persand (2001) as they (unusually) proxy the risk-free rate by the return on long-term bonds.

BEYR is used as the market timing criterion, the regime-switching strategy is superior, albeit marginally, to the extreme value strategy.

For ease of exposition, we summarize all the results in Table VI. On the basis of risk-adjusted returns, we provide answers to three questions: 1. Does any active strategy outperform the two buy-and-hold benchmark portfolios? 2. Is the BEYR superior to the equity yield as a market timing criterion? 3. Is the regime switching strategy superior to the extreme value strategy?

6. Conclusion

We use the Bond-Equity Yield Ratio (BEYR) as a relative pricing tool to dynamically allocate capital between equities and long-term bonds on a monthly basis. More precisely, we assess the short-term predictive ability of the BEYR from an economic perspective by implementing trading strategies that rely on either the extreme values or regime switches of the BEYR. Our empirical results can be summarized as follows.

First, active strategies outperform passive benchmark portfolios in the US only. This is in contrast to Berge and Ziemba (2006). In each of the five countries included in their sample, strategies based on extreme values of the spread between the long-term government bond yield and the earnings yield (i.e. the BEYR with earnings) are found to achieve a superior performance than the buy-and-hold equity strategy. Data snooping is nevertheless a severe issue in their study, as 44 ‘different’ strategies (depending on the chosen threshold) are tested. In addition, they do not compare the active strategies to the buy-and-hold long-term bond portfolio. As shown, the Sharpe ratio of the buy-and-hold long-term bond portfolio can be higher than the Sharpe ratio of the buy-and-hold equity portfolio. While the active strategies may beat the buy-and-hold equity portfolio on a risk-adjusted basis, they may fail to outperform the long-term bond portfolio (as in Belgium and the UK).

Second, active strategies appear to be more successful when the market timing criterion is the BEYR, rather than the equity yield. However, the difference in raw and/or risk-adjusted returns is not always economically significant. For instance, although the use of the BEYR with earnings in the US leads to the highest Sharpe ratio (somewhat validating the Fed model), the dominance of the BEYR over the earnings yield appears to be economically insignificant. All in all, the profitability of the active strategies does not seem to significantly depend on the criterion used to time the market (i.e. the equity yield or the BEYR).

Third, the regime-switching strategy (which is based on the forecasted probability of being in the high regime of the BEYR) appears to be the best strategy to time the market. However, the performance of the regime-switching strategy is closely correlated to the extreme value strategy (which is based on the 90th percentile of the historical distribution of the BEYR). When one of the two strategies fails to beat the buy-and-hold benchmark portfolios, the other usually fails too (and vice versa).

This out-of-sample analysis casts doubt on the ability to time the market with the help of the BEYR (or the equity yield). However, there do exist circumstances under which active strategies based on the BEYR could make positive risk- and transaction cost-adjusted returns. This is at least indicative that further research is warranted on how the BEYR might be best modeled and forecast. For instance, other nonlinear time series or structural models might be employed to better capture the stylized features of the BEYR. Unfortunately, specification search is a serious issue when more sophisticated models are explored: some of these models are indeed bound to work both in-sample and out-of-sample by pure chance (Goyal and Welch, 2006). Another possible avenue for further research would be to generate multistep-ahead predictions as the BEYR might perform better over longer investment horizons.

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Table I
Summary Statistics for the Bond-Equity Yield Ratio.

BEYR with dividends	BE	NL	UK	US
Mean	2.21	1.83	2.15	2.75
Median	2.24	1.76	2.13	2.54
Maximum	4.54	3.27	3.19	5.96
Minimum	1.02	1.01	1.03	1.52
Std Dev	0.61	0.45	0.33	0.88
Skewness	0.81	0.85	-0.02	1.51
Kurtosis	4.13	3.53	3.91	5.25
Jarque-Bera	58.24^{***}	48.10^{***}	12.50^{***}	214.22^{***}
Ljung box Q^*	2851.92^{***}	2661.96^{***}	1456.32^{***}	3397.67^{***}
ARCH(7)	365.02^{***}	376.30^{***}	120.55^{***}	771.47^{***}
BEYR with earnings	BE	NL	UK	US
Mean	0.97	0.87	1.23	1.19
Median	0.97	0.84	1.25	1.18
Maximum	1.85	1.75	1.77	1.96
Minimum	0.30	0.42	0.52	0.67
Std Dev	0.24	0.25	0.22	0.25
Skewness	-0.07	0.61	-0.56	0.21
Kurtosis	4.07	3.19	3.63	3.35
Jarque-Bera	17.98^{**}	23.21^{***}	24.60^{***}	4.54
Ljung box Q^*	2100.62^{***}	2689.82^{***}	1462.12^{***}	2204.65^{***}
ARCH(7)	316.05^{***}	274.28^{***}	172.94^{***}	287.63^{***}

ARCH(7) denotes Engle's LM test for autoregressive conditional heteroscedasticity of up to seventh order. The test statistic follows an $F(7,372)$ distribution under the null of no ARCH effect. BE, NL, UK, US respectively stand for Belgium, Netherlands, United Kingdom and United States. */**/*** rejects the null hypothesis at the 10/5/1% levels.

Table II
Passive and active strategies in the United States: Average returns, volatility of returns and trading profitability.

Trading strategies	Total wealth	Average return	Std. dev. of returns	Sharpe ratio	Nb. of switches
B&H bonds	310.07	0.612	2.022	0.114	-
B&H equities	586.03	1.019	4.295	0.148	-
BEYR with dividends					
EVS	533.12 (527.03)	0.927 (0.921)	3.223	0.169 (0.168)	20
RSS	515.24 (512.56)	0.887 (0.884)	2.407	0.210 (0.209)	9
BEYR with earnings					
EVS	783.69 (775.69)	1.153 (1.147)	3.834	0.201 (0.200)	18
RSS	743.03 (739.22)	1.082 (1.079)	2.526	0.277 (0.276)	9
Dividend yield					
EVS	409.13 (406.07)	0.783 (0.779)	3.034	0.132 (0.131)	13
RSS	391.44 (391.22)	0.735 (0.735)	2.109	0.168 (0.168)	1
Earnings yield					
EVS	893.52 (885.81)	1.194 (1.190)	3.070	0.265 (0.263)	15
RSS	415.77 (415.54)	0.765 (0.765)	2.035	0.189 (0.189)	1

EVS = Extreme Value Strategy using the 90th percentile of the distribution of the BEYR as threshold value. RSS = Regime-Switching Strategy based the forecasted probability of being in the high regime of the BEYR. Figures are in percent per month. Entries in parentheses are figures net of transaction costs. Initial investment amount is 100.

Table III
Passive and active strategies in the United Kingdom: Average returns, volatility of returns and trading profitability.

Trading strategies	Total wealth	Average return	Std. dev. of returns	Sharpe ratio	Nb. of switches
B&H bonds	399.46	0.744	2.010	0.082	-
B&H equities	411.94	0.835	4.349	0.059	-
BEYR with dividends					
EVS	411.94 (411.94)	0.835 (0.835)	4.349	0.059 (0.059)	0
RSS	500.25 (498.53)	0.929 (0.927)	4.158	0.084 (0.084)	6
BEYR with earnings					
EVS	393.82 (392.88)	0.808 (0.807)	4.264	0.054 (0.053)	4
RSS	450.82 (449.79)	0.864 (0.863)	3.907	0.073 (0.073)	4
Dividend yield					
EVS	459.52 (455.59)	0.859 (0.835)	3.631	0.078 (0.077)	15
RSS	440.52 (439.73)	0.818 (0.817)	2.919	0.082 (0.082)	3
Earnings yield					
EVS	474.38 (470.84)	0.881 (0.877)	3.641	0.083 (0.082)	13
RSS	443.55 (442.26)	0.820 (0.818)	2.846	0.085 (0.084)	5

EVS = Extreme Value Strategy using the 90th percentile of the distribution of the BEYR as threshold value. RSS = Regime-Switching Strategy based the forecasted probability of being in the high regime of the BEYR. Figures are in percent per month. Entries in parentheses are figures net of transaction costs. Initial investment amount is 100.

Table IV
Passive and active strategies in the Netherlands: Average returns, volatility of returns and trading profitability.

Trading strategy	Total wealth	Average return	Std. dev. of returns	Sharpe ratio	Nb. of switches
B&H bonds	296.17	0.578	1.495	0.110	-
B&H equities	500.12	0.963	4.854	0.113	-
BEYR with dividends					
(0.119)	11				
EVS	408.70 (404.90)	0.812 (0.807)	3.830	0.104 (0.103)	16
RSS	353.83 (352.61)	0.726 (0.724)	3.552	0.088 (0.087)	6
BEYR with earnings					
EVS	338.54 (335.43)	0.713 (0.709)	3.840	0.078 (0.077)	16
RSS	205.52 (204.94)	0.433 (0.431)	3.305	0.006 (0.005)	5
Dividend yield					
EVS	209.43 (208.12)	0.455 (0.452)	3.659	0.011 (0.010)	11
RSS	171.44 (171.13)	0.336 (0.335)	3.238	-0.024 (-0.024)	3
Earnings yield					
EVS	162.08 (160.51)	0.319 (0.314)	3.595	-0.026 (-0.028)	17
RSS	236.90 (236.50)	0.499 (0.498)	3.062	0.028 (0.028)	3

EVS = Extreme Value Strategy using the 90th percentile of the distribution of the BEYR as threshold value. RSS = Regime-Switching Strategy based the forecasted probability of being in the high regime of the BEYR. Figures are in percent per month. Entries in parentheses are figures net of transaction costs. Initial investment amount is 100.

Table V
Passive and active strategies in Belgium: Average returns, volatility of returns and trading profitability.

Trading strategy	Total wealth	Average return	Std. dev. of returns	Sharpe ratio	Nb. of switches
B&H bonds	367.97	0.692	1.498	0.165	-
B&H equities	380.82	0.812	4.736	0.078	-
BEYR with dividends					
EVS	403.47 (400.91)	0.805 (0.802)	3.884	0.093 (0.092)	11
RSS	432.97 (431.23)	0.835 (0.833)	3.678	0.106 (0.105)	7
BEYR with earnings					
EVS	338.54 (335.43)	0.713 (0.709)	3.840	0.078 (0.077)	16
RSS	545.85 (543.97)	0.968 (0.966)	3.976	0.132 (0.131)	6
Dividend yield					
EVS	266.00 (264.31)	0.581 (0.577)	3.728	0.036 (0.035)	11
RSS	253.08 (252.33)	0.531 (0.529)	3.004	0.029 (0.028)	5
Earnings yield					
EVS	304.85 (301.87)	0.662 (0.657)	3.986	0.054 (0.053)	17
RSS	270.42 (270.27)	0.559 (0.559)	2.771	0.041 (0.041)	1

EVS = Extreme Value Strategy using the 90th percentile of the distribution of the BEYR as threshold value. RSS = Regime-Switching Strategy based the forecasted probability of being in the high regime of the BEYR. Figures are in percent per month. Entries in parentheses are figures net of transaction costs. Initial investment amount is 100.

Table VI
Market-timing strategies and criteria. A summary.

Questions	US	UK	NL	BE
Active > Passive ?	*YES*	*NO*	*NO*	*NO*
BEYR > Equity Yield ?	*YES*	*NO*	*YES*	*YES*
RSS > EVS ?	*YES*	*YES*	*NO*	*YES*

Active>Passive? = Does any active strategy outperform the two buy-and-hold benchmark portfolios? BEYR>Equity Yield? = Is the BEYR superior to the equity yield as a market timing criterion? RSS>EVS? = Is the regime-switching strategy superior to the extreme value strategy?

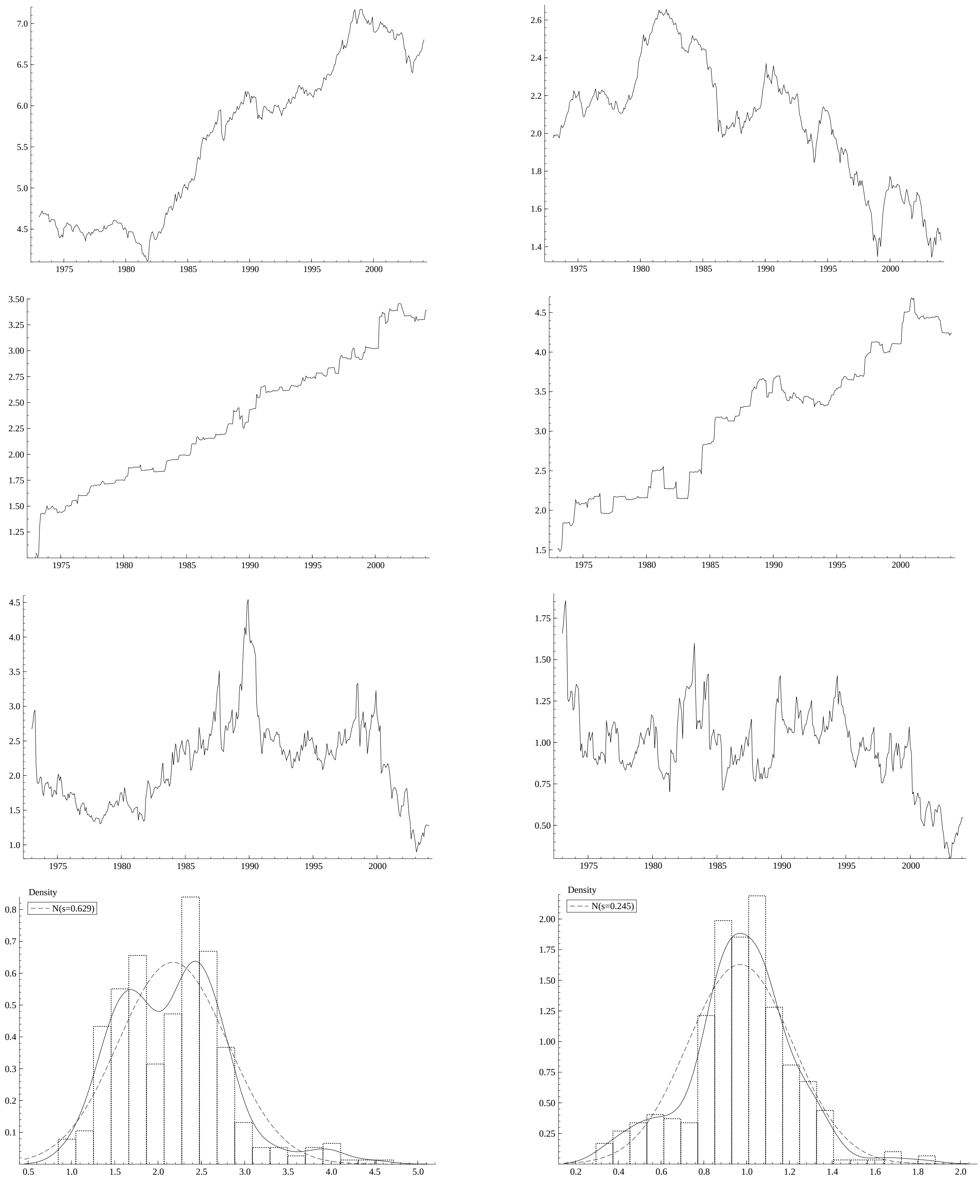

Figure I. Belgium. From top left to bottom right: $ln(P)$; $ln(GOVT)$; $ln(D)$; $ln(E)$; bond yield / dividend yield (BEYR1); bond yield / earnings yield (BEYR2); estimated density and histogram of BEYR1 against Normal; estimated density and histogram of BEYR2 against Normal.

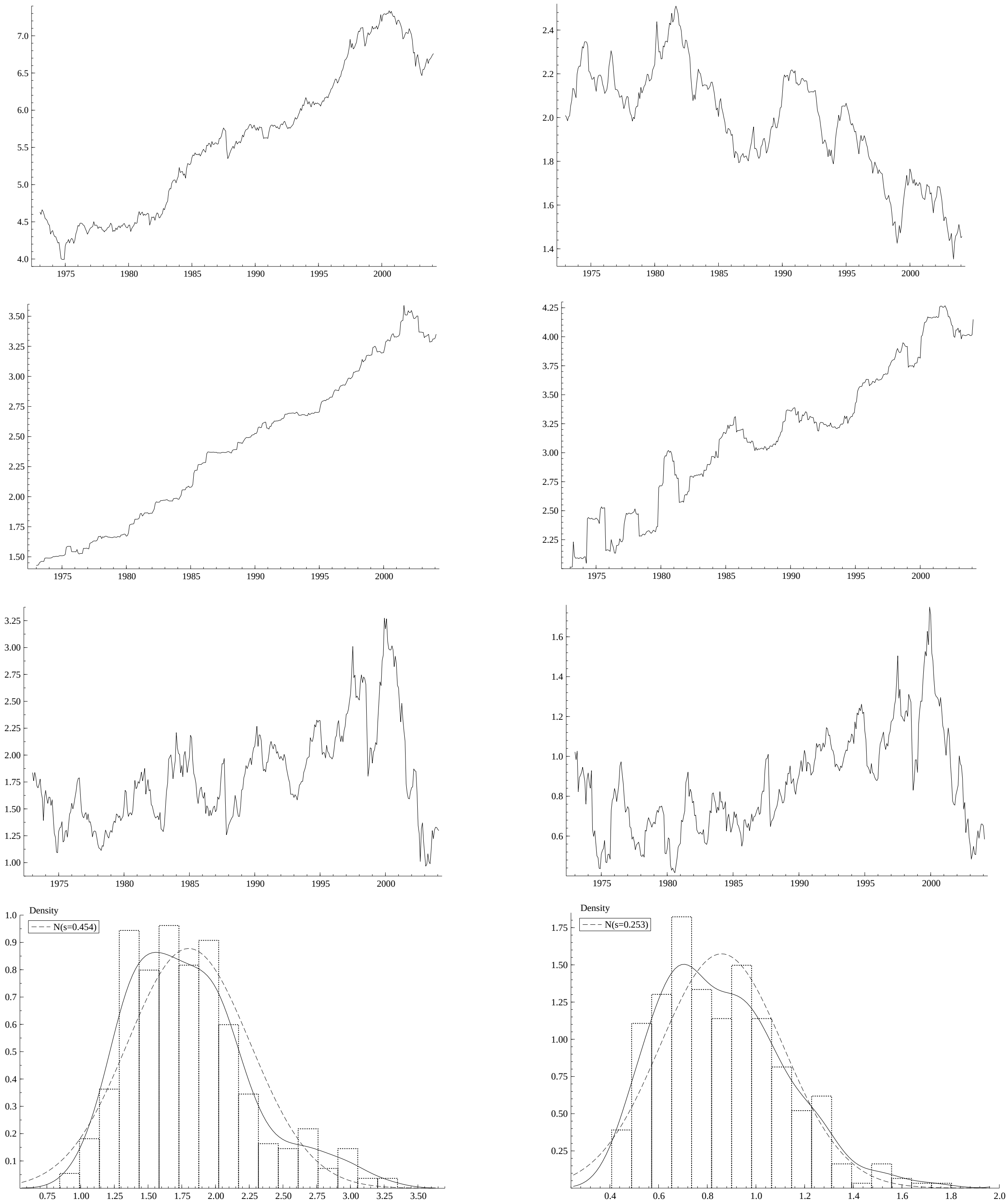

Figure II. Netherlands. From top left to bottom right: $ln(P)$; $ln(GOVT)$; $ln(D)$; $ln(E)$; bond yield / dividend yield (BEYR1); bond yield / earnings yield (BEYR2); estimated density and histogram of BEYR1 against Normal; estimated density and histogram of BEYR2 against Normal.

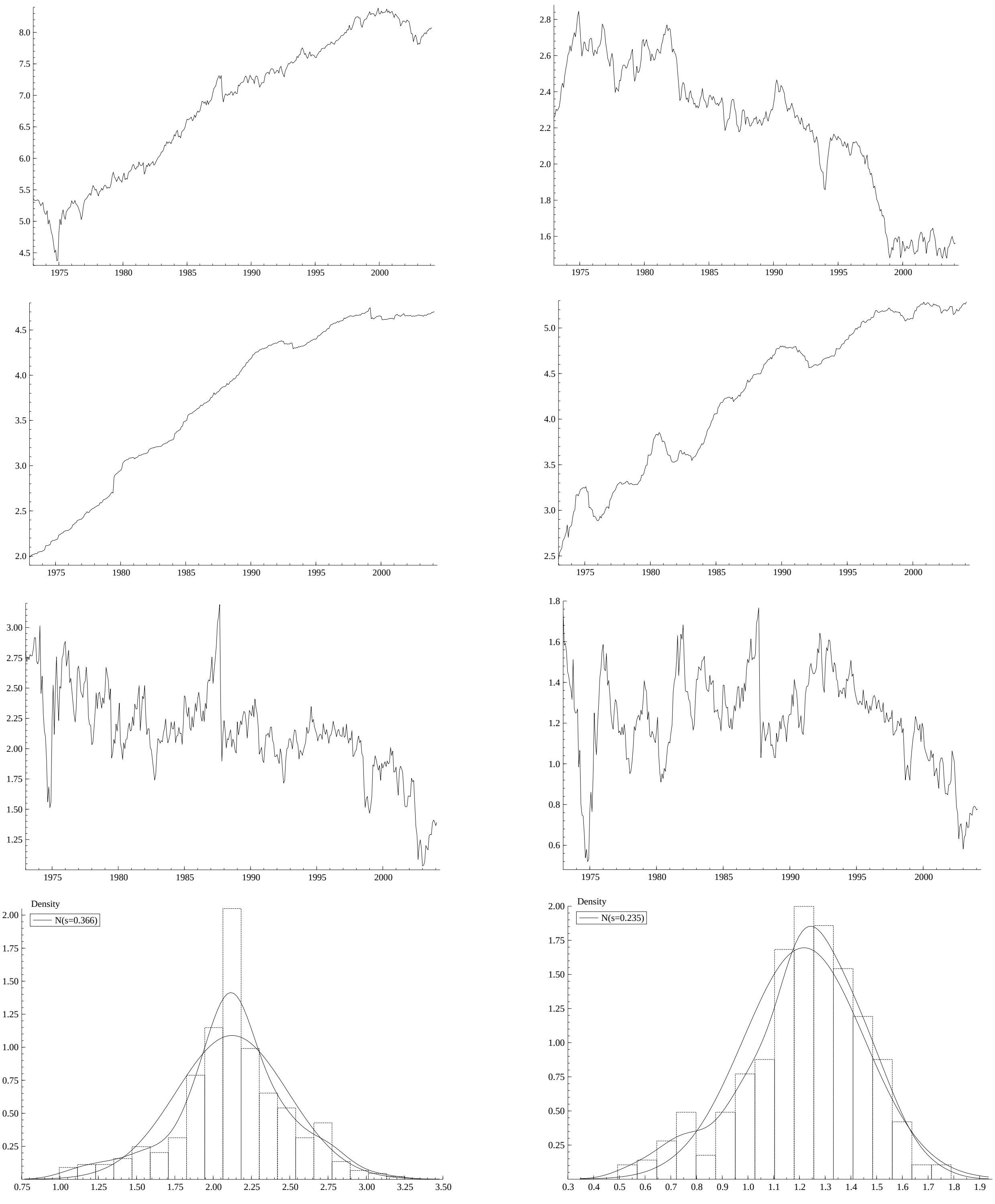

Figure III. United Kingdom. From top left to bottom right: $ln(P)$; $ln(GOVT)$; $ln(D)$; $ln(E)$; bond yield / dividend yield (BEYR1); bond yield / earnings yield (BEYR2); estimated density and histogram of BEYR1 against Normal; estimated density and histogram of BEYR2 against Normal.

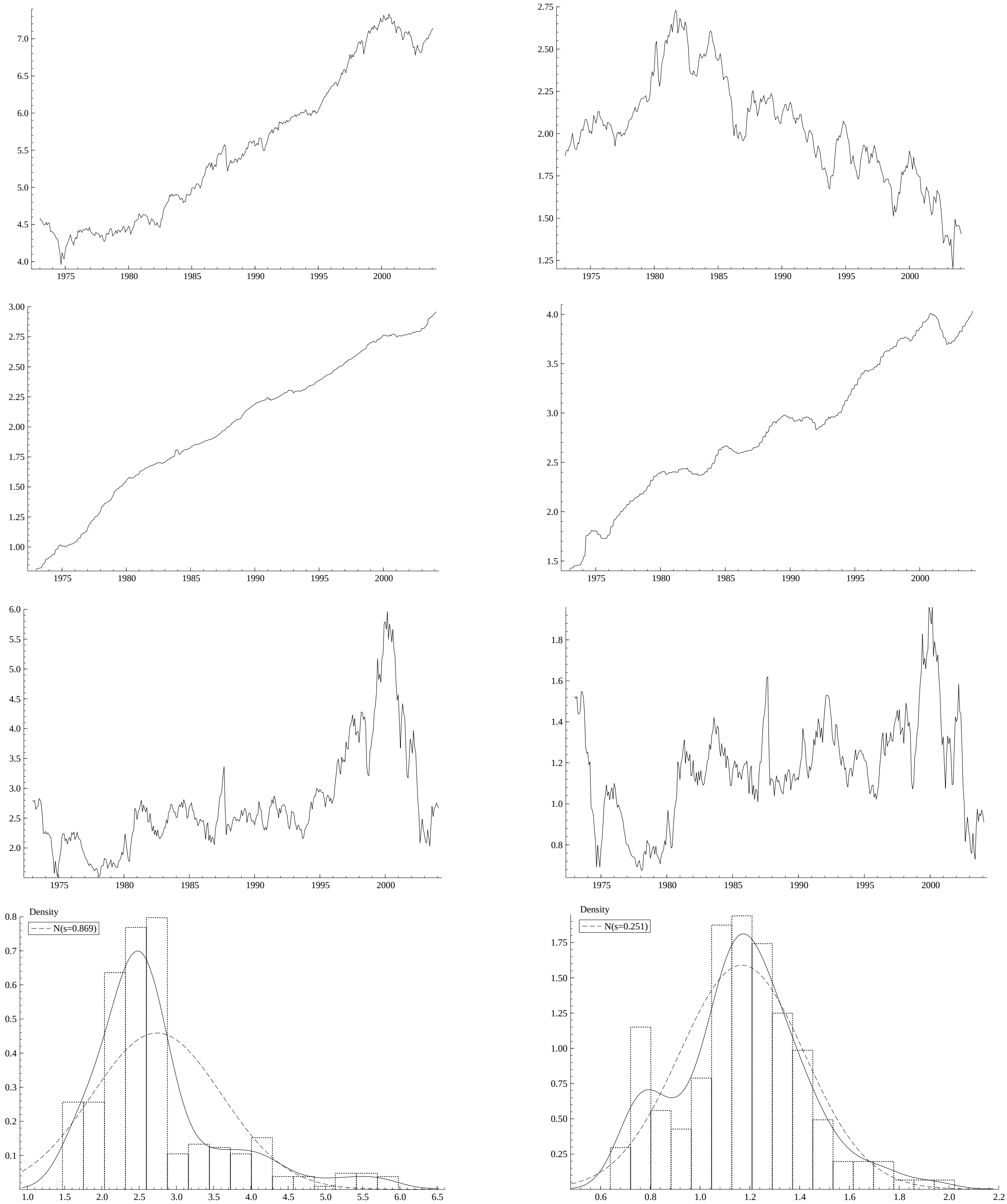

Figure IV. United States of America. From top left to bottom right: $ln(P)$; $ln(GOVT)$; $ln(D)$; $ln(E)$; bond yield / dividend yield (BEYR1); bond yield / earnings yield (BEYR2); estimated density and histogram of BEYR1 against Normal; estimated density and histogram of BEYR2 against Normal.