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by

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Abstract

This paper analyzes whether, and to what extent, the Danish 1, 5 and 10-year equity premia are predictable. We examine the predictive power of a comprehensive list of financial ratios, interest rates and so forth. The results show that the 5-year premium is predictable in the sense that the model explains a non-trivial proportion of the variability of the equity premium. Moreover, the model is good at predicting turning points in the premium. We also analyze the portfolio implications of the model and find that the model is useful in predicting the optimal return maximizing portfolio choice. Finally, the paper presents forecasts for the 5-year equity premium.

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1. Introduction

The relationship between the stock market and the bond market and between the return on the two assets has been an active research area for many years in economics. In the academic literature on the topic, two approaches can be identified. The first approach attempts to explain the fundamental nature of the relationship between the two asset returns using general equilibrium theory. The second approach investigates the empirical relationship between the two asset returns and other variables that may be of importance within a partial equilibrium framework. This literature has in particular focused on whether and to what extent it is possible to predict the movement of the stock market relative to the bond market, which has bearings for the efficient market hypothesis.

In recent years, a large proportion of the general equilibrium research on stock and bond returns has been influenced by the Consumption-CAPM. According to this theory, the high return on stocks relative to bonds reflects the different covariances the two assets have with consumption. Because stock returns tend to covary more with consumption than bond returns, stocks are a poorer hedge against consumption fluctuations, and due to that stocks require a premium for investors to be willing to hold them. Kocherlakota (1996) surveys this literature and arrives at the conclusion that the magnitude of the equity premium remains a puzzle for the US, see also the pioneering paper by Mehra and Prescott (1985).

The other strand of the literature has searched for and actually found variables that have predictive power against the equity premium. This literature has shown that several financial ratios like the dividend price ratio, the price earnings ratio but also short and long term interest rates may have predictive power against the equity premium, see e.g. Lamont (1998) and Blanchard (1993). To the extent that it is possible to predict the return on stocks relative to the known or predetermined bond yield, this may be interpreted as a signal of market inefficiency. A related literature has solely been concerned with the predictability of stock returns and found that the aforementioned financial statistics also have predictive power against stock returns in particular in the medium and long term, see e.g.. Campbell and Shiller (1998) and the survey in Campbell *et al.* (1997).

The purpose of this paper is to analyze the Danish equity premium and in particular to study whether the premium is predictable. While results for the Danish market should be of interest in themselves, the paper may also be of interest in a broader perspective as the predictability literature has mainly focused on the US, whereas less is known for other markets. Moreover, the paper examines the predictive power of a fairly comprehensive list of potential predictor variables both in a single and multi-variable setting, that is, we investigate whether a candidate variable (e.g. the dividend-price ratio) is a useful predictor variable both when used in isolation and when other predictor variables are allowed for. We examine the 1-year, the 5-year and the 10-year equity premium within the period 1922-97. Our results show that the 5-year premium is predictable in the sense that there are predictor variables that explain a non-trivial proportion of the variability in the premium. In contrast to several of the earlier studies, however, we do not stop at this stage but proceed to investigate whether the statistical model is actually useful for forecasting purposes. To this end we check the stability of the model within the sample, and we also calculate the risk adjusted return we would have obtained had we followed the predictions of the model from 1971 and onwards in choosing between investments in stocks and bonds. We compare this risk adjusted return to a pure bond and a pure stock strategy, and find that the model outperforms these strategies. An important explanation of the success of the model is its ability to predict turning points and significant movements in the equity premium and hence to predict when it pays to choose either a diversified stock portfolio or a bond portfolio.

The paper also presents the prediction of the model for the 5-year period 1998-2002. This is of importance also from a practical view point because several analysts have predicted that stock markets will display large declines in the near future. Thus, Campbell and Shiller (1998) have argued that the stock market outlook in the US is extraordinarily bearish. Their prediction, frequently cited in the Financial Press, is entirely based on the current low dividend-price ratio, which they argue is likely to increase to its historical mean via essentially large declines in stock prices. Engsted and Tanggaard (1998) have replicated this analysis on Danish data, and their prediction is almost as gloomy as the forecast by Campbell and Shiller (1998). An important contribution of this paper is to demonstrate that the outlook for Denmark is not nearly as pessimistic when proper account is taken of other predictor variables.

Thus, by allowing for not only the dividend-price ratio but also for other variables, the stock market forecast is certainly not a crash. Moreover, in the Danish case there is no reason to believe that the dividend-price ratio should return to its mean simply because this variable is not stationary. This has to do with institutional changes in the Danish economy that took place in the beginning of the 1980s where the dividend-price ratio declined sharply, see Nielsen and Olesen (1999).

Section 2 of the paper presents the historical magnitude and movement of the equity premium at the three horizons and, furthermore, sketches the framework for the predictability analysis. Section 3 discusses a list of variables that might have predictive power and we also briefly comment on their statistical properties, which is of importance for the way we can formulate the regression equations. Section 4 presents the regression results for the 1-, 5- and 10-year horizon. Section 5 evaluates the statistical models in terms of parameter stability in-sample while section 6 evaluates the 5-year model in a portfolio performance setting. Section 7 reports and discusses the forecast for the 5-year period 1998-2002, and section 8 summarizes the paper.

2. Stock Returns, Bond Yields and Equity Premia

The 1-year, 5-year and 10-year nominal stock return along with the 1-year, 5-year and 10-year nominal yield to maturity on government bonds are illustrated in Figures 1, 2 and 3 [1]. The stock returns consist of the dividend yield and the capital gain (the equity price change).

Figure 1 shows that the 1-year stock return is highly volatile as compared to the short interest rate. There is very little correlation between the stock return and the interest rate in the short term; the simple correlation coefficient equals 0.19. Because stocks tend to yield higher return than bonds the 1-year equity premium is positive in the majority of the years. The average annual equity premium over the period 1924-1996[2], defined as the difference between the 1-year stock and bond return equals 2.3 per cent, and is fairly low by international comparison.

[1] All returns are log returns (defined as the log to one plus the return) and they are all annualized. Moreover, they are forward looking. Our data are from the Nielsen, Olesen and Risager (1998) Database, Copenhagen Business School.

[2] Note that the notation adopted implies that the last recorded return is ultimo 1996 and is for the calendar year 1997.

< Insert Figures 1, 2 and 3 around here >

Figure 2 depicts the 5-year stock return (5-year geometric average of the annual returns) and the 5-year interest rate. Because economic theory predicts a close relationship between the return on equity and the interest rate, cf. below, it is encouraging to notice the existence of a high degree of correlation in the medium term as witnessed also by the correlation coefficient which equals 0.62. Figure 3 displays the corresponding series for the 10-year horizon. At this horizon, the bond and stock return are also closely correlated. The correlation coefficient equals 0.78.

The close relationship between the two asset returns is familiar from the theory of equity pricing, see e.g. Campbell *et al.* (1997)[3] . In this context stock prices are determined as the expected discounted value of future dividends. This forward looking pricing equation is related to or follows from a no-arbitrage equation between the stock and the bond markets, which states that the expected k-period stock return Sk_t^e (where k=1, 5 and 10 years), consisting of both a dividend yield and a capital gain component, is equal to the k-period interest rate Bk_t properly adjusted for a risk premium γk_t , (1)

$$Sk_t^e = Bk_t + \gamma k_t$$

If the realized stock return Sk_t exceeds this expected or equilibrium return, stocks earn excessive returns. Likewise, bonds yield excessive returns if the realized stock return turns out to be lower than its expected level in (1)[4].

[3] The relationship between stock and bond returns is also known from the neoclassical investment model, which produces a first order condition for optimality that says that the total return on a unit of capital, measured as the dividend yield plus the capital gain, should equal the opportunity cost of capital appropriately adjusted for depreciation and risk, see e.g. Blanchard and Fisher (1989).

[4] By use of (1), excess returns can be determined as $EXCk_t = Sk_t - Bk_t - \gamma k_t$.

According to the efficient market hypothesis, it is impossible to earn excess returns in a systematic way, that is, over long horizons excess returns should on average be zero. A necessary condition for this to be the case is that realized excess returns are unforecastable on the basis of available information (i.e. white noise), meaning that the best estimate (the point estimate) of excess returns is always zero. Thus, predictability is a sign of market inefficiency. What we need in order to make the efficiency hypothesis testable is an operational model for the equilibrium returns in (1).

The often used hypothesis is that the risk premium is constant over time. Under this assumption, the efficient market condition is equivalent to the statement that the equity premium PRk_t $(/ Sk_t\text{-}Bk_t)$ is unforecastable except for the constant term capturing the constant risk premium. The efficient market hypothesis is tested by examining whether the premium PRk_t can be forecasted on the basis of available information. This test is conducted by regressing the realized premium PRk_t on a set of potential predictor variables, cf. below, and if these variables explain a non-trivial proportion of the variability of the premium we may conclude that there is departure from efficiency under the null that the risk premium is constant.

If the risk premium is time variant, predictability may but need not signal market inefficiency, see also Campbell *et al.* (1997). In the light of the inherent difficulty in testing the efficiency hypothesis, we interpret predictability as weak evidence against efficiency, because the potential time variability of the risk premium endows proponents of the efficient market hypothesis with an escape clause.

3. Potential Predictor Variables and Their Statistical Properties

The close medium and long term relationship between stock returns and interest rates is naturally an important focus for a paper that investigates whether, and to what extent, it is possible to predict stock returns. However, since the paper also deals with the efficiency issue, which relates to the predictability of excess returns rather than stock returns, we have chosen the equity premium as the dependent variable. Another motivation for this choice is that 5- and 10-year stock returns and interest rates are non-stationary, whereas the return difference is stationary, see Appendix 1 for unit root tests.

Hence, we can analyze the equity premium by conventional statistical methods. In the statistical analysis that follows, the 1-year premium is defined as the (natural) log of one plus the 1-year stock return minus the log of one plus the 1-year interest rate, denoted *PR1*. The corresponding 5- and 10-year premia are denoted *PR5* and *PR10*, respectively. Below, we discuss potential predictor variables. The variables that all relate to fundamentals are selected because they often enter in both academic research and practitioners' applications.

The dividend price ratio. Several studies for the US have shown that the ratio between current dividends ${}_{t-1}D_t$ and the end of period stock price P_t has predictive power in the medium and long term in particular, see e.g. Campbell *et al.* (1997). According to these empirical studies a low ratio signals falling future stock prices (and not increasing dividends). Hence, a low dividend price ratio is a warning of low future stock returns. Because the Danish dividend price ratio is non-stationary, according to standard unit root tests, we do not use the ratio as it is but subtract an equally weighted moving average of the dividend-price ratio (the current and past five years observations) from the current dividend-price ratio, resulting in a stationary variable. This stochastically detrended dividend price ratio is denoted $D\tilde{/}P$[5].

The dividend yield. Another measure of fundamentals is the dividend yield *Yld*, defined as ${}_{t-1}D_t/P_{t-1}$, that is, current dividends divided by beginning-of-period stock prices. The dividend yield can be viewed as an alternative to the dividend price ratio with the difference being the timing of stock prices. This variable is also non-stationary, and we shall therefore also work with the dividend yield subtracted by an equally weighted average of the current and past five observations. This modified dividend yield is labeled $\tilde{Y}ld$.

[5]Any of the detrended variables that we are using can be written as: $\tilde{X}_t = X_t - (X_t + ... + X_{t-5})/6 = (5/6)(X_t - (X_{t-1} + ... + X_{t-5})/5)$. Hence, the impact of X_t on the dependent variable in the predictor model is (5/6) times the coefficient to the detrended variable.

Interest rates. For each horizon we use the appropriate interest rate subtracted by a moving average of the current and past five observations. A motivation for introducing interest rates as predictors for the equity premia is that the empirical relation between stock returns and bond returns may not be a one-to-one relationship as implicitly assumed when using the premium as the dependent variable. This may be captured by including interest rates. The modified interest rate variables are henceforth labeled $\tilde{B}1_t,\ \tilde{B}5_t\ and\ \tilde{B}10_t$, respectively.

Term structure variables. An upward sloping yield curve may signal higher economic activity in the future, which in turn may be positively correlated with earnings and stock returns. To the extent that this potentially valuable information is not incorporated (correctly) in current stock prices, the term structure may have predictive power for the equity premium. The term structure variable for the 10- versus 1-year horizon is defined as the log of one plus the 10-year interest rate minus the log of one plus the 1-year interest rate and denoted $TE10\text{-}1_t$. The other term structure variables are defined analogously and denoted $TE5\text{-}1_t$ and $TE10\text{-}5_t$, respectively.

Mean reversion. In the Danish case there is evidence of mean reversion in the sense that good years in the stock market are followed by bad years and *vice versa*, see Risager (1998). To capture this we include lagged 1-year equity premia, denoted $PR1_{t-1}$, $PR1_{t-2}$ and $PR1_{t-3}$, respectively. Further lags have proved to be insignificant as predictors [6]. It is important to emphasize that these are the lagged equity premia and that there is no overlap between these variables and the dependent variable.

It is customary to distinguish between three kinds of market (or informational) efficiency, depending on the specification of the information set that can be used for predicting excess returns: weak-form efficiency (information set consisting of past realizations of returns and prices), semi-strong-form efficiency (all publicly available information) and strong-form efficiency (all information, including privately held information). Evidence of mean-reversion can be interpreted as evidence against market efficiency in its weakest form, while forecastability on the basis of the other predictor variables is evidence against market efficiency in its semi-strong form, albeit not definitive evidence as noted earlier.

[6] Note that in the 1-year premium equation this implies that the lagged dependent variable appears as an regressor. This leads to biased OLS estimates, but the OLS estimates are still consistent as there is no serial correlation in the disturbance term.

4. Regression Results

In the analysis to be reported below we first perform a single variable analysis where each candidate predictor variable is entered separately. The well-known weakness of this approach is that the parameter estimates will be biased if some of the other (omitted) variables have explanatory power and if there is correlation between the included and the omitted variables. We therefore also run regressions with all variables entering at the same time, and from the general specification we derive the parsimonious representation in which all variables are significant[7]. The latter model is the preferred one for both econometric and economic reasons because the model includes all relevant information. All coefficient estimates are obtained by OLS. Due to the use of overlapping observations, there are potential serial correlation and heteroskedasticity problems at the 5 and 10 year horizons. The standard errors of the coefficients are therefore estimated using the Newey-West method, cf. Newey and West (1987), which gives consistent estimates. For the 1 year horizon, White's heteroskedasticity consistent method is used for estimating the standard errors. For the parsimonious representations at each horizon diagnostic graphics including a plot of the fit of the model are shown in Appendix 2.

4.1. The 1-Year Equity Premium

The results for the 1-year horizon are reported in Table 1. Rows 1 to 7 give the single variable regressions while row 8 shows the full model with all predictor variables included simultaneously. Row 9 is the parsimonious equation, which is the preferred model.

The results show that the term structure (10 minus 1 year) is significant at the 1 per cent level in the parsimonious regression.

A rise in the 10-year interest rate relative to the 1-year rate signals a higher equity premium. The parsimonious regression also includes the lagged 1-year equity premium. High past equity premia are associated with declining future premia, that is, there is evidence of mean reversion.

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[7] The least significant variable is first omitted. After the model has been reestimated, the next insignificant variable is deleted, and so forth. We use the standard 5 per cent significance level in the modeling reduction process.

It is interesting to note that the dividend price ratio, emphasized by Campbell *et al.* (1997) and Campbell and Shiller (1998), is insignificant (even at the 10 percent level) when entered separately and is removed in the modeling reduction process leading to the parsimonious model. Altogether, the two significant variables only explain 16 per cent of the variability in the dependent variable. The conclusion is therefore that there is a lot of noise in the 1-year premium and due to that predictor variables do a poor job in forecasting the premium in the short term.

< Table 1 >

4.2. The 5-Year Equity Premium

The results for the 5-year premium are statistically stronger than for the 1-year premium. In the parsimonious equation reported in Table 2, both the dividend yield, the interest rate and the past 1-year equity premia are all highly significant. Furthermore, the parsimonious model explains 44 per cent of the variability of the 5-year premium, which is a satisfactory result for a pure predictor model.

< Table 2 >

The parsimonious model can be rewritten in a form where only the 5-year stock return appears on the left hand side[8],

(2)

$$S5_t = 0.026 + 1.07B5_t^* + 2.72(Yld_t - Yld_t^*) - 0.16PR1_{t-1} - 0.06PR1_{t-3} + u_t$$

where a '*' denotes moving averages over the past 5 years (excluding the current value) and u_t is the residual.

[8] We have ignored the term *-0.066*$B5_t$ because this is negligible, and the coefficient is not significantly different from zero.

This equation has several interesting characteristics. First, a one percentage point increase in the dividend yield is associated with a 2.72 per cent increase in the 5-year stock return (and equity premium). This estimate may seem high, but the high degree of statistically significance underscores the point that the dividend yield is an important predictor variable. Second, the interest rate affects stock returns through the average of the past 5 years´ interest rates. The effect is roughly a one-to-one effect, meaning that a one percentage point increase in the average interest rate over the past 5 years approximately predicts a one percentage point increase in the 5-year stock return. It is important to note that a change in the contemporaneous interest rate has a negligible effect if this change does not persist into the future. Third, past equity premia also play an important role at the 5-year horizon. High returns in the past signal low stock returns in the future. According to the coefficient estimate as much as 80 per cent of any 1-year premium will *ceteris paribus* be reversed within the coming 5-year period.

4.3. The 10-Year Equity Premium

The parsimonious equation for the 10-year premium is given in line 9 in Table 3. The dividend yield is again significant at the one per cent level. The lagged annual premium is also significant at the one per cent level. According to the coefficient estimate, the 40 per cent excess return on stocks in 1997 is associated with a 1.96 per cent lower premium in the forthcoming 10-year period. Thus, there is also at this horizon a strong tendency to mean reversion. The modified 10-year interest rate is not significant suggesting that the current long interest rate has a one to one effect on the 10-year stock return, without any effect from lagged interest rates. The R^2 equals 0.26 and hence is considerably lower than for the 5-year horizon.

< Table 3 >

4.4. Summing up

The results obtained so far show that the forecasting variables are most useful in a medium term perspective, which is a conclusion that will be further strengthened when we examine the parameter stability of the models. At the 1-year horizon, there is a substantial amount of fluctuations in the equity premium that cannot be explained by the movements of the broad spectrum of forecasting variables (fundamentals) that we have looked at, and it is therefore likely that the short term is dominated by non-fundamental factors, noise trading etc. The fundamentals also explain relatively little of the variability of the 10-year premium, which may simply reflect that contemporaneous financial statistics have very little to say about returns over such a long time span.

5. Model Evaluation: Parameter Stability

A necessary condition for equity premium predictability is that the predictor variables in question should be able to explain a non-trivial proportion of the variability of the premium over the sample. In order for the model to be useful for forecasting purposes it is, however, also important that the relationship between the predictor variables and the premium is stable over time. The only way to judge stability is to examine the historical relationship between the premium and the predictor variables. If the historical parameter estimates are stable, we may have some confidence also in future parameter stability and hence in out-of-sample forecastability. However, there is of course always a risk that a forecasting rule which has been successful in the past may become obsolete in the future due to learning behavior in the market (or some other structural breaks). It is not possible to hedge against this risk.

In order to analyze the within sample stability of the regressions, we have for each horizon estimated the parameters recursively. It turns out that the parameters in the parsimonious equations for the 1-year and 10-year horizon are unstable in particular towards the end of the sample period, see Appendix 3. In the model for the 5-year horizon, the parameters are reasonably stable after the beginning of the 1970s, see Figures 4-8. Similarly, by estimating the three models on data only for the post World War II period it turns out that it is only the model for the 5-year horizon that has (reasonably) stable parameters across the full sample and sub-sample period, see the regression results in Appendix 4[9].

[9] For the 1- and 10-year model we even observe that the relevant predictors change.

< Figures 4-8 >

Another way to test the forecasting ability of a statistical model is to estimate the model over a given sub-sample, construct forecasts for the remainder of the sample and then compare the forecasts with the realizations of the dependent variable. For the 5-year horizon we therefore estimate the model on the sub-sample 1927 to 1970 and subsequently make forecasts for the period 1971 to 1992[10]. Figure 9 compares the actual 5-year premium with the predicted premium.

< Figure 9 >

The diagram shows that the model performs well in a qualitative sense, that is, in predicting the significant movements of the premium and in particular the important turning points. Thus, when the premium has risen (fallen) by significant amounts the model correctly predicts this change in almost all cases. However, it is also clear that the model's quantitative performance is less impressive; often the realized equity premia are close to the boundaries of the OLS forecasting interval. Moreover, there is a tendency to either over- or underpredict the premium. This phenomenon, however, is almost inevitable when forecasts are made over overlapping horizons. To understand the nature of this phenomenon, suppose we are at the New Years Eve in 1991 and that we attempt to forecast the five year premium for 1992-96. Let us further suppose that 1994 turns out to yield an extremely high return in the stock market for some unforeseeable reasons. Given that this is something we cannot know in 1991, the predicted 5-year premium is likely to underestimate the actual premium. Moreover, the model will for the same reason also underpredict in 1992, and so forth.

[10] We have conducted similar forecasting exercises for the 1 and 10 year horizons, leading to the conclusion that the actual forecasting ability of the premium models are poor, see Appendix 5. This confirms the conclusion from the recursive estimation that the model coefficients are unstable.

The implication is that we may observe persistent over- or underprediction *ex post* but we cannot correct for it *ex ante*[11]. In spite of the shortcomings of the model it is of interest to note that the forecast for 1993-97 is almost exactly equal to the actual premium, which is very high (10.8 per cent per annum) due to the exceptionally good stock market years 1996 and 1997. The most important explanation underlying this prediction is the mean reversion component (the lagged equity premia) which predicts a large equity premium for this period due to a very poor stock market performance in the years 1989 to 1991. Notice also that the model prediction in 1991 is very close to the realized premium (for 1992-96).

6. Model Evaluation: Portfolio Strategies (5 Year Model)

In order to shed further light on the usefulness of the 5-year predictor model, it is informative to analyze the consequences of making investment decisions on the basis of this model. To arrive at the most clear-cut insights, assume that the investor picks a pure stock or bond portfolio depending on what the model is recommending. Moreover, assume that the investor demands a (constant) premium in order to be willing to invest in stocks. Let this premium be equal to the unconditional equity premium. As the model for this purpose is estimated over the period 1927-1970, where the unconditional (logarithmic) mean equity premium equals 1.91 per cent, we assume that this is the investor's risk premium. Thus, if the model in late 1971 predicts a premium that exceeds 1.91 per cent, the potential investor goes into stocks. If the predicted premium is below the critical 1.91 per cent, the investor goes into bonds. The performance of this strategy over the period 1971-92 is then compared to the risk adjusted return on the two benchmark strategies, namely, a pure stock strategy and a pure bond portfolio. We ignore transaction costs, but they are not likely to influence our results in a crucial way. We also ignore investor taxes, so the case is mostly relevant for investors who are taxed symmetrically, e.g. banks.

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[11] The point is that we use 5 year ahead forecasts. That is, the forecast for the 5 year premium as of 1997 is based on observations on the 5 year premium up to 1992. As the 5 year periods beginning in 1992 and 1997, respectively, are non-overlapping no serial correlation should be expected. If we on the other hand were to make 1 year ahead forecasts (e.g. forecasting the premium as of 1993) we would have to take account of serial correlation. This could for instance be done by explicitly allowing for serial correlation in the disturbance term when setting up and estimating the premium model.

Figure 10 plots the risk adjusted returns on the pure stock and bond benchmark strategies as well as the outcome of following the model recommendation. The returns are risk adjusted in the sense that the risk premium 1.91 per cent is subtracted from the pure stock return and from the return associated with the model recommendation whenever the model recommendation has resulted in a stock investment.

< Figure 10 >

The diagram shows that by following the model, the investor makes the maximizing return decision almost every year; there are only three years where the return associated with the model based choice is not the highest attainable. The average (arithmetic) annualized risk adjusted return from following the model recommendation is 14.0 per cent. The pure bond strategy yields 12.1 per cent, whereas the pure stock strategy gives 10.7 per cent after the risk adjustment. Hence, the yield difference to a pure bond investment is around 2 per cent per year, whereas the yield difference compared to a pure stock strategy is around 3 per cent. A simple mean t-test suggests that the differences in returns between the model strategy and the benchmark stock strategy is highly significant, that is, the return differences between the model strategy and the pure stock strategy has a mean that is significantly larger than zero, using a one per cent significance level.[12] The corresponding comparison between the model and the bond strategy yields, unfortunately, less clear-cut results. The t-test is significant almost at the 5 per cent level, but the result hinges primarily on the three observations in the period 1978-1980.[13]

[12] The t-ratio is 4.2 with 22 degrees of freedom. Note that the return difference can be shown to be normally distributed using the Doornik and Hansen (1994) small sample test.

[13] Moreover, the return difference is not normally distributed.

7. The 5-Year Premium for 1998-2002: Model Prediction and Discussion

Due to the 5-year model's forecasting ability and in particular the model's track record in the recent past, it is of interest to discuss the prediction for 1998-2002[14].

By plugging the values of the modified dividend yield, the modified 5-year interest rate and the lagged 1-year premium variables ($PR1_{t-1}$ and $PR1_{t-3}$) by late 1997 into the 5-year model we arrive at the forecast for the period 1998-2002. *The point forecast* for the equity premium is roughly zero per cent which is low compared to its historical average. The contributions of each of the predictor variables are given in Table 4. The constant (risk premium) contributes with 2.5%, the dividend yield adds 0.5% to this, whereas the interest rate variable further adds 2%. Because of the high premium in the past, we shall, however, subtract 5.3%. Hence, altogether the premium is expected to be close to zero in the 5-year period 1998-2002.

Recalling that the model has been successful at predicting turning points and significant movements in the premium historically, it is interesting to note that the model predicts a turning point in the 5 year premium with a significant reduction of the premium compared to the last observation in 1992. If we follow the portfolio decision strategy in section 6, this suggests that investors should have gone into bonds in late 1997.

< Table 4 >

[14] It should be noted that the precise premium forecasts that one arrives at depends on which of the predictor variables one includes in the model. Thus, using for instance the modified dividend-price ratio as the sole predictor will lead to different forecasts. We think that by using a multi-variable setting and a general-to-specific model reduction process we have identified the predictor variables that are most relevant of the candidate predictors at hand. We therefore rely more on the forecasts of the parsimonious model than the ones one would obtain from the different specifications in Table 2.

Given that the 5-year interest rate is 5 per cent in late 1997, the forecast for the premium implies that the (annualized) 5-year stock return should be 5 per cent. Assuming that the dividend yield is 1.5 per cent throughout the 5 year forecast period - which corresponds to the level in recent years - the stock market price index is predicted to rise by 3.5 per cent annually in the period 1998-2002. The model therefore predicts a much less optimistic outlook than experienced in the recent past. The considerable fall in interest rates that the Danish economy has experienced in recent years is a key explanation of the less optimistic future stock return scenario. Another explanation is the very high premium in the recent past and due to the highly significant tendency to mean reversion this also produces a less optimistic outlook. The current dividend yield is broadly in line with its level in the past 5 years, thus having a rather small effect on the stock return prediction.

As is evident from the forecasting exercise in section 5, *the point forecasts* for the 5 year premium are sometimes imprecise, implying that more emphasis should be put on *interval forecasts* when deriving specific numbers for the future premium. As usual when forecasting stock market returns, the uncertainty attached to the forecast is considerable. Given that the residuals are normally distributed, the 95% confidence bands can be estimated from twice the standard error of the equation, that is, as +/- 7.6% relative to the point forecast, see Table 2. Hence, *in terms of the annual return on the stock market* the confidence band is (-2.6%,+12.6%). Assuming a dividend yield equal to 1.5% per year, the confidence band for the annual growth in the share price index is (-4.1%,+11.1%). Because many analysts are very pessimistic at the moment, see e.g. Cole *et al.* (1996) and Campbell and Shiller (1998), let us briefly focus attention on the bearish side of these confidence intervals. If the share price index stands at 100 to begin with and if the index declines by 4.1% annually, the share price index may fall to roughly 80 after 5 years. Hence, a 20% fall in the index is the rough lower bound of the confidence interval[15].

[15] By the same line of reasoning, the upper bound of the confidence interval predicts an increase in the stock market index by 55 per cent over the 5 year period.

The forecast reported above is the forecast that historical experience and the use of standard predictors can provide us with. The point forecast is the central estimate of the model. Due to the (considerable) uncertainty inherent in the model the actual outcome may deviate from the point forecast but the deviations are equally likely in both directions, as set out by the forecast interval. Thus, the model does not attach greater probability to negative deviations than to positive ones, and *vice versa*. Due to that it may be valuable to add judgmental factors in order to find out which part of the confidence band - the lower or the upper one - we will attach most probability to. In the Danish case, we think that there are some factors that may suggest a negative outcome. First, there is a risk that the economy moves into recession after four years with high economic activity, which will dampen earnings growth. Second, there is a risk of an American stock market crash, which may spread to the rest of the World. In this context it is, however, important to note that stocks in the US have increased much faster than in Denmark. On the other hand, there are also more bright sides. First, the Danish economy is in a transition phase to an economy with much more emphasis on stock investment. Thus, institutional investors have increased the share of stocks in their portfolios quite considerably in recent years, but they are far from the long run equilibrium level. The stock market has also received much more attention in recent years from ordinary citizens. Hence, there appears to have been a structural shift in the demand curve, which makes it easier to support a fairly high price level provided liquidity plays a role. Second, there is nowadays much more emphasis on share holder value and the notion that firms should make money. Due to that it is easier for firms to make rational business decisions in order to maintain profitability. Third, the Danish equity premium has been fairly low by international comparison over a long historical period. With capital being highly mobile it is possible that the Danish premium will approach the higher Anglo-Saxon level, notwithstanding that the US equity premium might fall but from a very high level compared to the Danish premium, see Blanchard (1993).

As a final piece of information in judging the forecast, Figure 11 plots the model´s consecutive 5-year stock return forecasts until 1997 along with the realized returns until 1992.

The trend in the (forecasts of the) 5-year stock return is declining such that the gap between the expected stock return and the bond yield gradually disappears. Thus, as noted earlier the forecast in late 1997 is that the stock market over the period 1998-2002 will give a return that is equal to the bond return. The figure also shows that the anticipated premium in the period 1993-97 to a large extent compensates for the negative premium in the period 1987-91. Hence, the very high 5-year stock return recorded in 1992 along with the predicted returns can be interpreted as a compensation for poor stock returns in the preceding period. In this context it should be noted that for the whole period 1987-97, the premium is only 0.9 per cent per year compared to a historical average that equals 1.4 per cent.

< Figure 11 >

8. Summary

This paper has examined whether, and to what extent, the return on Danish stocks relative to bonds can be predicted by financial ratios and other financial statistics. We have examined both the 1-year, 5-year and 10-year equity premium. We have investigated the predictor ability of the dividend-price ratio, the dividend yield, various short and long term interest rates, and we have also allowed for past equity premia to have an effect on the current equity premium, reflecting the possibility of mean reversion. The issue of forecastability has not only been examined by testing the significance of the aforementioned predictor variables, but we have also investigated whether parameters are stable and whether the model is helpful in predicting when stocks outperform bonds and *vice versa*.

The main result that comes out of our analysis is that the 5-year premium is predictable. Thus, the preferred model is good at predicting significant movements and turning points in the 5-year premium. Due to that the model is also a useful tool for portfolio decisions, that is, to predict when it pays to be more exposed to stocks than to bonds, and *vice versa*. Thus, the results show that if investors had followed the model in deciding between stock and bond investments, they would have made systematic excess returns compared to a pure stock strategy. The results also show that it is only a subset of the variables that have predictive power.

More specifically, the dividend yield is of some value, but it is really interest rates and the past equity premium that are the key predictor variables. Finally, the ability to predict the equity premium is evidence against market efficiency in its semi-strong form if there is a constant risk premium in the market. In any case, the predictability result is evidence against the simultaneous hypothesis of efficient markets and a constant risk premium. Due to parameter instability and low explanatory power, the 1- and 10-year equity premia can not be said to be predictable.

The preferred 5 year premium model can be used for forecasting the equity premium and the stock return over the years 1998-2002. It is mainly due to a historically low 5-year interest rate and very high returns in the recent past, that the model predicts a low 5-year stock return that is roughly equal to the contemporaneous 5-year interest rate, implying a zero equity premium. The expected outcome is not impressive, but not a disaster either. Thus, the outlook for the Danish market is not extraordinarily bearish as argued by Engsted and Tanggaard (1998), using the single variable dividend-price approach due to Campbell and Shiller (1998). Whether or not our conclusion, based on a multi-variable approach, carries over to the US is another matter that we have not addressed.

It is important to emphasize that the reported forecasts are based on historical relationships between stock returns and financial ratios. Any forecast that has to be used in real-life situations will of course also depend on other judgmental factors and broad perspectives on the outlook for the economy in general. The paper has discussed a few factors that should be taken into account when making such a 'normative' forecast.

Postscript

It is of interest to compare the model's forecast with the actual performance of the market. According to the model the market should go up by 3.5% per year as from late 1997. In the two years 1998 and 1999 that have passed since the first model forecast was made, stock prices have altogether increased by 14.6%. Thus, the model is on track.

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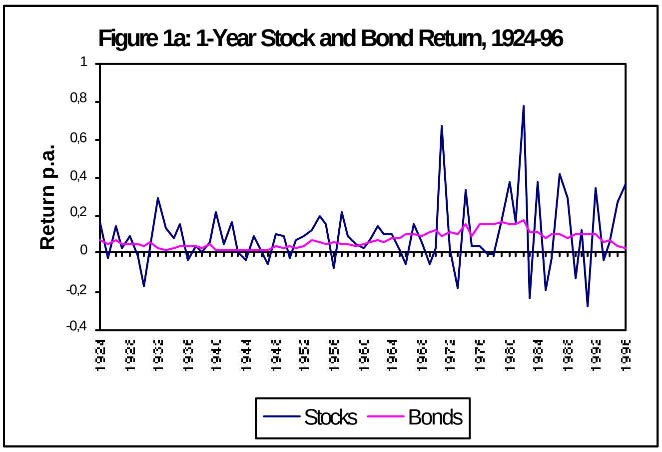


Figure 1a: 1-Year Stock and Bond Return, 1924-96
Return p.a.
Stocks
Bonds

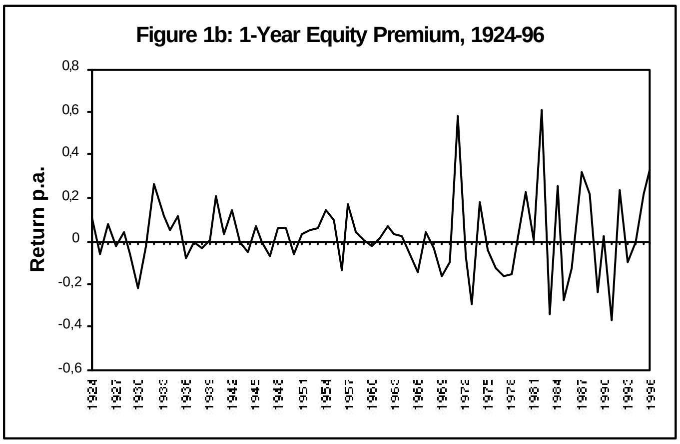


Figure 1b: 1-Year Equity Premium, 1924-96
Return p.a.

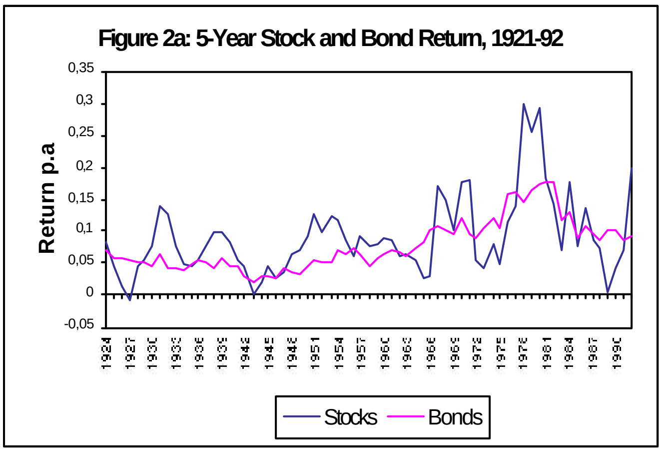


Figure 2a: 5-Year Stock and Bond Return, 1921-92
Return p.a
Stocks
Bonds

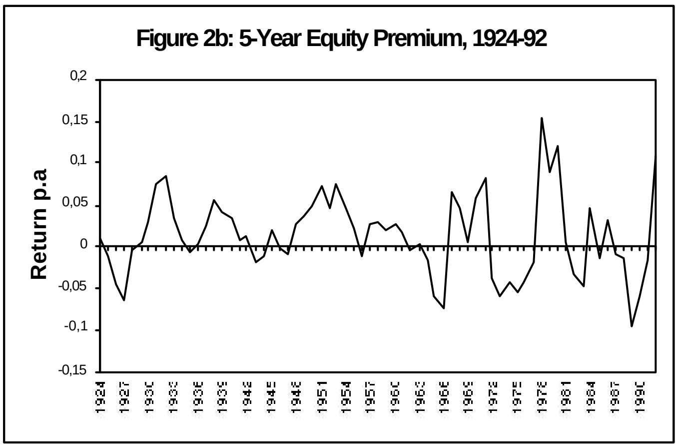


Figure 2b: 5-Year Equity Premium, 1924-92
Return p.a

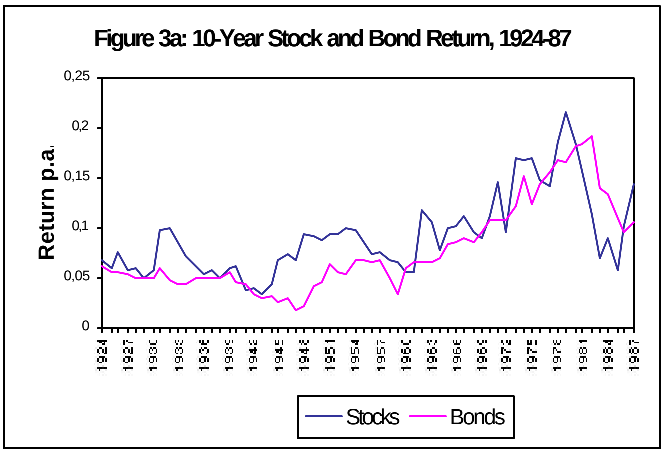


Figure 3a: 10-Year Stock and Bond Return, 1924-87
Return p.a.
Stocks
Bonds

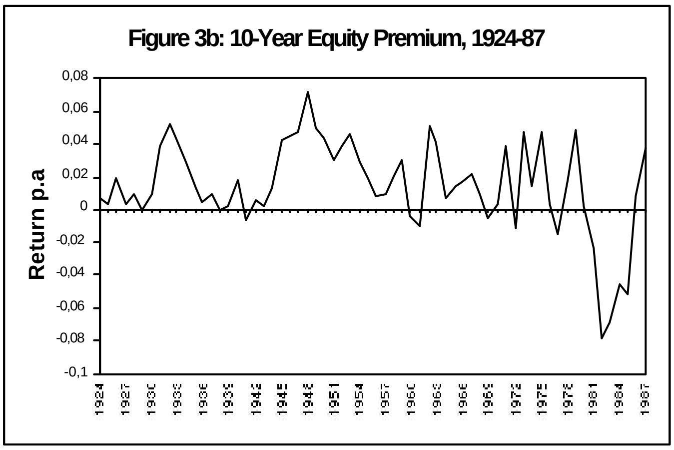
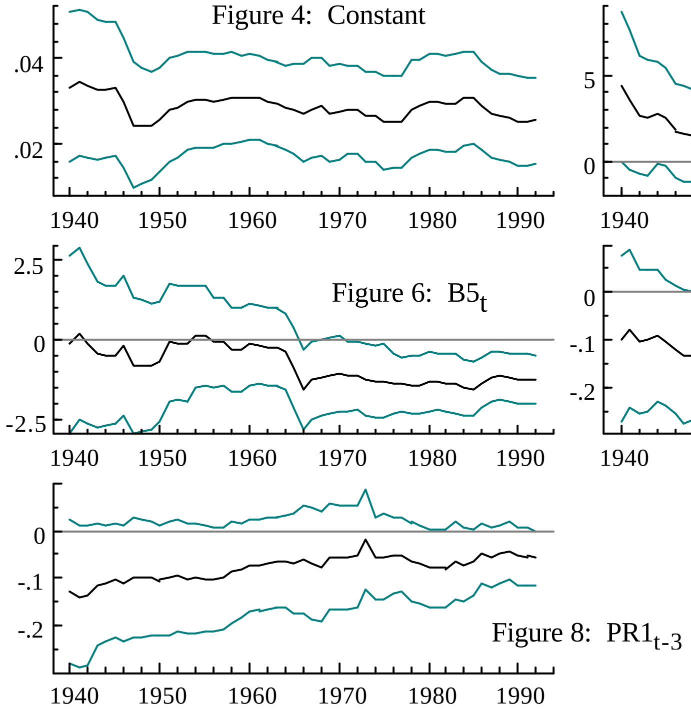


Figure 3b: 10-Year Equity Premium, 1924-87
Return p.a

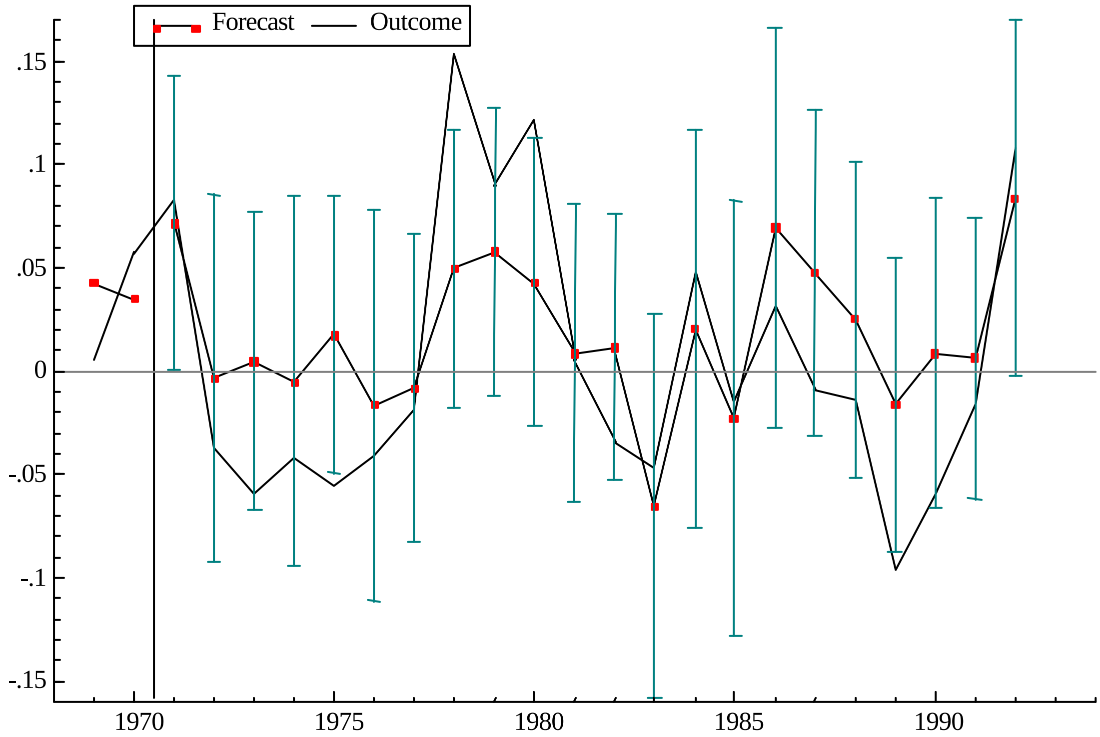
Figures 4-8 Recursive Parameter Estimates for 5-Year Equity Premium Model

1940-1992 (starting year 1927)



Note: Confidence bands only indicative (based on OLS coefficient standard errors).

Figure 9 Forecasting the 5-Year Equity Premium $PR5_t$, 1971-1992



Note: OLS confidence bands only indicative.

Figure 10 5-Year Risk-Adjusted Return to Portfolio Strategies 1971-1992

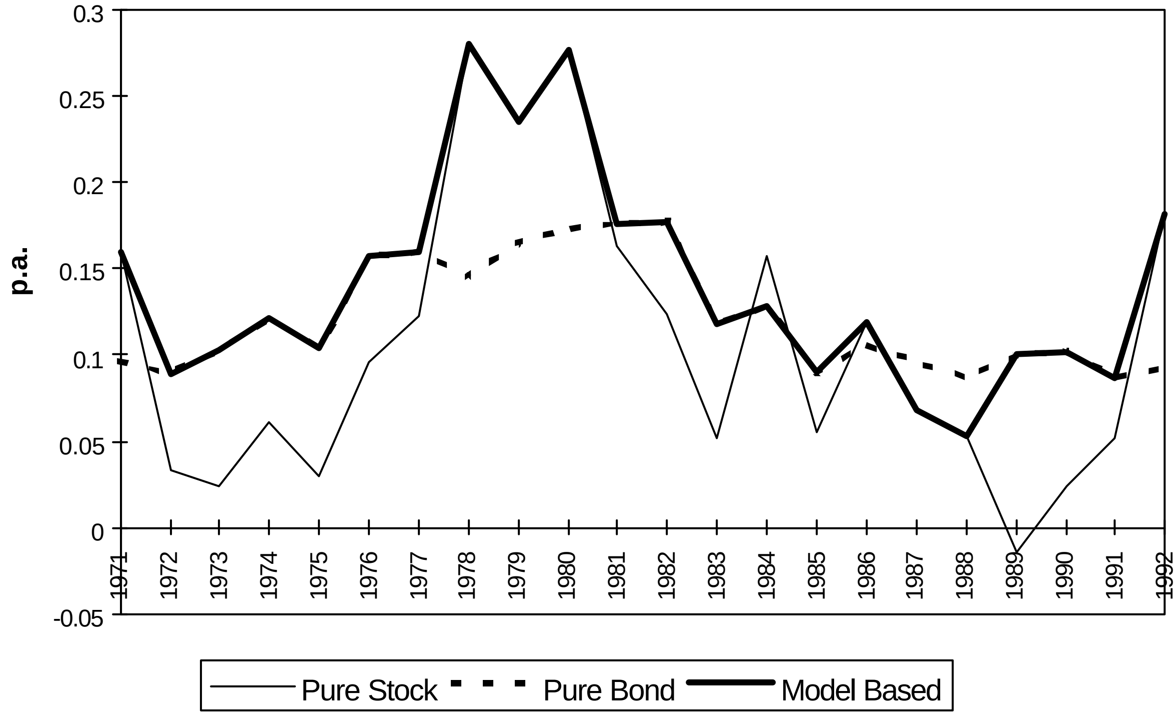


Figure 11 5-Year Stock and Bond Return, 1927-97

Consecutive Stock Return Forecasts for 1993 to 1997

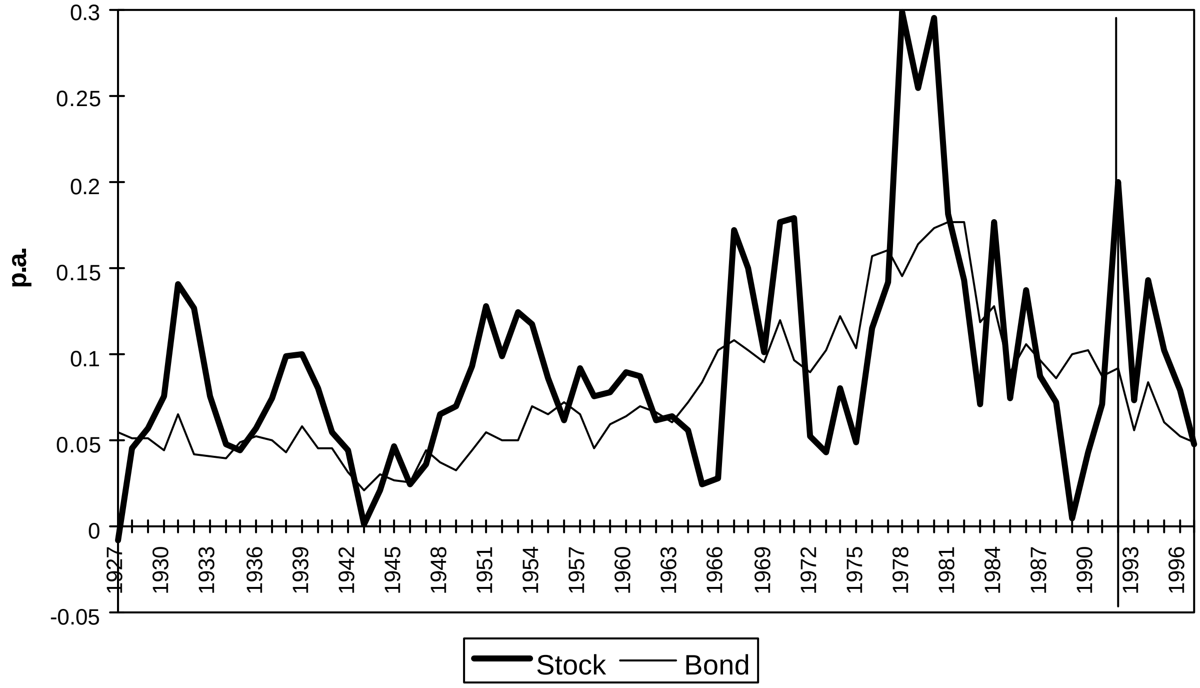


Table 1: The 1-Year Equity Premium $PR1_t$, 1929-96[1,2,3]

	CONS	$\tilde{D/P}_t$	$\tilde{Yld}_t$	$\tilde{B}1_t$	$TE10\text{-}1_t$	$TE10\text{-}5_t$	$TE5\text{-}1_t$	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1.	0.011 (0.018)	2.885 (2.298)									-	0.153	0.03
2.	0.010 (0.017)		2.523 (2.934)								-	0.154	0.02
3.	0.005 (0.018)			-1.015 (1.375)							-	0.154	0.01
4.	-0.016 (0.019)				2.782* (1.490)						-	0.150	0.07
5.	0.003 (0.017)					0.982 (1.954)					-	0.155	0.00
6.	-0.011 (0.022)						3.287* (1.762)				-	0.150	0.06
7.	0.009 (0.018)							-0.184[4)] (0.118)			-	0.152	0.05
8.	0.004 (0.021)	-10.02 (6.110)	13.54*** (5.237)	-1.808 (1.578)	3.056* (1.640)	-0.729 (2.512)	---	-0.664*** (0.240)	-0.023 (0.168)	0.005 (0.136)	-	0.141	0.27
9.	-0.018 (0.018)				3.883*** (1.268)			-0.280** (0.124)			-	0.143	0.16

Notes: 1) OLS and White´s heteroskedasticity consistent estimator of coefficient standard errors. F denotes the standard error of the residual term. F and R^2 are calculated from the OLS formula, excluding the two years 1971 and 1982 for which dummies are introduced.
2) Two impulse dummies for 1971 and 1982, respectively, control for the abnormal high return during the years 1972 and 1983.
3) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.
4) Lags 2 and 3 are insignificant.

Table 2: The 5-Year Equity Premium $PR5_t$, 1927-92[1,2]

	CONS	$\tilde{D}/P_t$	$Y\tilde{l}d_t$	$\tilde{B}5_t$	TE10-1_t	TE10-5_t	TE5-1_t	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1.	0.019*** (0.006)	2.469*-** (0.622)									5	0.043	0.24
2.	0.018*** (0.006)		2.071** (0.834)								5	0.045	0.14
3.	0.014** (0.006)			0.349 (0.328)							5	0.049	0.01
4.	0.013* (0.007)				0.152 (0.355)						5	0.049	0.00
5.	0.015** (0.006)					-0.243 (0.674)					5	0.049	0.00
6.	0.012 (0.008)						0.434 (0.400)				5	0.049	0.01
7.	0.021*** (0.007)							-0.133*** (0.018)	-0.126*** (0.029)	-0.108*** (0.024)	5	0.039	0.38
8.	0.021*** (0.006)	-0.702 (0.892)	2.95*** (1.10)	-0.963** (0.382)	0.770*-** (0.284)	-0.328 (0.646)	---	-0.195*** (0.037)	-0.063 (0.038)	-0.080** (0.032)	5	0.037	0.49
9.	0.026*** (0.006)		3.258*-** (0.696)	-1.279*** (0.272)				-0.160*** (0.026)		-0.059*** (0.019)	5	0.038	0.44

Notes: 1) OLS and Newey-West estimation of coefficient standard errors (number of lags used in Newey-West shown in “lag”-column).
2) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.

Table 3: The 10-Year Equity Premium $PR10_t$, 1927-87[1,2]

	CONS	$\tilde{D}/P_t$	$Yl\tilde{d}_t$	$\tilde{B}10_t$	$TE10\text{-}1_t$	$TE10\text{-}5_t$	$TE5\text{-}1_t$	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1.	0.017*** (0.005)	1.405*** (0.576)									5	0.025	0.23
2.	0.017*** (0.005)		1.377*** (0.449)								5	0.026	0.19
3.	0.014** (0.006)			0.376 (0.237)							8	0.028	0.04
4.	0.019*** (0.005)				-0.503 (0.534)						5	0.028	0.05
5.	0.016*** (0.005)					-0.606 (0.606)					5	0.028	0.05
6.	0.015*** (0.006)						-0.138 (0.282)				5	0.029	0.00
7.	0.018*** (0.005)							-0.057*** (0.019)	-0.060* (0.034)	-0.060*** (0.020)	5	0.026	0.22
8.	0.021*** (0.005)	-0.317 (1.398)	1.758 (1.278)	-0.307 (0.288)	-0.187 (0.367)	-0.037 (0.372)	---	-0.065 (0.044)	-0.014 (0.034)	-0.023 (0.018)	5	0.026	0.31
9.	0.018*** (0.005)		1.433*** (0.456)					-0.049*** (0.018)			5	0.025	0.26

Notes: 1) OLS and Newey-West estimation of coefficient standard errors (number of lags used in Newey-West shown in "lag"-column).
2) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.

Table 4: Forecast of 5-Year Premium on Stocks $PR5_t$, 1998-2002

	Contributions			
Forecast	CONS	$Yl\tilde{d}_t$	$\tilde{B}5_t$	$PR1_{t-1\ \&\ t-3}$
-0.0021	0.0256	0.0044	0.0209	-0.0531

Appendix 1:

Statistical Properties of the Variables

Table A1.1: Univariate Summary Statistics

Variable	Sample	Sample Mean (pct.)	Sample std.dev. (pct.)	Min. (pct.)	Max. (pct.)	Skewness	Excess Kurtosis	Doornik-Hansen statistic	AR(1)-coefficient
PR1	1929-96	2.24	17.9	-37.4	61.0	0.70	1.65	8.01**	-0.22 (0.12)
PR5	1927-92	1.43	4.8	-9.6	15.3	0.27	0.20	1.46	0.46 (0.11)
PR10	1927-87	1.46	2.9	-7.9	7.1	-0.96	1.57	8.87**	0.63 (0.10)
$\widetilde{DP}$	1927-96	-0.19	0.9	-3.2	1.5	-0.64	0.26	5.49*	0.52 (0.10)
$\widetilde{Yld}$	1927-96	-0.19	0.9	-3.4	1.3	-0.83	1.49	7.98**	0.66 (0.10)
$\widetilde{B}1$	1929-96	-0.02	1.8	-4.9	4.0	-0.39	-0.09	1.99	0.48 (0.11)
$\widetilde{B}5$	1927-92	0.12	1.6	-5.4	4.5	-0.44	1.67	9.52***	0.62 (0.10)
$\widetilde{B}10$	1927-87	0.22	1.6	-4.7	3.7	-0.99	1.46	9.53***	0.76 (0.09)
TE10-1	1927-96	0.77	1.4	-2.0	3.8	0.02	-0.42	0.09	0.33 (0.12)
TE5-1	1927-96	0.49	1.1	-2.9	3.5	-0.44	0.87	4.52	0.26 (0.12)
TE10-5	1927-96	0.28	1.1	-2.3	3.2	0.02	0.35	1.78	0.30 (0.12)

Note: Sample mean, standard deviation (based on T), skewness and excess kurtosis relate to the first four moments of a given distribution. For the standard normal distribution the numbers would be 0, 1, 0 and 0, respectively. A positive (negative) skewness indicates that the distribution is skewed to the right (left), i.e. has its weight to the left (right) and a long tail to the right (left). The skewness is zero for any symmetric distribution. A distribution has positive (negative) excess kurtosis if it is more peaked (more flat topped and fat tailed) than the normal distribution. The Doornik-Hansen $\mathbf{P}^2$-test statistic indicates whether the four moments are from a normal distribution, see Doornik and Hansen (1994). A large value of the test statistic leads to rejection of the null of normality. *, ** and * denote rejection of the null at 10%, 5% and 1% significance level, respectively. The Doornik-Hansen test has better size properties in small samples than the usual (asymptotic) Jarque-Bera test. The reported AR(1)-coefficient is based on a regression of each variable on itself lagged one-period. OLS coefficient standard errors in parentheses.**

Table A1.2: Phillips-Perron Z_t-test for Unit Root

	Lag length (l)						
Variables	***0***	***1***	***2***	***3***	***4***	***5***	***6***
1927-96 (70 obs)							
Yld	-1.617	-1.678	-1.629	-1.672	-1.633	-1.598	-1.573
$\tilde{Yld}$	-3.745***	-3.949***	-3.959***	-3.977***	-3.856***	-3.682***	-3.536**
D/P	-2.078	-1.972	-1.906	-1.921	-1.904	-1.904	-1.860
$\widetilde{D/P}$	-4.687***	-4.790***	-4.829***	-4.829***	-4.738***	-4.597***	-4.447***
TE10-1	-5.633***	-5.537***	-5.668***	-5.817***	-5.837***	-5.883***	-5.907***
TE10-5	-5.955***	-5.918***	-5.972***	-6.065***	-6.067***	-6.061***	-6.043***
TE5-1	-6.231***	-6.180***	-6.292***	-6.330***	-6.402***	-6.528***	-6.579***
1929-96 (68 obs)							
B1	-1.917	-1.468	-1.533	-1.599	-1.645	-1.709	-1.727
PR1	-9.817***	-9.844***	-9.940***	-10.07***	-10.30***	-10.64***	-11.00***
S1	-9.792***	-9.813***	-9.860***	-9.917***	-10.02***	-10.14***	-10.22***
$\tilde{B}1$	-4.624***	-4.376***	-4.611***	-4.771***	-4.879***	-4.922***	-4.922***
1927-92 (66 obs)							
B5	-1.621	-1.443	-1.440	-1.485	-1.507	-1.526	-1.555
PR5	-4.738***	-4.843***	-4.889***	-4.757***	-4.663***	-4.436***	-4.292***
S5	-3.714***	-3.710***	-3.839***	-3.820***	-3.858***	-3.701***	-3.640***
$\tilde{B}5$	-3.877***	-3.766***	-3.851***	-3.951***	-3.992***	-3.964***	-3.956***
1927-87 (61 obs)							
B10	-1.096	-1.077	-1.111	-1.141	-1.173	-1.194	-1.204
PR10	-3.626***	-3.641***	-3.680***	-3.664***	-3.653***	-3.647***	-3.625***
S10	-2.265	-2.265	-2.250	-2.244	-2.200	-2.186	-2.173
$\tilde{B}10$	-2.690*	-2.666*	-2.754*	-2.801*	-2.831*	-2.816*	-2.793*

Note: The Phillips-Perron unit root test is based on the first order autoregression $x_t=\mu+\rho x_{t-1}+u_t$ (without trend) where the disturbance term u_t has mean zero but can otherwise be heterogenously distributed and serially correlated, see Hamilton (1994, Table 17.2). The Z_t test statistic is a modified t-statistic for the null hypothesis of a unit root (ρ=1), correcting for the possible non-standard properties of u_t. The null of a unit root is rejected in favour of the stationary alternative (ρ<1) if Z_t is negative and sufficiently large in numerical value. *. ** and * denote rejection of a unit root at the 10%, 5% and 1% significance level, respectively. Critical values are from Hamilton (1994, Table B.6). All regressions include a constant term while no deterministic trend is allowed for. Serial correlation is allowed for up to the selected lag length of *l*.**

Table A1.3: Kwiatkowski *et al.* (1992) (KPSS) test for Unit Root

	Lag length (l)						
Variables	***0***	***1***	***2***	***3***	***4***	***5***	***6***
1927-96 (70 obs)							
Yld	2.553***	1.375***	0.9762***	0.776***	0.6595**	0.5829**	0.5296**
$\tilde{Yld}$	0.2589	0.1564	0.1252	0.1128	0.1103	0.1128	0.1175
D/P	2.865***	1.585***	1.138***	0.9093***	0.7741***	0.6849**	0.6225**
$D\tilde{/}P$	0.1845	0.1212	0.1010	0.0948	0.0969	0.1040	0.1138
TE10-1	0.1967	0.1500	0.1220	0.1061	0.0993	0.0945	0.09161
TE10-5	0.4895**	0.3798*	0.3243	0.2900	0.2783	0.2740	0.2738
TE5-1	0.5000**	0.3996*	0.3319	0.3001	0.2727	0.2474	0.2337
1929-96 (68 obs)							
B1	3.915***	2.085***	1.423***	1.089***	0.8890***	0.7561***	0.6621**
PR1	0.02835	0.03572	0.0405	0.0458	0.0530	0.0634	0.0723
S1	0.2289	0.2860	0.3106	0.3346	0.3679*	0.4047*	0.4241*
$\tilde{B}1$	0.5955**	0.4098*	0.3104	0.2613	0.2355	0.2222	0.2156
1927-92 (66 obs)							
B5	4.542***	2.366***	1.614***	1.235***	1.010***	0.8598***	0.7534***
PR5	0.1929	0.1343	0.1175	0.1180	0.1262	0.1453	0.1666
S5	1.201***	0.7473***	0.5776**	0.5031**	0.4640**	0.4489*	0.4370*
$\tilde{B}5$	0.3484*	0.2157	0.1636	0.1380	0.1250	0.1190	0.1167
1927-87 (61 obs)							
B10	4.518***	2.314***	1.570***	1.199***	0.9775***	0.8314***	0.7286**
PR10	0.9330***	05757**	0.4485*	0.3878*	0.3535*	0.3327	0.3207
S10	3.000***	1.657***	1.188***	0.9478***	0.8028***	0.7034**	0.6308**
$\tilde{B}10$	0.4069*	0.2355	0.1766	0.1493	0.1351	0.1281	0.1249

Note: The KPSS test for a unit root is a Lagrange Multiplier test of the null hypothesis that the variable in question can be described by a stationary process possibly around a deterministic trend, against the alternative that the process also includes a random walk component, that is, the null is one of stationarity, see Kwiatkowski *et al.* (1992). The null is rejected in favour of the unit root alternative if the test statistic is sufficiently large. *, ** and * denote rejection of the null (i.e., a unit root is present) at the 10%, 5% and 1% significance level, respectively. Critical values are from Kwiatkowski *et al.* (1992). The lag length *l* determines how many lags are allowed for in the stationary component of the process. No trend is allowed for in the tests, that is, the null is one of mean-stationarity.**

Appendix 2:

Diagnostic Graphics

Figure A2.1 **Diagnostic Graphics For Parsimonious 1-Year Equity Premium Model**

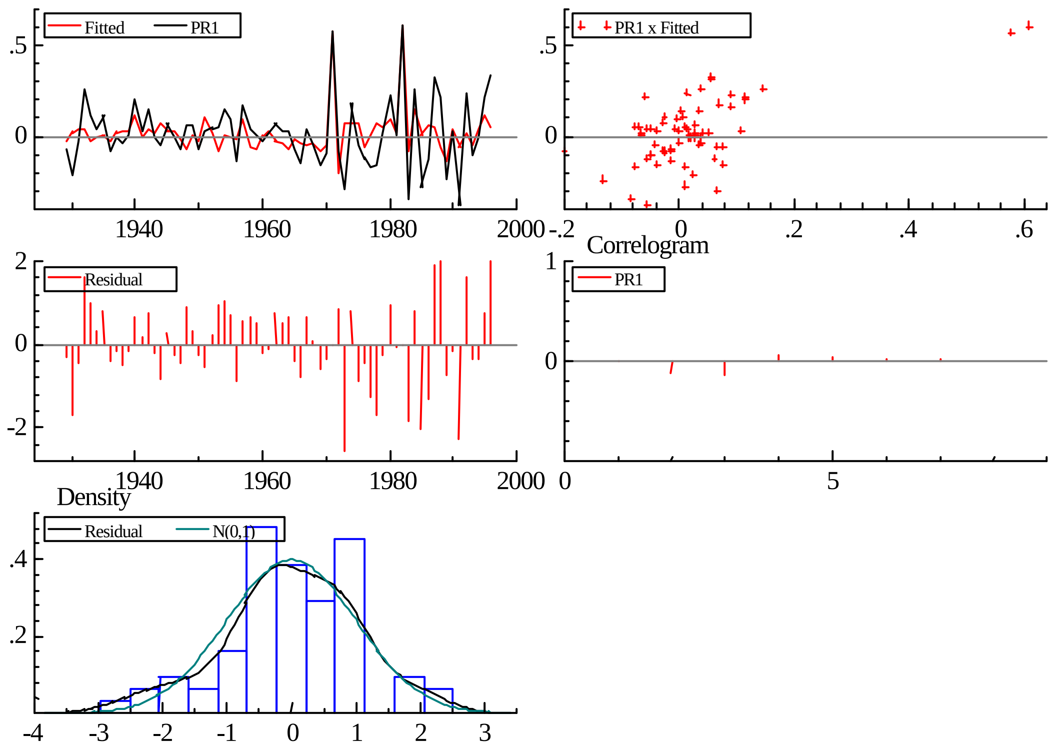


Figure A2.2 **Diagnostic Graphics For Parsimonious 5-Year Equity Premium Model**

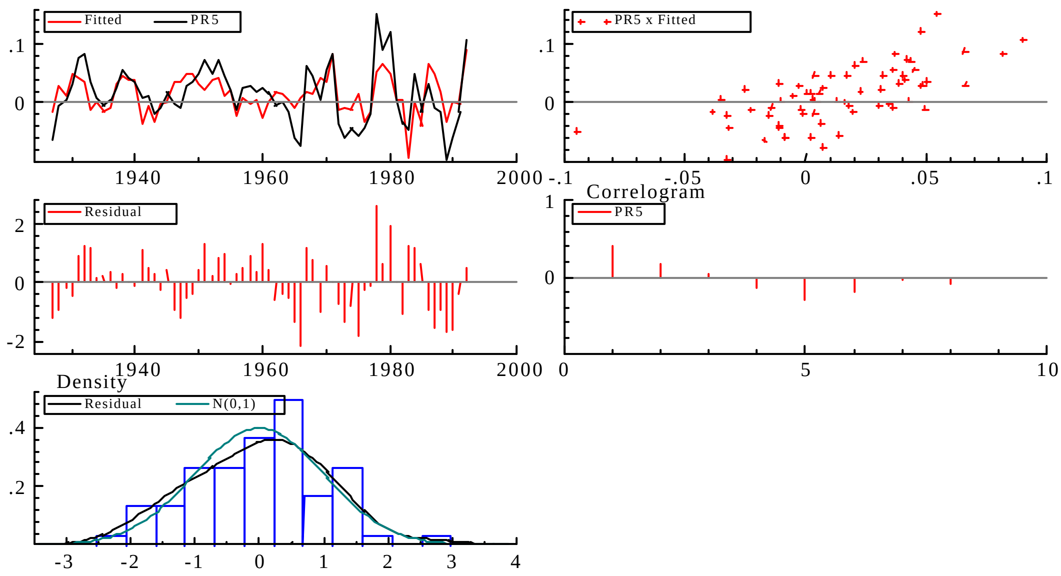
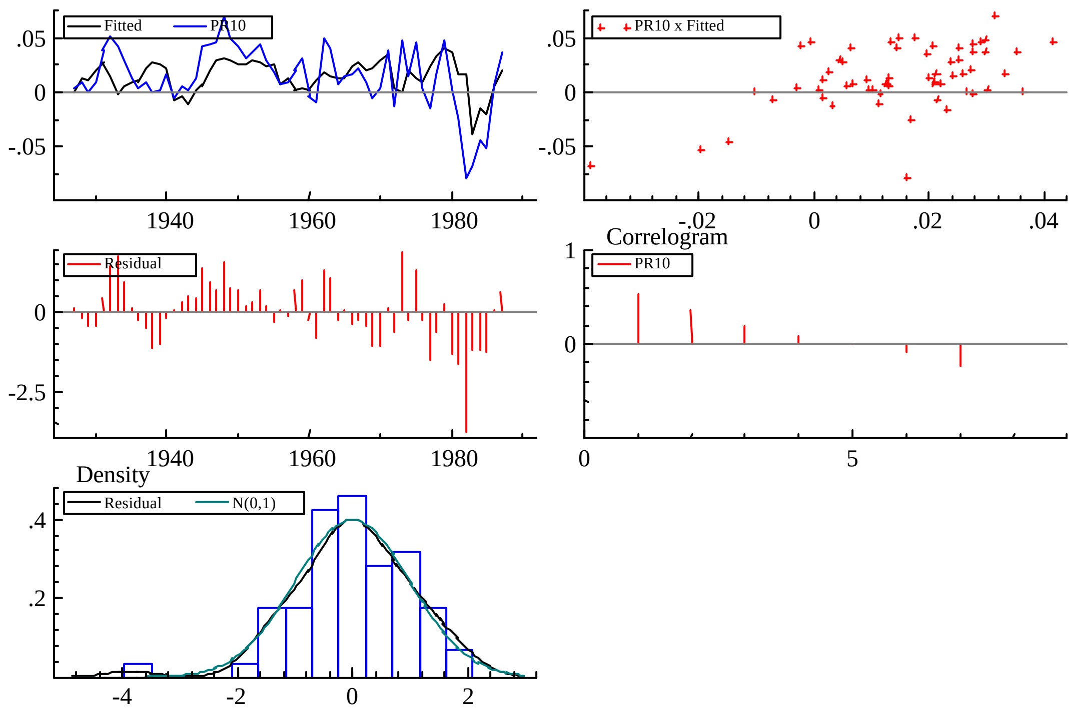


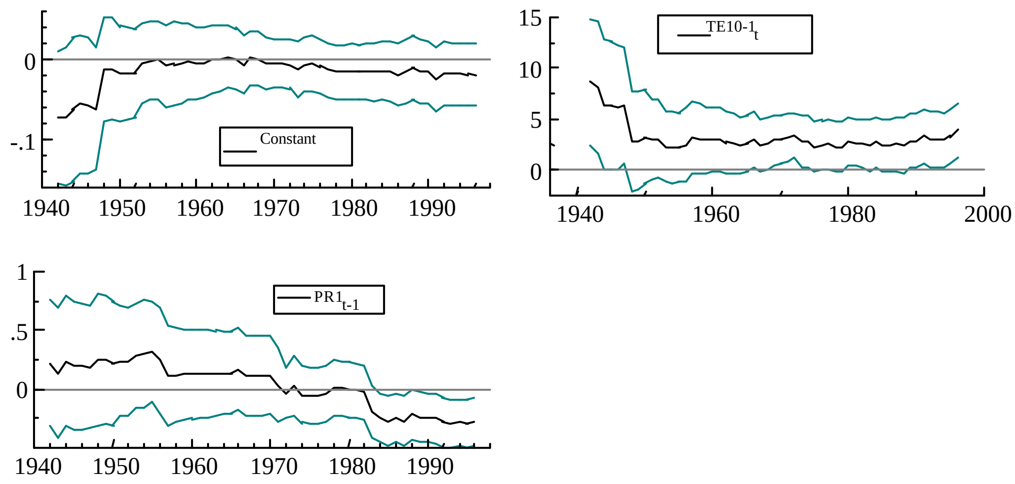
Figure A2.3 Diagnostic Graphics For Parsimonious 10-Year Equity Premium Model



Appendix 3:

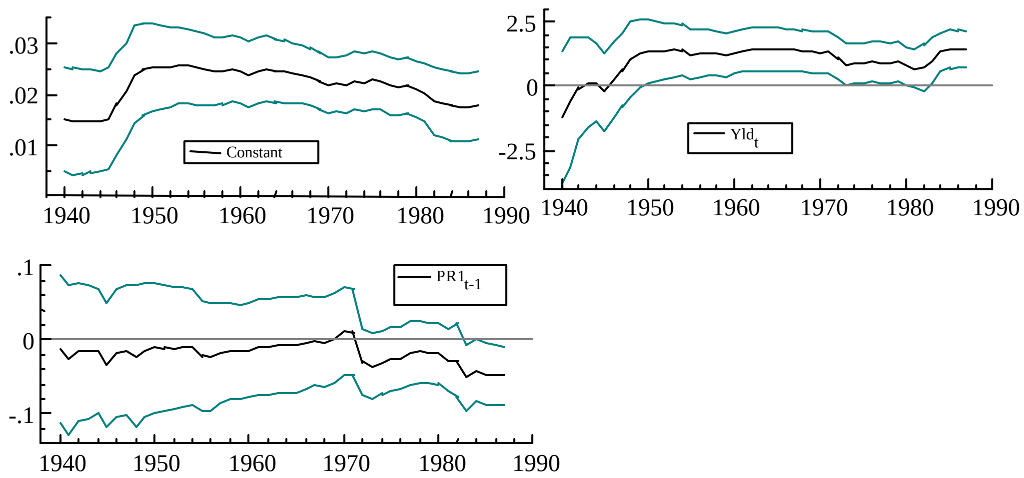
Recursive Parameter Estimates for the Parsimonious 1 and 10 Year Equity Premium Model

Figure A3.1 Recursive Parameter Estimates for 1-Year Equity Premium Model, 1940-1996 (starting year 1929)



Note: Coefficients to dummies not shown. Indicative OLS confidence bands.

Figure A3.2 Recursive Parameter Estimates for 10-Year Equity Premium Model, 1940-1987 (starting year 1927)



Note: Indicative OLS confidence bands.

Appendix 4:

Parameter Estimates Over Samples Beginning in 1952

Table A4.1: The 1-Year Equity Premium $PR1_t$, 1952-96[1,2,3,4]

	CONS	$D\tilde{/}P_t$	$Y\tilde{l}d_t$	$\tilde{B}1_t$	$TE10\text{-}1_t$	$TE10\text{-}5_t$	$TE5\text{-}1_t$	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1	0.012 (0.-024)	6.-775** (3.309)									-	0.168	0.12
2	0.005 (0.-023)		3.978 (4.003)								-	0.175	0.05
3	-0.003 (0.-027)			-0.636 (1.554)							-	0.179	0.01
4	-0.018 (0.-024)				2.552 (1.936)						-	0.174	0.05
5	-0.007 (0.-023)					0.914 (2.234)					-	0.179	0.00
6	-0.012 (0.-027)						3.251 (2.313)				-	0.175	0.05
7	0.000 (0.-025)							-0.225*[4)] (0.126)			-	0.172	0.07
8	0.022 (0.-025)	1.841 (8.323)	9.967 (6.080)	-3.500** (1.713)	1.492 (1.980)	0.438 (3.016)	----	-0.384 (0.282)	0.180 (0.20-6)	0.067 (0.146)	-	0.162	0.33
9	0.029 (0.-023)		9.205 *** (3.058)	-3.835 *** (1.324)				-0.444 *** (0.112)			-	0.155	0.29

Notes: 1) OLS and White's heteroskedasticity consistent estimator of coefficient standard errors. F denotes the standard error of the residual term. F and R^2 are calculated from the OLS formula, excluding the two years 1971 and 1982 for which dummies are introduced.
2) Two impulse dummies for 1971 and 1982, respectively, control for the abnormal high return during the years 1972 and 1983.
3) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.
4) Lags 2 and 3 are insignificant.

Table A4.2: The 5-Year Equity Premium $PR5_t$, 1952-92[1,2]

	CONS	$\tilde{D}/P_t$	$\tilde{Yld}_t$	$\tilde{B}5_t$	TE10-1_t	TE10-5_t	TE5-1_t	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1.	0.017** (0.008)	3.037*** (1.045)									5	0.049	0.25
2.	0.015* (0.008)		2.009* (1.119)								5	0.053	0.12
3.	0.009 (0.008)			0.285 (0.321)							5	0.056	0.01
4.	0.010 (0.009)				0.011 (0.481)						5	0.057	0.00
5.	0.012 (0.009)					-0.414 (0.738)					5	0.056	0.01
6.	0.009 (0.009)						0.477 (0.460)				5	0.056	0.01
7.	0.015* (0.009)							-0.134*** (0.023)	-0.132*** (0.038)	-0.110*** (0.031)	5	0.045	0.39
8.	0.022** (0.009)	-0.176 (1.83)	3.126*** (1.14)	-1.212** (0.493)	0.732* (0.381)	-0.597 (0.717)	----	-0.185*** (0.042)	-0.048 (0.053)	-0.068 (0.044)	5	0.044	0.50
9.	0.025*** (0.009)		3.783*** (0.932)	-1.427*** (0.291)				-0.175*** (0.033)		-0.052*** (0.018)	5	0.043	0.47

Notes: 1) OLS and Newey-West estimation of coefficient standard errors (number of lags used in Newey-West shown in "lag"-column).
2) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.

Table A4.3: The 10-Year Equity Premium $PR10_t$, 1952-87[1,2,3]

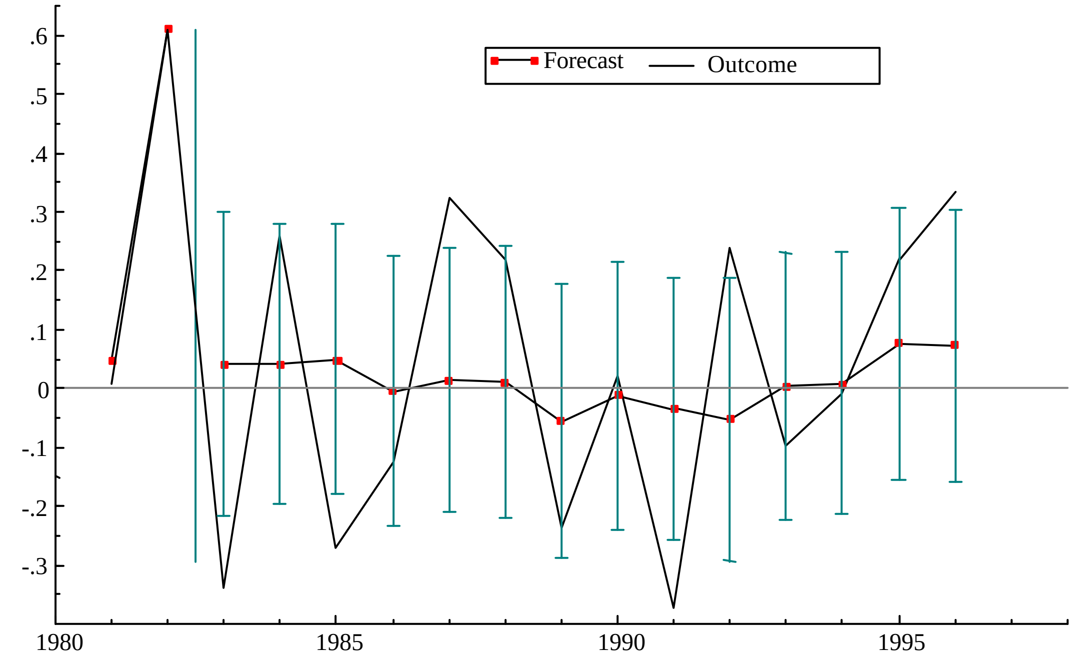
	CONS	$\widetilde{D/P}_t$	$\widetilde{Yld}_t$	$\widetilde{B10}_t$	$TE10\text{-}1_t$	$TE10\text{-}5_t$	$TE5\text{-}1_t$	$PR1_{t-1}$	$PR1_{t-2}$	$PR1_{t-3}$	Lag	F	R^2
1.	0.012** (0.005)	1.896*** (0.561)									5	0.027	0.33
2.	0.011* (0.006)		1.364*** (0.451)								5	0.029	0.19
3.	0.007 (0.007)			0.473** (0.194)							8	0.031	0.08
4.	0.013*** (0.005)				-0.603 (0.709)						5	0.031	0.08
5.	0.011* (0.005)					-0.479 (0.665)					5	0.032	0.04
6.	0.010 (0.007)						-0.362 (0.455)				5	0.032	0.02
7.	0.010 (0.007)							-0.044*** (0.016)	[3]	-0.040*** (0.010)	5	0.031	0.14
8.	0.015*** (0.006)	3.292** (1.373)	-0.994 (1.349)	-0.238 (0.248)	-0.335 (0.510)	0.480 (0.375)	----	0.047 (0.048)	-0.005 (0.035)	-0.050* (0.026)	5	0.028	0.40
9.	0.013** (0.006)	1.819*** (0.477)								-0.030*** (0.009)	5	0.026	0.36

Notes: 1) OLS and Newey-West estimation of coefficient standard errors (number of lags used in Newey-West shown in “lag”-column).
2) *** = significant at 1%; ** = significant at 5%; * = significant at 10%. Asymptotic normal distribution, two-sided test.
3) Lag 2 insignificant.

Appendix 5:

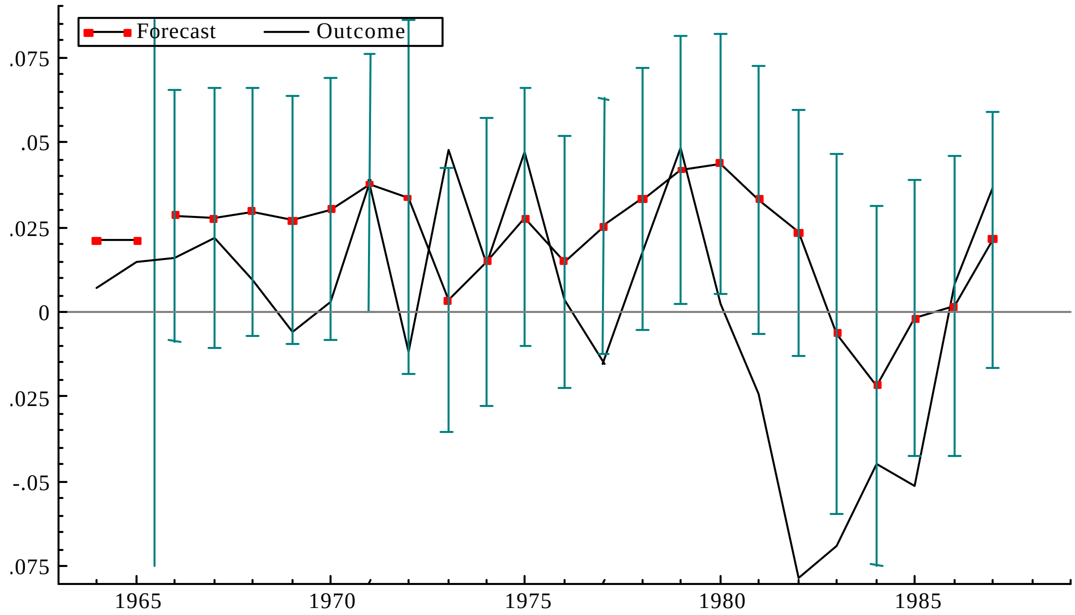
Forecasting ‘Out-of-sample’ for the Parsimonious 1 and 10 Year Equity Premium Model

Figure A5.1 Forecasting the 1-Year Equity Premium $PR1_t$, 1983-1996



Note: Forecasting exercise begins in 1983 which is the first year after the latest dummy, i.e. the dummy for 1982. OLS confidence bands only indicative.

Figure A5.2 Forecasting the 10-Year Equity Premium $PR10_t$, 1966-1987



Note: OLS confidence bands only indicative.