BANK OF FINLAND DISCUSSION PAPERS

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Finlands Banks diskussionsunderlag

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This paper has been written whilst visiting Bank of Finland. I gratefully acknowledge their generous support. Thanks are due to Juha Tarkka, Jouko Vilmunen, Esa Jokivuolle and Matti Virén for helpful comments and to Heli Tikkunen for research assistance.

Suomen Pankin keskustelualoitteita
Finlands Banks diskussionsunderlag

http://www.bof.fi

ISBN 951-686-727-8
ISSN 0785-3572
(print)

ISBN 951-686-728-6
ISSN 1456-6184
(online)

Suomen Pankin monistuskeskus
Helsinki 2001

Factors affecting asset price expectations: fundamentals and policy variables

Bank of Finland Discussion Papers 13/2001

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Abstract

This paper examines what factors move US and European stock and bond markets, extending earlier work by Campbell and Ammer (1993). Inflation news is incorporated into the stock and bond decomposition and explicit attention is given to different horizons over which expectations are formed. Sensitivities to monetary policy instruments and fundamental factors are examined. The data are monthly. For the euro area, a unique data set is constructed. The results illuminate a number of widely-held preconceptions and confirm that inflation news volatility is a non-trivial factor in the stock and bond return decompositions.

Key words: stock prices; bond prices; return decompositions, fundamental factors

JEL Codes: E44, G12

Arvopaperien hintaodotuksiin vaikuttavat tekijät: fundamenttien ja politiikkamuuttujien merkitys

Suomen Pankin keskustelualoitteita 13/2001

Nico Valckx
Tutkimusosasto

Tiivistelmä

Tutkimuksessa tarkastellaan, mitkä tekijät vaikuttavat hinnanmuutoksiin Yhdysvaltojen ja Euroopan osake- ja joukkolainamarkkinoilla, ja siinä laajennetaan Campbellin ja Ammerin aiempaa (1993) tutkimusta tästä aiheesta. Tutkimuksessa inflaatiouutiset liitetään osakkeiden ja joukkolainojen hintojen muutosten hajotelmaan. Lisäksi tarkastelussa eriytetään myös eri tekijöitä odotusten aikahorisontin pituuden mukaan. Arvopaperien hintojen herkkyyttä politiikkamuuttujien ja talouden perustekijöiden suhteen arvioidaan. Aineisto on kuukausitasoista, ja euroalueen osalta se on uutta, tätä tutkimusta varten konstruoitua. Tulokset auttavat arvioimaan useita arvopaperien hintoihin liittyviä yleisiä uskomuksia ja tukevat ajatusta, että inflaatiouutisten volatiilius on olennainen tekijä osakkeiden ja joukkolainojen hintojen hajotelmissa.

Asiasanat: osakkeiden hinnat, joukkolainojen hinnat, tuottohajotelmat, perustekijät

JEL luokitus: E44, G12

Contents

1 Introduction

The aim of this research is to extract information from asset prices, and more specifically, to decompose US and EU stock and bond excess return movements into fundamental factors. This extraction of information from financial market data may prove to be valuable, both for monetary policymakers and investors. The Fed or ECB can get a clearer idea of what is moving stock and bond prices, so as to be able to discriminate between rational and irrational market exuberance.[1] It can also serve as an input for analysing wealth effects due to stock and bond market ups and downs, or to further the understanding of (macroeconomic) announcement effects, see, eg, Fleming and Remolona (2001). Investors can benefit from asset price decompositions to improve their asset allocation strategy and timing decisions since the analysis offers a structured way to examine regime shifts in financial market expectations and it helps to understand specific epsiodes during which markets are seemingly at odds with fundamentals.

A major benefit of financial markets is that they aggregate a greater amount of information than is possessed by any small number of market participants alone, as laid out by Bernanke and Woodford (1997). Assuming markets are efficient – as is very likely to be the case for well-developed US and European asset markets – new and relevant information about the state of the economy should quickly translate into asset prices. Chen, Roll and Ross (1986), for example, find that industrial production and inflation news are priced for a cross-section of US stock returns. Relatedly, since financial markets provide continuously and immediately available data (at low cost), asset price changes may reveal shifts in underlying state variables quite rapidly. Other approaches relying on low(er) frequency data may find it more difficult to be very timely in detecting reversals. Besides, people may reveal their beliefs quite truthfully, as they have money at risk in asset markets, eg, asset prices affect their wealth or because fundamentals may create expectations of rising dividends or capital gains.

In this respect, the dynamic Gordon model, as proposed by, among others, Campbell (1991) and Campbell and Ammer (1993), may be a good way of adding asset prices to the information set of policymakers and investors. It is an atheoretical approximation to a dynamic accounting identity which holds that the current level of asset prices is related to the discounted value of future returns and dividends. It allows for a decomposition of innovations in excess stock and bond returns into constituent news factors. In this study, some generalizations of previous research are proposed. First, inflation enters *explicitly* in the stock and bond return decomposition. Second, more attention is given to different horizons over which expectations of factors are formed. Third, the issues are examined not only for the US but also for the Euro-Zone. For the US, a standard financial data set is used, while for the Euro-Zone, aggregate financial and macroeconomic data have been carefully constructed, specifically for this study, going back to the start

[1] Most ambitiously, the Fed or ECB could also add this information to its portfolio of data about the economic outlook. The idea being that extracting information about inflation and growth from asset prices is appropriate in the sense that it represents new, non-standard information by which a more accurate interest rate policy is facilitated. It is well known that the information value of traditional indicators may change over time or even completely fade away. Therefore, regularly adding new sources of information reduces the probability of making wrong decisions, ie, based on too few or non-informative indicators.

of the European Monetary System (EMS) in 1979. Throughout the text, the EU results are compared with US evidence which is available over a longer time span. Some apparent differences are emphasized. In addition, data are monthly, so as to take most advantage of the use of financial market data.[2] Previous studies were mostly concerned with quarterly or annual data. After having derived and estimated the importance of the stock and bond factors, in line with Campbell and Mei (1993), their sensitivity to policy variables (such as money growth and discount rates) and asset pricing factors is assessed, and correlations with actual movements of fundamentals (inflation, growth and interest rates) are estimated.

To anticipate the results, we find that US and European stock return volatility is mostly due to volatility in future excess return news and, apart from that, inflation news volatility is also quite a significant factor. With respect to the bond market, in the US, current bond return news is a dominating factor while in the EU, innovations in future bond factors are much larger than current excess bond return news. There is also some support for the claim that declines in discount rates account for an unexpectedly high US equity premium over the period 1950–1999. With respect to policy and fundamentals, expectations of excess stock and bond returns and constituent factors, respectively, change significantly, both in the US and EU, in response to discount rate and Fed Funds rate changes but not to money growth. As for fundamentals, changes in the outlook for inflation, unemployment and the leading indicator entail strong revisions in excess stock returns and stock factor expectations. As for bond market betas, the role and importance of fundamentals for Europe and the US is more dissimilar.

The remainder of the paper is organised as follows. Section 2 contains some references to empirical and theoretical literature on the information content of asset prices for inflation, growth and other fundamentals. In section 3, the approach of this study is explained. Section 4 presents the data and the results. The final section contains conclusions and policy implications.

2 Background

In empirical studies, asset market data (mostly stock and bond returns, term and default spreads) have been shown to contribute significantly to predicting future economic growth and inflation, both in the US and internationally, see, eg, Fama (1984a–b, 1990a–b), Jorion and Mishkin (1991), Estrella and Hardouvelis (1991), Davis and Fagan (1997). In related work, Lamont (2000) shows that economic tracking portfolios (ie, portfolios of base assets with returns that mimic an aggregate economic variable) are useful to forecast macroeconomic variables. It also serves to raise the sensitivity of asset prices to news about future economic variables.

On the theoretical level, there are several ways in which to establish a relationship between asset prices and the macroeconomy. First, Fisher equation models imply that inflation and inflation risk can be derived from equity and bond returns – assuming that the real rate of return shows little variation. See, eg, Fama

[2] Going to even higher frequency – weekly or daily data – would require an interpolation of economic aggregates, such as inflation and economic/dividend growth, and some other relevant macroeconomic instrumental variables, as in Lamont (2000). In this paper, however, we do not follow this line of research.

(1990b), Mishkin (1992), Boudoukh, Richardson and Whitelaw (1994) for empirical evidence.

Second, several versions of the capital asset pricing model (CAPM) have been developed to find relationships with macroeconomic variables. Merton (1973) has elaborated the Intertemporal CAPM in which state variables track changes in the investment opportunity set. However, virtually any series can qualify as a state variable, a feature that makes empirical testing rather difficult. Lucas (1978) and Breeden (1979) have set up the Consumption CAPM in which consumption risk affects the pricing of equities. See, eg, Breeden, Gibbons and Litzenberger (1989), Kandel and Stambaugh (1991), for empirical applications. In the Production CAPM, Cochrane (1991) relates stock returns to future economic activity. Ferson (1995) reviews these theories and assesses the empirical evidence. See Campbell (1999) for an international survey of stylised facts.

Third, static and dynamic Gordon models connect stock prices to the dividend yield, discount rate and growth. Shiller (1981) used the dividend discount model to evaluate whether stock prices are excessively volatile. He calculates the rational stock price back over time as reflecting changes in dividends. The approach was extended later on, as in Shiller and Beltratti (1993), to include discount rate changes. Blanchard (1993) shows that over time, the equity premium, generated by the (static) Gordon model, and inflation move together. Using a dynamic Gordon model, Campbell and Ammer (1993) decompose stock and bond return innovations into measurable components. They find that, for the US, stock and bond return innovations are driven largely by news about future excess stock returns and inflation, respectively.

3 The approach in this study

3.1 The model

This section contains a brief review of the dynamic Gordon model decompositions for stock and bond returns. Ways to explicitly incorporate an inflation component are proposed. Next, the way of analysing comovements of stocks, bonds and their components, with fundamental factors is described. The section ends with some remarks on estimation.

3.1.1 Decomposition of stock return innovations

Campbell (1991) defines the one-period log real holding return on stocks as $h'_{t+1} \equiv \log(P'_{t+1} + D'_{t+1}) - \log(P'_t)$, where P'_t is the real stock price at the end of period t (ex dividend), and D'_{t+1} is the real dividend paid during period t. The right-hand side of this identity can be loglinearized using a first-order Taylor expansion, as

$$h'_{t+1} \approx k + \rho p'_{t+1} + (1-\rho) d'_{t+1} - p'_t \qquad (3.1)$$

where lowercase letters are used for logs, ρ and k are parameters of linearisation, primes indicating that variables are inflation-adjusted (ie, expressed in real terms). The equation can be rewritten as an expectational difference equation, ruling out rational bubbles (ie, $\lim_{j\to\infty}\rho^j p'_{t+j} = 0$), which would cause the log real stock price to explode. Finally, this gives a decomposition of the unexpected real stock return or real stock return innovations, as

$$h'_{t+1} - E_t h'_{t+1} = (E_{t+1} - E_t)\left\{\sum_{j=0}^{\infty}\rho^j \Delta d'_{t+1+j} - \sum_{j=1}^{\infty}\rho^j h'_{t+1+j}\right\}$$

or (3.2)

$$\varepsilon_{h',t+1} = \eta_{d',t+1} - \eta_{h',t+1}$$

The second equality in (3.2) introduces simpler notation for the components of the unexpected real stock return $\varepsilon_{h',t+1}$. The variables $\eta_{d',t+1}$ and $\eta_{h',t+1}$ denote revisions in expectations or news about future real dividend growth and future real returns, respectively.

Inflation can enter this expression in two ways. First, using nominal instead of real variables in the right-hand side of (3.1), gives

$$\begin{aligned} h'_{t+1} &\approx k + \rho(p_{t+1} - q_{t+1}) + (1-\rho)(d_{t+1} - q_{t+1}) - (p_t - q_t) \\ &\equiv k + \rho p_{t+1} + (1-\rho)d_{t+1} - p_t - \pi_{t+1} \end{aligned} \tag{3.1b}$$

with d and p refering to nominal dividends and stock prices, respectively, q and π denoting the log price level and inflation, respectively.

This causes equation (3.2) to change to

$$h'_{t+1} - E_t h'_{t+1} = (E_{t+1} - E_t)\left\{\sum_{j=0}^{\infty}\rho^j \Delta d_{t+1+j} - \sum_{j=0}^{\infty}\rho^j \pi_{t+1+j} - \sum_{j=1}^{\infty}\rho^j h'_{t+1+j}\right\}$$

or (3.2b)

$$\varepsilon_{h',t+1} = \eta_{d,t+1} - \eta_{\pi,t+1} - \eta_{h',t+1}$$

The second equality in (3.2b) uses similar short notation as in (3.2). In addition, the variable $\eta_{\pi,t+1}$ represents expectational revisions or news about future inflation and $\eta_{d,t+1}$ (without prime) refers to news about future nominal dividend growth.

Second, instead of working with stock returns as such, one can express (3.1) in terms of excess stock returns, or equity premium, defined as $e_{t+1} \equiv h_{t+1} - \pi_{t+1} - r_{t+1}$, with h referring to the nominal stock return, r_{t+1} the log 1-period real interest rate from t to t+1 and π_{t+1} inflation from t to t+1. This leads to equation (3.2c) with inflation and real rate news as additional factors in the decomposition of excess stock return (equity premium) innovations,

$$e_{t+1} - E_t e_{t+1} = (E_{t+1} - E_t)\left\{\sum_{j=0}^{\infty}\rho^j \Delta d_{t+1+j} - \sum_{j=0}^{\infty}\rho^j \pi_{t+1+j} - \sum_{j=0}^{\infty}\rho^j r_{t+1+j} - \sum_{j=1}^{\infty}\rho^j e_{t+1+j}\right\}$$

or (3.2c)

$$\varepsilon_{e,t+1} = \eta_{d,t+1} - \eta_{\pi,t+1} - \eta_{r,t+1} - \eta_{e,t+1}$$

with Δd referring to nominal dividend growth, $\eta_{d,t+1}$, $\eta_{\pi,t+1}$, $\eta_{r,t+1}$ and $\eta_{e,t+1}$ denoting revisions in expectations (or news) about future *nominal* dividend growth, inflation, real rates and future excess returns (or future equity premium), respectively.

It may be of separate interest to break down the infinite horizon news factors into specific subhorizon factors since this allows for an even more detailed analysis. In the empirical work below, results of a breakdown into ultra-short, short, medium, and long term subhorizon factors are included.

3.1.2 Decomposition of bond return innovations

Campbell, Lo and MacKinlay (1997) contains a similar decomposition for the one-period log nominal coupon bond return, by replacing dividends with coupon payments in (3.1). This yields

$$r_{c,n,t+1} \approx k + \rho p_{c,n-1,t+1} + (1-\rho)c - p_{c,n,t} \tag{3.3}$$

where ρ and k are parameters of linearisation, different from those for stocks, c denotes the (fixed) log nominal coupon payment, $r_{c,n,t+1}$ measures the one-period log nominal coupon bond return, $p_{c,n,t}$ stands for the nominal bond price at the end of period t for n time periods to maturity. Transforming (3.3) like the analogous stock return expression (3.1), one obtains the decomposition of bond return innovations as the sum of revisions in expectations of future returns, up to maturity.

$$r_{c,n,t+1} - E_t r_{c,n,t+1} = -(E_{t+1} - E_t)\sum_{j=1}^{n-1} \rho^j r_{c,n-j,t+1+j} \tag{3.4}$$

Campbell and Ammer (1993) used a similar expression for zero-coupon bonds, and transformed them into excess returns. For the case of coupon bonds, define the excess coupon bond return (or term premium) as $x_{c,n,t+1} \equiv r_{c,n,t+1} - \pi_{t+1} - r_{t+1}$, such that

$$x_{c,n,t+1} - E_t x_{c,n,t+1} = -(E_{t+1} - E_t)\left\{\sum_{j=0}^{n-1} \rho^j \pi_{t+1+j} + \sum_{j=0}^{n-1} \rho^j r_{r+1+j} + \sum_{j=1}^{n-1} \rho^j x_{c,n-j,t+1+j}\right\}$$

or (3.5)

$$\varepsilon_{x,t+1} = -\eta_{\pi,t+1} - \eta_{r,t+1} - \eta_{x,t+1}$$

where r_{t+1} and π_{t+1} denote the 1-period log real interest rate and inflation rate from t to t+1, as before. The short notation is similar to the one used in 3.1.1. Current excess bond return (or term premium) innovations are minus the sum of expectational revisions of future inflation, real rate and future excess bond return (or future term premium) factors. Again, in the empirical work below, results are also split up into subhorizons.

3.1.3 Comovements with fundamental factors

Suppose there are K fundamental factors affecting stock and bond returns, as can be derived from a K-factor model, as, eg, in Litterman and Scheinkman (1991) or Chen, Roll and Ross (1986). Following Campbell and Mei (1993), one can then estimate the sensitivity or the beta of stock and bond return innovations to the K factor-innovations, f_k, and these betas can be broken down into their constituent news components. In general, the unconditional[3] beta of, eg, excess stock return innovations to factor k-innovations, f_k, is defined as

$$\begin{aligned}\beta_{\varepsilon_e,f_k} &\equiv \frac{\mathrm{Cov}(\varepsilon_e,f_k)}{\mathrm{Var}(f_k)}\\ &= \frac{\{\mathrm{Cov}(\eta_d,f_k)-\mathrm{Cov}(\eta_\pi,f_k)-\mathrm{Cov}(\eta_r,f_k)-\mathrm{Cov}(\eta_e,f_k)\}}{\mathrm{Var}(f_k)}\\ &= \beta_{\eta_d,f_k}-\beta_{\eta_\pi,f_k}-\beta_{\eta_r,f_k}-\beta_{\eta_e,f_k}\end{aligned} \tag{3.6}$$

This decomposition may be of separate interest if one were to analyse the comovement of stock and bond returns with unanticipated events, such as shocks to aggregate consumption, oil prices, the spread between long and short rates, or between high and low-grade bonds, or changes in expected inflation, which are the forces analysed in Chen, Roll and Ross (1986). The beta-analysis reveals not only the overall sensitivity, but also whether and by how much specific components of asset prices are sensitive to some unanticipated events, and possibly what horizon of each factor is most exposed to such events.

3.1.4 Construction and estimation of news variables

How should the news variables and the revisions of expectations of future fundamentals be generated? Following earlier work by Campbell and Shiller (1988), and Hodrick (1992), among others, vector autoregression (VAR) is used to calculate empirical proxies for expectations of future fundamentals. It is postulated that expectations of returns are linear in a vector of appropriately chosen state variables. Consider a vector of state variables with L elements, x_{t+1}, that follows an autoregressive process

$$x_{t+1} = Ax_t + v_{t+1} \tag{3.7}$$

where A is the companion matrix of the VAR system, v_{t+1} is a white noise term. The optimal forecast at time t of x_{t+1} is Ax_t, and the optimal forecast of x_{t+n} is $A^n x_t$. Likewise, the optimal forecast at time t+1 of x_{t+1} is Ax_t+v_{t+1}, and the optimal forecast of x_{t+n} is $A^n x_t + A^{n-1}v_{t+1}$. Hence, in general, the revision in expectations about the value of x_{t+n} can be written as $(E_{t+1}-E_t)x_{t+n} \equiv A^{n-1}v_{t+1}$. The model (3.7)

[3] One could equally construct conditional betas if all the elements of the variance-covariance matrix were time-varying and conditional on some information set.

therefore implies that the revision at time t+1 of the discounted multiperiod forecast of the state vector x, in the case of a finite horizon is

$$
\begin{aligned}
(E_{t+1} - E_t)\sum_{j=0}^{n-1}\rho^j x_{t+1+j} &= \left(I + \rho A + \rho^2 A^2 + \ldots + \rho^{n-1}A^{n-1}\right)v_{t+1} \\
&= \left(1 - \rho^n A^n\right)(I - \rho A)^{-1} v_{t+1}
\end{aligned}
\tag{3.8a}
$$

or, in case of an infinite horizon,

$$
(E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j x_{t+1+j} = (I - \rho A)^{-1} v_{t+1} \tag{3.8b}
$$

Individual elements in (3.7) and (3.8a–b) can be identified by defining an L-element column vector l_j whose j–th element is one and whose other elements are all zero. This vector picks the j–th element out of the state vector. For example, if excess return is the first element of the state vector, inflation second and nominal interest rate third, this implies that the components of excess return news in (3.2c) can be written as follows:

$$
\begin{aligned}
\varepsilon_{e,t+1} &= l'_1\, v_{t+1} \\
\eta_{d,t+1} &= \varepsilon_{e,t+1} + (l'_2 + l'_3 + l'_1 \rho A)(I - \rho A)^{-1} v_{t+1} \\
\eta_{\pi,t+1} &= l'_2\, (I - \rho A)^{-1} v_{t+1} \\
\eta_{r,t+1} &= (l'_3 - i'_2)(I - \rho A)^{-1} v_{t+1} \\
\eta_{e,t+1} &= l'_1\, \rho A (I - \rho A)^{-1} v_{t+1}
\end{aligned}
\tag{3.9}
$$

Innovations in fundamental factors[4] are determined by innovations v_{t+1} to the economic state variables, by the scalar ρ, and by the VAR matrix A. The asset decompositions in 3.1.1 and 3.1.2 are calculated in this way.

Estimation of the parameters is generally performed by generalised method of moments, since the VAR coefficients and the elements of the variance-covariance matrix of VAR innovations are estimated jointly. GMM is prefered over standard OLS since it produces a heteroskedasticity-consistent variance-covariance matrix for the complete set of parameters. To compute standard errors of betas in 3.1.3 or of a statistic such as the variance of inflation news relative to excess stock return innovations, the delta method is used (see Campbell, Lo and MacKinlay, 1997, p. 540).

[4] Note that the dividend factor innovations in (3.9) are taken to be the residual in this so-called "full accounting" decomposition. They can also be determined directly under a partial accounting framework, if one adds a dividend growth series to the state vector. However, due to the discrete nature of dividend payouts, this is generally not done. See, eg, Campbell and Ammer (1993) for this rationale. The latter approach did not reveal substantial differences though, hence only results for the full accounting approach are reported (partial accounting results are available on request).

4 Empirical results

4.1 Data

For the US, a standard data set is used, consisting of S&P 500 total return and dividend growth, bond return (10-year bonds), Treasury bill return (90 days), CPI inflation and a number of instrumental variables, viz, the S&P 500 dividend yield, a long-term yield spread (10-year minus 3-month), a short-term yield spread (1-year minus 3-month), a bond default spread (Moody's Baa minus Aaa rate), and a commercial paper spread (commercial paper rate minus T-bill rate). Data are extracted from BIS, Federal Reserve of St. Louis Economic Database (FRED), and Global Financial Data. The sample is monthly, 1954:6–2000:12. For the VAR estimation, four lags were chosen since this described the data most parsimoniously (based on likelihood ratio tests and several information criteria). Estimation was also performed over several subsamples, with results broadly in line with those reported for the full sample.

For the Euro-Zone, data for the 11 EMU member countries[5,6] were used to construct aggregates out of the respective country variables. Previous studies were concerned with country level data only (related studies are Black and Fraser, 1999, for UK, US, Japan, Germany and Australia, Cuthbertson et al., 1997, for UK, Shiller and Beltratti, 1993, for UK and US). Interestingly, the creation of EMU has stimulated research into Euro-Zone issues necessitating the use of composite EU fundamentals (as, for example, in studies on EU-wide money demand, growth or inflation). This paper is the first attempt to apply the Campbell-Ammer asset decomposition to Euro-Zone stock and bond data. As for the aggregation, the approach of Beyer, Doornik and Hendry (2001) was followed, using variable GDP weights (all converted in DEM). Similar to the portfolio formation principle in Fama and French (1992), nominal[7] annual GDP weights of year t are applied to year t+1 country variables (log growth rates, actually; except for interest rates which are already percentages) to obtain the EU aggregate growth rate, which was used to reconstruct the Euro-Zone level or index (in fact, this is a chain-weighting procedure). As for stock returns and dividend growth, the Morgan Stanley Capital International (MSCI) indices were used because of the consistency in the definition and construction of their stock market indices across countries.[8] Bond yields and money market rates were taken from IFS (line 61 and 60b, respectively), and were transformed into effective 1-

[5] Note that although Greece entered EMU as 12th member country in January 2001 it was not included, since the study ends 2000:12. It would not materially affect the results in any case as Greece has a small weight in the EMU aggregates.

[6] Many statistics were lacking for Luxemburg. This was handled by treating Belgium and Luxemburg as one entity (quite naturally, since they have many common statistics under the BLEU, the Belgium-Luxemburg Economic Union).

[7] Beyer, Doornik and Hendry (2001) use real GDP weights but do not object to the use of nominal GDP weights. Given data availability and risks of deflators being defined differently across the EU-11, nominal GDP weights are used in this study.

[8] Note that MSCI publishes EMU-wide stock index statistics since 1987 using market capitalisation weights, which is theoretically the most appealing weighting scheme for these data. Nevertheless, the correlations with our series (levels as well as first differences) is 0.999, mean and standard deviations are almost equal, rendering differences between the alternative weighting schemes negligible.

month returns. As for instruments, different indicators vis-à-vis the US instruments were chosen, mainly because of lack of data but also because of the longstanding interest in these variables. The instruments include EU-11 MSCI dividend yield, a long-term yield spread (10-year minus 3-month), and the Italy-Germany bond spread and money market spread (proxying for default spreads and cyclical uncertainty). The latter two have been scrutinized by market participants in search of arbitrage profits due to the convergence play within the EMS (see, eg, Knot, Klaas and Sturm, 1999). The sample is monthly, 1979:1–2000:12, coinciding with the start of the EMS and the Exchange Rate Mechanism (ERM). The most parsimonious VAR had lag length two.

Instruments are used so as to get the best possible (conditional) expectations of returns and inflation, needed in a second stage to calculate the constituent stock and bond factors. In some sense, market participants may have different expectations because they can rely on a wider data set. Here, one is more limited, using an econometrician's data set and a formal VAR expectations formation principle.[9] Also note that apart from the inflation series, only financial data are used since these have been documented to contain significant business cycle characteristics, justifying the exclusion of the real (macroeconomic) series they are proxying and which ought to be reflected in stocks and bonds, see, eg, Fama and French (1993), Estrella and Hardouvelis (1991), and section 2.

4.2 Results

Below, the main results are summarised. First, a variance decomposition of excess returns is presented. Next, the correlations between constitutent stock and bond factors are analysed. Third, the sensitivity to fundamental and policy variables is reported. Along the way, some comments are made with respect to the expectations theory of interest rates and the Fisher effect. Tables and Figures can be found in the Appendix.

4.2.1 Stock and bond return variance decompositions

In this section, the question of what moves the US and European stock and bond market is addressed. Decompositions of (unconditional) variance, resulting from equation (3.2c) and (3.5), are reported in Tables 1 and 2. For example, equation (3.2c) implies

$$\begin{aligned}\mathrm{var}(\varepsilon_e) = {} & \mathrm{var}(\eta_d) + \mathrm{var}(\eta_\pi) + \mathrm{var}(\eta_r) + \mathrm{var}(\eta_e) - 2\,\mathrm{cov}(\eta_d,\eta_\pi) - 2\,\mathrm{cov}(\eta_d,\eta_r) \\ & - 2\,\mathrm{cov}(\eta_d,\eta_e) + 2\,\mathrm{cov}(\eta_\pi,\eta_r) + 2\,\mathrm{cov}(\eta_\pi,\eta_e) + 2\,\mathrm{cov}(\eta_r,\eta_e)\end{aligned} \tag{4.1}$$

[9] Overall, the explanatory power of the different VAR-equations for US and Europe is satisfactory (generally, the R^2 is higher than 0.70 or 0.80 and many coefficients are statistically significant). Therefore the VAR supports a filtering of expectations from the data. Only the stock return equations have a poor fit (adjusted R^2 of only 0.04 and only a few coefficients being statistically significant) in line with existing research and consistent with the efficient market hypothesis, suggesting that changes in stock prices are already expectational innovations by themselves.

As such, a number like var(η_d) tells us what the variance of stock returns would be if if the dividend growth process remained unchanged and other factors became constant (Campbell and Ammer, 1993, p.10). Tables 1 and 2 give an idea of the impact of the different components' variances and covariances for the full horizon and subperiods relative to the variance of 1-period stock and bond return innovations, var(ε_e) and var(ε_x), for US and EU, such that numbers add up to one. The top panel of Table 1 provides the nominal rate and excess return factor variance-covariances. The lower panel reports dividend growth factor variance-covariances for the full accounting approach (dividends were handled as the residual in this decomposition; see footnote 4). Table 2 reports the excess bond return factor variance-covariances in a similar fashion.

One can see from Table 1 that, overall, in the US, most volatility of stock return innovations is due to volatility of future excess return news (ie, future equity premium news), while the variance of news about the dividend growth and discount rate is contributing much less, in line with Campbell and Ammer (1993) who use the CRSP stock market index. However, here, the covariance between future excess returns and dividend growth is as important as the variance of news about future excess returns, with an opposite sign. Another difference with Campbell-Ammer is that US numbers are not fractions; they exceed one, although the estimates are very imprecise. Interestingly, when inspecting the different horizons, one can observe that the variations of dividend growth and future return news are almost equally important contributors to current stock news variations, while their covariance is about double the size, with a negative sign (however, the estimation is imprecise). This suggests that depending on the perspective (infinite versus finite horizon), one can arrive at different conclusions with respect to the role and importance of dividend news. For example, Kothari and Shanken (1992) find that current and future dividend growth can explain half the variance of (annual) stock returns. Furthermore, with respect to inflation news volatility, this plays quite a sizeable role in relative terms, as reflected in the contribution to the respective variance-covariances. The real rate volatility generally has a less influential role in explaining stock volatility. Finally, note that the largest impact derives from the long term factor, mostly over 75 per cent, although these estimates are imprecise and may be slightly influenced by the full accounting convention[10] (see also footnote 4) and covariances between the horizons (not reported).

For Europe, the stock return decomposition gives slightly different results. First, the estimates are all much more precise. Second, numbers are fractions of current return innovations, suggesting that the stock market moves more than justified by innovations in any of the future fundamentals individually, contrary to the US. Third, note that variations of dividend growth news are as large as variations of future return news, and even more so at the long term (0.556 versus 0.125). The inflation-related news variance is larger than the real rate-related news variance, even more so than for the US. Finally, in many cases, the medium term impact is largest (in absolute value), whereas in the US, it is the long term.

As for the bond market, Table 2, there is a stronger difference between US and EU with respect to magnitude compared to Table 1. Variance-covariances are now below unity for the US, but large multiples in the EU; between 6 and 20

[10] Using the partial accounting framework, the variation of dividend news is smaller in size, between one-half and one-sixth (total impact versus subhorizons), but the dividend-excess return covariance news remains as important.

times as volatile as for the US[11] (take the square root of 35.9/0.09 and 31.2/0.68, for example). In Table 1, numbers were higher but at most about double for the US versus Europe. This reflects the fact that in the US, current bond return news is a dominating factor – in size and volatility – compared to new information about future bond innovations. In the EU, innovations in future bond factors are much larger than current excess bond return news; future volatility in terms of standard deviation is about 5.5 times (square root of 31.2) the current news volatility. In total, in the US, volatility of future excess bond returns is the largest contributing factor. In the EU, the contribution is shared between the various variance-covariance components. Again, the inflation news factor tends to be important in relative (percentage) terms. In the EU, most of the impact is clearly due to short and medium term variance-covariances, whereas in the US, the picture is less clear. However, as can be seen, there must also be non-negligible covariances between different horizons, in addition to those reported, to sum up to the total impact column.

In addition, Table 3 expresses the relative importance of the individual stock and bond factors, respectively, in terms of a regression with current stock and bond innovations as a dependent variable. The overall impression is that US and European regressions are equally (un)satisfactory; R^2 is about the same for both. As for the stock market, in the US, most explanatory power of a single total factor is due to future excess returns (R^2 of 0.52), in line with the results from Table 1. In the EU, the inflation factor is the single most important factor (R^2 of 0.38). This remains more or less so when looking at the different subhorizons. The second column reports the R^2 of a regression where all horizons of each factor are entered separately, allowing for different effects of, eg, short term versus long term changes in expectations on contemporary stock news. It can be seen that the response of stock return news to revisions in expectations is different for each horizon; the R^2 is always larger for the multiple regression than for the univariate, total factor regression. This is most clearly the case for dividend growth news; the total factor explains only 0.005 of the variation of excess stock return news, while entering the individual horizons of the dividend factor jointly gives an R^2 of 0.712 for the US. This suggests that a careful decomposition of horizons may matter when accounting for the impact of factors that move the stock market. Clearly, not all horizons are equally important in explaining the stock market movements. In the US, most important are medium and long term horizons, whereas in the EU, short and medium term horizons are equally more important for inflation and real rate factors. This may reflect some short-termism in Europe vis-à-vis the US, in line with Cuthbertson, Hayes and Nitzsche (1997) for the UK and Black and Fraser (2000) for the US, studying dividend-price ratios.

As for bonds, the results in Table 3 indicate that future excess bond return innovations track most of the current bond market movements, both in the US and the EU. In general, the US bond market is more predictable than the EU market as evidenced by the higher R^2 for the US than for EU regressions. This may be due to the frequent crises that have hit the EMS since its existence (see, eg, Knot, Klaas and Sturm, 1999). Consistent with Table 2, US future excess bond return innovations explain (almost) all variation of current changes (R^2 of almost 1.00 for joint and long term factor). The inflation component seems to carry moderate

[11] The quality of the EU bond data may not be as good as the US data, since returns had to be approximated using a bond yield transformation, as in Campbell, Lo and MacKinlay (1997, Chapter 10, p. 408).

information with respect to bond market movements (R^2 of 0.34 in the US). This contrasts with Campbell-Ammer who attribute most variation in bond returns to news about future inflation. For the EU, the inflation-related information of bond return news seems to break down once subhorizons are examined (R^2 less then 0.10) but on aggregate, entering horizons in a joint regression, it does a better job (R^2 of 0.22). Since this is also the case for the other factors in Europe, it seems to suggest that changes in current bond returns are very small and rather invariant, as mentioned in the comments to Table 2. As already discussed, the decomposition of news factors into different subhorizons is highly informative. It clearly shows that asset market movements in response to fundamental factors depend on the time horizon one has in mind (see also Cuthbertson, Hayes and Nitzsche 1997).

4.2.2 Stock and bond factor correlations

Two sets of correlations are reported: correlations between the constituent stock and bond factors, and between different horizons per factor.

Table 4 reports correlations between stock return factors. Since the factor decomposition, equation (3.2c), allows a breakdown for different horizons, it is possible to analyse factor correlations, not only for the full period, but also for different horizons. The first line shows the correlation between the real rate and inflation factor innovations, and is related to tests of the Fisher effect (for stocks; normally it is tested for bonds).[12] The evidence is in line with Mishkin (1992) in that there is no support for a short-run Fisher effect, while a long-run Fisher effect is not rejected. The correlation between inflation and real rates, for US and EU, respectively, is –0.969 and –0.956 in the ultra-short term, but it becomes non-significant in the long run, –0.833 (standard deviation 0.576) and –0.061 (standard deviation 1.123).

Furthermore, it is interesting to note that inflation innovations are negatively correlated with the equity premium (ie, excess return) innovations in the short run, but moving in line in the long run, as in Blanchard (1993). In the US, inflation innovations are positively associated with (nominal) dividend growth overall, but this hides opposing forces over different horizons (negative association in the short run, positive association in the long run). In the EU, the comovement between inflation news and (nominal) dividend growth is slightly negative overall, again making up for different associations over different subhorizons.

Next, note that real rate innovations are significantly negatively correlated with equity premium innovations overall, but positively over very short periods. This conforms with Fama and French (2000) who, using a static Gordon model, find that declines in discount rates account for an unexpectedly high equity premium over the period 1950–1999, for the US. Related, the results show that

[12] The Fisher effect holds that expected inflation is fully reflected in the nominal interest rate (or stock return, respectively), while the real rate (real stock return) remains constant. An inverted Fisher effect expresses the idea that the nominal interest rate (stock return) remains constant while the real rate (real stock return) is negatively correlated with inflation. The Mundell-Tobin effect says that nominal interest rates (stock returns) may rise less than one-for-one with expected inflation and hence, that inflation drives real interest rates (real returns) down. The idea being that inflation acts as a tax on money balances. In response to this implicit tax, the public economizes on its holdings of money balances, and substitutes for earning assets, which drives the real rate down (cf. Woodward 1992, p. 316).

dividend growth innovations add to higher equity premiums (significantly over very short to medium term horizons).

Table 5 gives the correlation structure of bond return factors, analogous to Table 4. The correlations also support the view in Mishkin (1992) on the distinction between short versus long run Fisher effects, as mentioned above; the short term correlation is –0.971 and –0.959 (standard deviation 0.003) while the long term correlation is –0.15 (standard deviation 0.80) and –0.07 (standard deviation 0.49), for US and Europe, respectively. Bond factor inflation innovations tend to drive down future excess bond returns, in line with Campbell-Ammer (p. 24), who argue that "when investors learn that inflation will be higher than expected, they also tend to learn that excess bond returns are lower than they expected". Correlation between bond real rate innovations and excess returns is generally low.

Table 6 displays the forward term structure of correlations, over different horizons, for each stock and bond news factor. The first four columns report the stock news factors forward correlations. Overall, these correlations tend to be positive and larger between adjacent horizons compared to those between more distant horizons. Only with respect to dividend growth, different horizons tend to have negative correlations, especially those with long term growth innovations. This can be rationalised by recognising that dividend policy is one of the main firm financial decision variables. Given the fact that there are cyclical swings in profitability, negative correlations indicate some form of mean reversion in dividend growth, ie, higher than expected dividend growth in the short run will cancel out in the long run. It also conforms to Table 3 where the regression R^2 is low overall, but high for joint horizons of dividend growth news. The evidence is broadly similar across the US and EU, although statistical significance is better for the EU results.

The last three columns of Table 6 show the bond news factors forward term structure of correlations. Interestingly, the EU results (and to some extent, also the US results) tell a nice story about the real term structure of interest rates. As can be seen, the ultra short term news is not closely correlated with any other horizon, whereas other horizons of real rate innovations have correlations larger than 0.85. This seems to indicate that the very short term largely moves independently, and may be heavily influenced by monetary policy and liquidity shocks (see, eg, Hamilton, 1997, and Dow, 1995). Changes in expectations about medium and long term real rates seem to move more in a parallel way, presumably because in the long run, fundamentals and time preferences matter more. This is consistent with earlier findings of Litterman and Scheinkman (1991); the short rate moves independently, and a spread and volatility factor are needed to capture the behaviour of long rates. Also note that factor correlations are higher between adjacent horizons, consistent with the stock factor forward correlations results.

4.2.3 Stocks, bonds, fundamentals and policy variables

Table 7 and 8 contain beta decompositions, as outlined in section 3.1.3, of policy and macroeconomic variables with stock and bond factors, for the US and EU, respectively. As can be seen, except for EU stocks, expectations of excess stock and bond returns change significantly in response to discount rate and Fed Funds rate changes (ARIMA innovations) with overall discount rate betas of –1.51 and

–2.01 for US, and –0.85 and –0.07 for EU stocks and bonds. The results imply, for example, that an unexpected decrease of the official US interest rate by 1 per cent is associated with a 1.51 per cent upward revision of the current stock return. On the other hand, revisions in expectations of excess returns on stocks and bonds seem not to be sensitive to money growth innovations.[13,14] Hence, as far as monetary policy is concerned, policy transmission seems to work primarily through interest rate policy, rather than through money growth targeting. One can get more detail as to the channels through which monetary policy news affects stock and bond prices by inspecting the constituent stock and bond factors. Both for stocks and bonds, the largest impact derives from the future excess return innovations. For stocks, the dividend news innovation also has a large and significant effect on the overall beta. Tables 7 and 8 imply that an unexpected interest rate cut positively affects current stock returns through increased dividend growth and lower inflation and real rates expectations, outweighing the impact of increased future excess return innovations. For the bond markets, there is a difference between US and EU. In the US, an interest rate cut affects current bond market returns positively, through the combined positive impact of reduced inflation and lower future excess returns. In Europe, the overall effect is rather small; there is a negative effect through increased future bond return expectations which is offset by the positive effect from reduced future inflation and real rate expectations.

As for fundamentals, changes in the outlook for inflation, several indicators of real activity and Fama-French HML[15] (high-minus-low portfolio returns) entail significant revisions in excess stock returns. Basically, signs are in line with basic intuition and with existing evidence.[16] Typically, these exposures are larger in Europe than in the US, but significance levels are higher in the US than in Europe. For example, in the US, the stock (bond) inflation beta implies a 1 per cent (79 points) downward revision of current excess stock (bond) returns when inflation rises by 1 per cent, due to the large positive inflation exposure and the lower negative real rate exposure. In Europe, the sensitivity of stocks to inflation is more negative (although statistically not significant), because of the negative impact on cash flows and future inflation news, prevailing over the positive impact of declining future real rates and future excess returns. Furthermore, US stock and bond markets seem to react positively to bad unemployment news, consistent with recent findings of Boyd, Jagannathan and Hu (2001), the reason being that higher

[13] There may be some simultaneity bias due to the liquidity effect of money on interest rates (if money growth increases, interest rates will tend to go down). Nevertheless, the results point out that the interest rate effect is strongest and most significant for stock and bond return innovations.

[14] In Europe, though, there is a significant negative (positive) exposure of the bond inflation (real rate) factor to shocks in money growth. It may be rationalised (1) by accepting that money demand rather than money supply shocks are a dominant factor of money growth innovations, (2) by the literature on the instability of money demand or (3) by the missing money hypothesis. See, eg, Duca (2000), Wesche (1997), Arnold (1997), and Fase (1994) for evidence in favour of these claims.

[15] In Europe, the HML factor is proxied by the MSCI value-growth portfolio return spread, which was constructed from country-level data. For the SMB factor, a European counterpart is not readily available, unfortunately.

[16] In Europe, the negative (positive) sign on the stock inflation beta for the leading indicator (unemployment) is somewhat hard to rationalise. One might argue that monetary policy has been succesful such that higher than expected growth of the leading indicator (lower unemployments) has not been translated into an increase of inflation risk, although this is a highly speculative assumption.

than expected unemployment is associated with reduced inflation and real rate expectations; the former in line with the traditional Phillips curve, the latter possibly due to Fed policy. In addition, future stock dividends appear to be stronger (together outweighing the negative impact of future excess stock returns), and for bonds, future excess returns appear to be weaker, boosting current excess returns. For Europe, no such pattern can be detected.

At the same time, in the US, as Table 7 shows, there is a significant comovement between excess stock return news and innovations in the HML and SMB factors, consistent with Fama and French (1993). The main effect seems to be due to the future excess return beta. Almost the same overall exposure to HML is found for EU (–0.31 versus –0.38 for US), but no single factor seems significant.

Finally, oil price and exchange rate movements seem not to affect US markets very significantly. In Europe, on the other hand, as Table 8 reveals, when the oil price increases unexpectedly (either in dollar terms or in euro), stocks and bonds go down. This due is to the negative effects of higher inflation and lower dividend growth, versus the positive effects of lower real rate and decreased future return expectations. A further depreciation of the euro seems beneficial for current European stock returns, mainly because of reduced future return expectations.

Tables 9 and 10 contain statistics with respect to the inflation, real rate and dividend factors contained in stocks and bonds. Reported are the correlations with observed values of inflation, real interest rates and industrial production growth. Table 9 contains correlations with the raw stock and bond factors, while Table 10 presents correlations with cumulated factors,[17] the idea being to display the expected level movements of the factors approximately, as in Lamont (2000). Alternatively, the cumulation may help to show persistent patterns present in the data which may be hard to detect otherwhise. Alongside, figures depicting the constituent stock and bond factors and cumulations over time are included.

As can be expected, the pure factors – being changes in the expected level – are very poorly correlated with observed levels of the respective variables, although the correlation between stock and bond inflation factor innovations and observed past month inflation levels is quite substantial. This may indicate the fact that monthly numbers are already very noisy, as acknowledged by Chen, Roll and Ross (1986). Furthermore, once the factors are accumulated over time as a way to restore the trend level, correlations are in general higher and more significant. On average, factor correlations in Table 10 are equally high for backward looking as for forward looking measures of inflation, real interest rates and production. Besides, in Europe (to a lesser extent, also in the US), inflation factor correlations are higher for 1-year ahead than for 1-month ahead results, implying some form of (in-sample) predictability. Further, note that the ultra short term results in Table 10 seem to indicate an opposite movement of the observed real rates and the real rate factor embodied in stocks and bonds. It is also evident that the dividend growth component bears little relation with future growth of industrial production (even negative correlations are apparent in Table 10). This seems to contradict Chen (1991) that stocks serve as a (dividend) claim against the (future) output of the economy, at least, as measured by industrial production. Finally, note that the inflation and real rate factors incorporated in excess stock

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[17] Table 10 reports correlations of observed series with cumulative factors. The cumulation is the sum of all numbers over time. Other types of cumulation are possible; we also experimented with 12-month moving sums, the results for which were qualitatively the same (not reported here).

and bond returns contain largely the same information regarding inflation and real interest rates. Only in the US are the long term horizon projections different, causing the overall correlations to be different as well.[18]

As is clear from the pictures, one can observe some interesting trends. For example, in the US, one can discern the large stock and bond factor innovation volatilities during the late 1970s and early 1980s, coinciding with the shift in monetary policy operating procedures. The cumulative inflation series reveal that inflation was low and falling until the early 1970s, rapidly rising afterwards, reaching a peak in 1980, but again under control as from the mid 1980s. Correspondingly, the real rate cumulative series shows a high real rate at the end ot the 1960s, end of the 1980s and a record high, recently, at the end of 2000. Nominal dividend growth has been gradually declining over time. Similarly, the outlook for future excess stock returns looks very dim at the end of 2000, as can be seen from the cumulative future excess return series, a conclusion shared by Fama and French (2000). In contrast, over the short run, 1-month excess returns have experienced cumulative increases since 1994, as evidenced by the boom in US asset prices, such that the series is back up to the level reached at the end 1950s-early 1960s. However, from the 1950s until 1978, short term excess returns seem to have been falling at a constant rate, while the series was relatively stable during the period 1980–1994, in line with the descriptive statistics in Fama and French (2000, their Table 4). Our results also point out that, for the US, high realised excess stock returns – as evidenced by the cumulative ε_e series – are not due to a combination of a decline in the (real) discount rates and high future dividend growth. Instead, the dividend growth is low, and the real discount rate is a record high at the end of 2000. As is clear from the graphs and from equation (3.2c), the low cumulative inflation and future return factors are needed to account for the millennium high (cumulative) excess return ε_e.

As for bonds, in the US the volatility of excess return and future bond return innovations has increased since 1980. Along the same lines, the expected return from cumulative 1-month investments has gradually declined toward the end of 2000, after a period of high turbulence in the past two decades, mainly because of high and time-varying expected future excess bond returns. As such, the special attention to the 1994 bond market debacle seems overstated; similar debacles have occurred in 1982, 1984, and 1988/1989. The graphical evidence also seems to contradict the finding of Thorbecke (2000) who attributes the 1994 debacle especially to news about inflation. If anything can be gleaned from the analysis here, it seems due rather to rising real interest rate and future excess bond return news, which are more related to monetary policy uncertainty.

The pattern of EU aggregate stock and bond factors is much the same as for the US. The stock market behaviour over 1979–2000 is almost identical to the US situation, hence the above analysis applies. As for bonds, there are some differences though. There is less cyclical behaviour in cumulated 1-month excess bond factor innovations, and there is a sizeable downturn in this series after 1999. The latter seems to be accounted for by the lower cumulative inflation and the increasingly high future excess bond return factors. There is also some graphical

[18] One might be tempted to treat the inflation and real rate factors as common for stocks and bonds. However, stocks have per definition an infinite lifetime contrary to bonds. Hence the inflation and real factors embodied in stocks may also pick up some inflation and real rate expectations beyond the largest remaining bond maturity, and therefore, both factors are conceptually different for stocks and bonds.

support for the claim that, in Europe, volatility of inflation, real rate and dividend growth factor innovations have come down towards the end of the sample. This may be due to the gradual convergence of prices, interest rates and other macro-economic fundamentals in Europe, as well as being related due to the end of the ERM and the start of EMU which the investors perceive as a credible device to bring down inflation uncertainty. However, one should remain cautious about drawing too strong conclusions from this exercise.

5 Conclusions

This paper has looked into decomposing excess stock and bond returns into constituent factors using the accounting framework laid out by, among others, Campbell and Ammer (1993). In addition, sensitivities with respect to monetary policy and fundamental factors are reported. The innovations proposed here include the use of monthly financial data and the comparison between US and Europe, for which EMU-wide stock and bond factors, as well as policy and fundamental variables, were constructed. There is also specific attention to the role of the inflation factor and more detail is added by decomposing the stock and bond factors into four relevant subhorizons. As such, the framework is significantly enriched and more informative than previous research.

The results suggest that current excess stock return volatility is mostly due to the volatility of future equity premium expectations, consistent with Campbell and Ammer (1993). However, inflation news volatility also has a significant impact. With respect to the bond market, in the US current bond return innovations are dominating whereas in the EU, innovations in future bond factors are much larger than current excess bond return news. There is some casual evidence of short-termism in Europe.

As for fundamentals, changes in the outlook for inflation, unemployment and the leading indicator entail strong revisions in excess stock returns and stock factor expectations. Concerning the bond betas, the role and importance of fundamentals is more distinct between Europe and the US, compared to the stock beta decompositions.

Finally, graphical evidence is presented showing that the pattern of EU aggregate stock and bond factors is much the same as for the US. Only the bond markets seem to behave differently after 1999, possibly due to a changeover to EMU in Europe. The graphs also reveal that the low cumulative inflation and future equity premium news factors are needed to account for the millennium high equity premium in the US and Europe. It can also be seen that the cumulative innovations are informative about observed real rates and inflation.

What lessons can monetary policymakers draw from the above analysis? First, when evaluating financial market performance, one gets to know how current unexpected asset price movements are related to changes in future news factors whose effects materialise over specific time horizons. As such, one can argue that the equity premium puzzle is no puzzle after all, see, eg, Fama and French (2000). The analysis has shown which of these factors were most important historically for the US and the Euro-Zone. A related exercise would be to provide some out-of-sample analysis and to demonstrate how one can use this model for real time decision making.

Second, the analysis has shed some light on economic and financial (stylised) facts from a financial markets' point of view – contributing to the understanding of these phenomena. The data reject a short run Fisher effect but support a long run effect. There is some support for the claim that declines in discount rates account for an unexpectedly high equity premium for the US. The results also seem to support a trade-off between inflation and unemployment, ie, a Phillips curve effect is in the data. Finally, the analysis offers an interpretation for the fact that, in the US, bad unemployment news is usually good for stocks and bonds.

The asset market decompositions may help monetary authorities to understand better the impact of their decisions on financial markets and to increase their knowledge about the monetary (ie, the interest rate) transmission mechanism through stock and bond markets. The analysis showed that expectations of excess stock and bond returns and their constituent factors change significantly, both in the US and EU, in response to discount rate and Fed Funds rate changes while they seem not to be sensitive to money growth innovations. Besides, the results seem to indicate that the EU real forward term structure largely moves independent over the very short term vis-à-vis other horizons, and may be heavily influenced by monetary policy and liquidity shocks.

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Appendix

Tables and figures

Table 1. **Variance decomposition of stock return innovations (ε_e)**

Due to	United States, 1954:6–2000:12 Total US	Decomposition per horizon Ultra Short	Short Term	Medium Term	Long Term	Europe, 1979:1–2000:12 Total EU	Decomposition per horizon Ultra Short	Short Term	Medium Term	Long Term
Common Nominal Rate and Excess Return Factor										
var(η_{nomr})	0.141	0.001	0.006	0.016	0.029	0.157	0.000	0.002	0.016	0.058
	(0.169)	(0.000)	(0.002)	(0.009)	(0.108)	(0.062)	(0.000)	(0.000)	(0.003)	(0.036)
% var(η_π)	44.7	27.1	48.3	67.8	38.1	69.7	26.0	32.3	60.7	97.6
	(34.71)	(0.32)	(7.43)	(30.94)	(46.69)	(8.2)	(0.3)	(2.0)	(5.5)	(22.5)
% var(η_r)	19.3	23.7	15.9	16.0	18.2	7.3	25.2	28.4	14.6	1.1
	(22.30)	(0.29)	(3.51)	(13.35)	(31.54)	(2.7)	(0.3)	(1.9)	(3.4)	(1.3)
% cov(η_π,η_r)	36.0	49.2	35.8	16.2	43.8	23.0	48.9	39.3	24.7	1.3
	(29.22)	(0.10)	(5.98)	(27.16)	(22.12)	(7.3)	(0.1)	(1.6)	(4.9)	(23.0)
var(η_e)	2.263	0.133	0.198	0.093	1.858	0.950	0.068	0.170	0.326	0.125
	(3.815)	(0.048)	(0.091)	(0.073)	(4.092)	(0.316)	(0.017)	(0.043)	(0.137)	(0.136)
2cov(η_e,η_{nomr})	–0.137	–0.009	–0.060	–0.034	0.318	–0.279	0.000	–0.019	–0.107	0.112
	(1.238)	(0.002)	(0.020)	(0.051)	(1.260)	(0.255)	(0.001)	(0.005)	(0.037)	(0.090)
% cov(η_e,η_π)	45.2	57.9	83.4	54.3	62.2	45.7	49.3	13.2	77.3	94.0
	(52.0)	(2.9)	(12.3)	(57.3)	(37.9)	(60.7)	(1.3)	(17.7)	(16.5)	(11.0)
% cov(η_e,η_r)	54.8	42.1	16.6	45.7	37.8	54.3	50.7	86.8	22.7	6.0
	(52.0)	(2.9)	(12.3)	(57.3)	(37.9)	(60.7)	(1.3)	(17.7)	(16.5)	(11.0)
Dividend Growth: Full Accounting										
var(η_d)	1.095	0.124	0.144	0.075	1.803	0.725	0.068	0.153	0.235	0.556
	(2.941)	(0.048)	(0.074)	(0.063)	(3.223)	(0.209)	(0.017)	(0.041)	(0.105)	(0.073)
–2cov(η_d,η_{nomr})	–0.148	0.008	0.047	0.001	–0.320	0.366	–0.001	0.015	0.075	0.060
	(1.055)	(0.002)	(0.018)	(0.039)	(1.061)	(0.218)	(0.001)	(0.004)	(0.033)	(0.100)
% cov(η_d,η_π)	56.8	57.3	81.4	44.8	67.6	94.4	48.7	21.7	69.5	83.9
	(35.5)	(2.8)	(12.5)	(152.0)	(44.0)	(15.1)	(1.3)	(13.8)	(21.9)	(21.4)
% cov(η_d,η_r)	43.2	42.7	18.6	55.2	32.4	5.6	51.3	78.3	30.5	16.1
	(35.5)	(2.8)	(12.5)	(152.0)	(44.0)	(15.1)	(1.3)	(13.8)	(21.9)	(21.4)
–2cov(η_d,η_e)	–2.214	–0.257	–0.335	–0.152	–2.688	–0.919	–0.136	–0.320	–0.544	0.090
	(6.769)	(0.096)	(0.165)	(0.128)	(7.328)	(0.460)	(0.033)	(0.084)	(0.239)	(0.082)

Notes

This table reports the variance decomposition of stock return innovations according to equation (2c), and numbers are scaled with the left-hand side's variance of stock return innovations, var(ε_e).

The upper part provides the real rate and inflation factor expectational innovations, η_r and η_π, which are pooled into a nominal rate factor, η_{nomr}. The lower part reports results for revisions in expectations on dividend growth, η_d, under a full-accounting identity approach where the dividend factor is determined as the residual term of equation 2(c), $\eta_d \equiv \varepsilon_e + \eta_r + \eta_\pi + \eta_e$. Here, the ε_e is attributed to the long term, hence the columns "Total" and "Long Term" sum to 100% and the other horizons sum to 0.

The columns give an idea of the impact of the different components' variances and covariances for the full horizon and subperiods relative to the variance of 1-period stock return innovations, var(ε_e). As for the subhorizons, covariances between factors over different horizons are not reported, hence the subhorizons do not necessarily add up to the "Total".

The horizons ultrashort refers to 1 to 3 months ahead, short term is for 4 months to 1 year ahead, medium term is for $1^1/_{12}$ year to 3 years ahead, long term denotes $3^1/_{12}$ year to infinity.

Numerical standard errors are calculated by the delta method and are reported in parentheses.

Table 2. **Variance decompositions of bond return innovations (ε_x)**

Due to	United States, 1954:6–2000:12					Europe, 1979:1–2000:12				
	Total US	Decomposition per horizon				Total EU	Decomposition per horizon			
		Ultra Short	Short Term	Medium Term	Long Term		Ultra Short	Short Term	Medium Term	Long Term
Common Nominal Rate and Excess Return Factor										
var(η_{nomr})	0.091	0.002	0.014	0.013	0.001	35.868	0.403	3.230	8.363	1.544
	(0.034)	(0.000)	(0.004)	(0.007)	(0.001)	(5.012)	(0.018)	(0.304)	(1.355)	(0.546)
% var(η_π)	43.2	27.0	47.6	70.8	44.0	48.3	25.9	32.1	57.5	94.6
	(6.3)	(0.3)	(7.1)	(31.6)	(44.8)	(2.7)	(0.3)	(2.0)	(5.1)	(14.7)
% var(η_r)	19.1	23.8	16.0	15.0	42.9	15.9	25.2	28.5	16.0	3.0
	(3.3)	(0.3)	(3.4)	(12.0)	(49.5)	(2.1)	(0.3)	(1.9)	(3.3)	(2.5)
% cov(η_π,η_r)	37.7	49.2	36.4	14.2	13.1	35.8	48.9	39.4	26.5	2.4
	(4.9)	(0.1)	(5.7)	(27.8)	(60.9)	(2.1)	(0.1)	(1.6)	(4.4)	(15.6)
Excess Bond Return Factor: Full Accounting										
var(η_x)	0.682	0.002	0.014	0.013	0.958	31.272	0.403	3.230	8.363	2.084
	(0.062)	(0.000)	(0.004)	(0.007)	(0.028)	(4.804)	(0.018)	(0.304)	(1.355)	(0.555)
–2cov(η_x,η_{nomr})	0.228	–0.003	–0.029	–0.026	0.041	–66.14	–0.805	–6.460	–16.73	–2.628
	(0.057)	(0.000)	(0.007)	(0.014)	(0.027)	(9.793)	(0.035)	(0.609)	(2.711)	(1.073)
% cov(η_x,η_π)	94.5	74.0	93.2	77.9	53.7	91.2	66.9	58.4	94.2	98.1
	(19.9)	(4.1)	(12.4)	(19.4)	(37.0)	(6.4)	(14.8)	(8.4)	(8.5)	(8.5)
% cov(η_x,η_r)	5.5	26.0	6.8	22.1	46.3	8.8	33.1	41.6	5.8	1.9
	(19.9)	(4.1)	(12.4)	(19.4)	(37.0)	(6.4)	(14.8)	(8.4)	(8.5)	(8.5)

Notes

This table reports the variance decomposition of bond return innovations according to equation (5), and numbers are scaled with the left-hand side's variance of bond return innovations, var(ε_x). Numerical standard errors are reported in parentheses. The real rate and inflation factors, η_r and η_π, are pooled into a nominal rate factor, η_{nomr}, presented in the top panel. The bottom panel provides results for the full-accounting identity, for which the future excess bond return news factor is determined as a residual, $\eta_x \equiv -\varepsilon_x - \eta_r - \eta_\pi$. The ε_x is attributed to the long run. Otherwhise, information is analagous to Table 1.

Table 3. **Stock and bond return factors regressed on stock and bond return innovations series, ε_e and ε_x**

		Total factor	Joint horizons	Ultra short	Short term	Medium term	Long term
Stock return factors regressed on excess stock return news, ε_e							
United States, 1954:6–2000:12							
η_e	R^2	0.522	0.660	0.058	0.082	0.417	0.242
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_π	R^2	0.100	0.345	0.004	0.005	–0.002	0.201
	prob-F	(0.000)	(0.000)	(0.085)	(0.045)	(0.724)	(0.000)
η_r	R^2	0.237	0.302	0.002	0.092	0.199	0.264
	prob-F	(0.000)	(0.000)	(0.136)	(0.000)	(0.000)	(0.000)
η_d	R^2	0.005	0.712	0.064	0.098	0.409	0.048
	prob-F	(0.051)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Europe, 1979:1–2000:12							
η_e	R^2	0.126	0.617	0.046	0.143	–0.002	0.405
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.465)	(0.000)
η_π	R^2	0.380	0.572	–0.003	0.450	0.412	0.408
	prob-F	(0.000)	(0.000)	(0.596)	(0.000)	(0.000)	(0.000)
η_r	R^2	0.283	0.413	0.001	0.362	0.328	0.167
	prob-F	(0.000)	(0.000)	(0.271)	(0.000)	(0.000)	(0.000)
η_d	R^2	0.275	0.835	0.043	0.172	0.021	0.715
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)
Bond return factors regressed on excess bond return news, ε_x							
United States, 1954:6–2000:12							
η_π	R^2	0.244	0.339	0.098	0.231	0.319	0.252
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
η_r	R^2	–0.001	0.374	0.033	0.001	0.254	0.194
	prob-F	(0.522)	(0.000)	(0.000)	(0.179)	(0.000)	(0.000)
η_x	R^2	0.928	0.999993	0.342	0.461	0.451	0.9996
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Europe, 1979:1–2000:12							
η_π	R^2	0.048	0.213	0.022	0.069	0.037	0.016
	prob-F	(0.000)	(0.000)	(0.009)	(0.000)	(0.001)	(0.022)
η_r	R^2	0.049	0.336	–0.003	0.054	0.092	0.059
	prob-F	(0.000)	(0.000)	(0.688)	(0.000)	(0.000)	(0.000)
η_x	R^2	0.100	0.993	0.223	0.371	0.160	0.282
	prob-F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes

The Table reports the adjusted R^2 and significance level in brackets (F-test probability) for each stock (bond) factor – either the total impact, all horizons entered jointly for each of the factors, or the individual horizon per factor – regressed on the stock (bond) return innovations ε_e (ε_x). Stock and bond return factors are derived from equation (2c) and (5), respectively.

For more information on factors and horizons, see Table 1 and 2.

Table 4. **Correlation Structure of Stock Return Factors**

	Total Impact	Ultra-short term	Short term	Medium term	Long term
United States, 1954:6–2000:12					
cor(η_π,η_r)	–0.613	–0.969	–0.646	0.245	–0.833
	(0.748)	(0.004)	(0.147)	(0.463)	(0.576)
cor(η_π,η_e)	0.456	–0.517	–0.819	–0.288	0.995
	(0.929)	(0.135)	(0.137)	(0.566)	(0.031)
cor(η_π,η_d)	0.622	–0.511	–0.789	0.108	0.769
	(0.832)	(0.140)	(0.170)	(0.593)	(0.473)
cor(η_r,η_e)	–0.840	0.401	0.285	–0.497	–0.874
	(0.299)	(0.143)	(0.284)	(0.489)	(0.430)
cor(η_r,η_d)	–0.720	0.407	0.314	–0.273	–0.535
	(0.605)	(0.147)	(0.302)	(0.538)	(1.015)
cor(η_e,η_d)	0.703	0.999	0.994	0.909	0.734
	(0.629)	(0.000)	(0.004)	(0.078)	(0.556)
Europe, 1979:1–2000:12					
cor(η_π,η_r)	–0.510	–0.956	–0.650	–0.414	–0.061
	(0.197)	(0.003)	(0.045)	(0.110)	(1.123)
cor(η_π,η_e)	–0.145	–0.605	0.076	–0.524	0.702
	(0.295)	(0.114)	(0.133)	(0.134)	(0.316)
cor(η_π,η_d)	–0.451	–0.593	0.135	–0.390	–0.207
	(0.211)	(0.112)	(0.138)	(0.172)	(0.247)
cor(η_r,η_e)	–0.534	0.633	–0.530	–0.314	–0.417
	(0.187)	(0.120)	(0.140)	(0.201)	(0.866)
cor(η_r,η_d)	–0.083	0.635	–0.519	–0.348	0.370
	(0.202)	(0.119)	(0.148)	(0.206)	(0.235)
cor(η_e,η_d)	0.554	0.999	0.995	0.985	–0.170
	(0.122)	(0.000)	(0.001)	(0.008)	(0.216)

Notes
This table reports correlations between stock return factors, according to equation (2c), for different horizons (see Table 1 for information on horizons and definition of variables). In parentheses, numerical standard errors, calculated by the delta method, are reported.

Table 5. **Correlation Structure of Bond Return Factors over Time**

	Total Impact	Ultra-short term	Short term	Medium term	Long term
United States, 1954:6–2000:12					
cor(η_π,η_r)	–0.655	–0.971	–0.658	0.217	–0.151
	(0.120)	(0.003)	(0.141)	(0.466)	(0.807)
cor(η_π,η_x)	0.328	–0.370	–0.816	–0.926	0.495
	(0.126)	(0.039)	(0.070)	(0.064)	(0.354)
cor(η_r,η_x)	0.028	0.138	0.102	–0.570	0.432
	(0.103)	(0.044)	(0.210)	(0.377)	(0.320)
Europe, 1979:1–2000:12					
cor(η_π,η_r)	–0.645	–0.959	–0.652	–0.437	–0.072
	(0.061)	(0.003)	(0.044)	(0.100)	(0.486)
cor(η_π,η_x)	–0.838	–0.191	–0.474	–0.851	–0.749
	(0.038)	(0.040)	(0.059)	(0.040)	(0.078)
cor(η_r,η_x)	0.140	–0.096	–0.358	–0.099	0.084
	(0.127)	(0.043)	(0.068)	(0.142)	(0.384)

Notes

This table reports correlations between bond return factors, according to equation (5), for different horizons (see Tables 1 and 2 for information on horizons and definition of variables). In parentheses, numerical standard errors are reported (calculated by the delta method).

Table 6. **Forward Term Structure Correlation of each of the Factors**

Horizon Correlations	Stock Factors η_e	η_π	η_r	η_d	Bond Factors η_π	η_r	η_x
United States 1954:6–2000:12							
UST-ST	0.599	0.791	0.795	0.551	0.790	0.800	0.939
	(0.224)	(0.088)	(0.094)	(0.258)	(0.087)	(0.092)	(0.027)
UST-MT	–0.110	0.439	0.096	–0.384	0.460	0.152	0.889
	(0.455)	(0.185)	(0.240)	(0.361)	(0.176)	(0.249)	(0.098)
UST-LT	–0.229	0.208	0.081	–0.495	0.228	–0.087	–0.573
	(0.240)	(0.229)	(0.320)	(0.280)	(0.313)	(0.210)	(0.038)
UST-ALL	0.190	0.591	0.493	–0.200	0.875	0.912	–0.369
	(0.402)	(0.379)	(0.299)	(0.248)	(0.059)	(0.041)	(0.092)
ST-MT	0.390	0.825	0.478	0.049	0.845	0.538	0.980
	(0.511)	(0.129)	(0.285)	(0.516)	(0.110)	(0.284)	(0.034)
ST-LT	–0.281	0.351	0.378	–0.650	0.502	0.197	–0.666
	(0.268)	(0.351)	(0.324)	(0.305)	(0.438)	(0.333)	(0.082)
ST-ALL	0.265	0.771	0.734	–0.273	0.976	0.948	–0.461
	(0.552)	(0.441)	(0.241)	(0.336)	(0.018)	(0.040)	(0.135)
MT-LT	0.330	0.522	0.848	–0.006	0.754	0.877	–0.657
	(0.523)	(0.332)	(0.280)	(0.705)	(0.301)	(0.214)	(0.136)
MT-ALL	0.590	0.812	0.840	0.143	0.822	0.523	–0.453
	(0.402)	(0.243)	(0.153)	(0.659)	(0.091)	(0.209)	(0.202)
LT-ALL	0.834	0.860	0.892	0.879	0.539	0.247	0.969
	(0.318)	(0.327)	(0.252)	(0.233)	(0.364)	(0.279)	(0.015)
Europe, 1979:1–2000:12							
UST-ST	0.432	0.419	0.042	0.394	0.420	0.050	0.733
	(0.149)	(0.053)	(0.051)	(0.155)	(0.053)	(0.051)	(0.029)
UST-MT	0.252	0.429	–0.095	0.130	0.428	–0.086	0.464
	(0.159)	(0.048)	(0.069)	(0.180)	(0.047)	(0.064)	(0.062)
UST-LT	–0.560	0.398	–0.156	–0.109	0.404	–0.167	–0.053
	(0.184)	(0.072)	(0.481)	(0.217)	(0.064)	(0.234)	(0.084)
UST-ALL	0.394	0.491	0.234	0.466	0.644	0.472	0.575
	(0.187)	(0.049)	(0.097)	(0.153)	(0.033)	(0.049)	(0.055)
ST-MT	0.510	0.973	0.975	0.489	0.974	0.976	0.865
	(0.111)	(0.015)	(0.024)	(0.118)	(0.014)	(0.021)	(0.027)
ST-LT	–0.076	0.947	0.838	–0.539	0.944	0.851	0.121
	(0.221)	(0.040)	(0.539)	(0.072)	(0.038)	(0.240)	(0.109)
ST-ALL	0.810	0.966	0.968	0.386	0.953	0.900	0.883
	(0.072)	(0.023)	(0.015)	(0.136)	(0.014)	(0.018)	(0.025)
MT-LT	–0.051	0.992	0.913	–0.317	0.990	0.920	0.514
	(0.350)	(0.009)	(0.352)	(0.148)	(0.009)	(0.154)	(0.099)
MT-ALL	0.850	0.996	0.943	0.555	0.966	0.834	0.981
	(0.096)	(0.002)	(0.028)	(0.134)	(0.006)	(0.032)	(0.004)
LT-ALL	0.151	0.992	0.852	0.415	0.948	0.710	0.557
	(0.259)	(0.006)	(0.411)	(0.156)	(0.016)	(0.256)	(0.096)

Notes

This table reports correlations between different horizons for each of the stock and bond return factors derived from equation (2c) and (5). UST denotes ultra-short term, ST short term, MT medium term, LT Long term and ALL measures the total impact In parentheses, numerical standard errors are reported (calculated by the delta method). See Table 1 and 2 for definitions of horizons and factors.

Table 7. **Stock and bond market beta decomposition: United States**

	Stock $\beta\varepsilon_{e,f} \equiv \beta\eta_{d,f} - \beta\eta_{\pi,f} - \beta\eta_{r,f} - \beta\eta_{e,f}$					Bond $\beta\varepsilon_{x,f} \equiv -\beta\eta_{\pi,f} - \beta\eta_{r,f} - \beta\eta_{x,f}$			
	$\beta\varepsilon_{e,f}$	$\beta\eta_{\pi,f}$	$\beta\eta_{r,f}$	$\beta\eta_{e,f}$	$\beta\eta_{d,f}$	$\beta\varepsilon_{x,f}$	$\beta\eta_{\pi,f}$	$\beta\eta_{r,f}$	$\beta\eta_{x,f}$
Fed funds rate	–0.5838	0.4107	0.4089	–2.1205	–1.8846	–0.8740	0.4514	–0.0145	0.4372
	(–1.85)	(2.75)	(4.21)	(–4.53)	(–5.85)	(–5.47)	(7.24)	(–0.34)	(3.26)
Discount rate	–1.5130	1.5064	0.7101	–3.3628	–2.6593	–2.0102	1.0241	0.0074	0.9786
	(–1.73)	(3.66)	(2.61)	(–2.56)	(–2.92)	(–4.52)	(5.85)	(0.06)	(2.63)
Money base	0.0591	0.0920	0.1159	–0.5280	–0.2609	–0.2564	0.0692	0.0332	0.1540
	(0.19)	(0.63)	(1.21)	(–1.14)	(–0.81)	(–1.62)	(1.09)	(0.79)	(1.18)
real M1	0.0942	0.1047	0.1128	–0.5247	–0.2130	–0.3664	0.0756	0.0191	0.2717
	(0.34)	(0.80)	(1.31)	(–1.27)	(–0.74)	(–2.59)	(1.35)	(0.51)	(2.32)
real M2	0.1227	0.0919	0.1264	–0.4094	–0.0685	–0.3131	0.0295	0.0544	0.2292
	(0.26)	(0.41)	(0.86)	(–0.58)	(–0.14)	(–1.30)	(0.31)	(0.86)	(1.15)
real M3	0.3384	–0.0280	0.1286	–0.5460	–0.1070	–0.1841	–0.0086	0.0555	0.1372
	(0.71)	(–0.12)	(0.86)	(–0.76)	(–0.21)	(–0.74)	(–0.09)	(0.85)	(0.67)
Inflation	–1.0194	3.1949	–2.1304	0.0383	0.0833	–0.7970	2.2219	–1.8152	0.3903
	(–1.50)	(10.86)	(–11.06)	(0.04)	(0.12)	(–2.28)	(21.39)	(–34.56)	(1.35)
Ind. production	0.0219	0.2156	0.0233	–0.0653	0.1955	–0.1912	0.0749	0.0188	0.0975
	(0.11)	(2.35)	(0.39)	(–0.22)	(0.96)	(–1.92)	(1.88)	(0.71)	(1.18)
Output gap (HP)	–0.1097	0.0867	–0.0203	0.1025	0.0592	–0.0807	0.0334	–0.0086	0.0559
	(–1.72)	(2.87)	(–1.02)	(1.06)	(0.88)	(–2.45)	(2.55)	(–0.99)	(2.06)
Unemploym. rate	1.0851	–1.1712	–0.4602	2.1675	1.6212	2.0181	–0.6592	–0.0603	–1.2985
	(1.20)	(–2.75)	(–1.63)	(1.60)	(1.72)	(4.40)	(–3.59)	(–0.49)	(–3.40)
NAPM index	0.0012	0.0010	0.0003	–0.0014	0.0010	–0.0017	0.0003	0.0001	0.0012
	(1.81)	(3.07)	(1.31)	(–1.43)	(1.44)	(–5.08)	(2.48)	(1.54)	(4.40)
Consumption	0.8618	0.0513	0.1514	–1.6785	–0.6141	–0.1847	0.1944	–0.0752	0.0655
	(1.87)	(0.24)	(1.07)	(–2.46)	(–1.30)	(–0.75)	(2.08)	(–1.24)	(0.32)
Leading indicator	1.2760	0.0424	0.1030	–0.8460	0.5754	–0.2369	–0.0296	0.0693	0.1972
	(3.91)	(0.27)	(1.02)	(–1.73)	(1.71)	(–1.35)	(–0.44)	(1.60)	(1.36)
Coincid. indicator	0.7242	0.1794	0.2327	–1.4560	–0.3197	–0.3949	0.1542	0.0450	0.1957
	(1.31)	(0.69)	(1.37)	(–1.77)	(–0.56)	(–1.34)	(1.37)	(0.62)	(0.80)
Lagging indicator	–0.5318	0.1009	0.0454	–0.1017	–0.4872	–0.0350	0.1033	–0.0156	–0.0527
	(–1.16)	(0.47)	(0.32)	(–0.15)	(–1.04)	(–0.14)	(1.11)	(–0.26)	(–0.26)
Oil price	–0.0128	0.0358	–0.0179	0.0048	0.0099	–0.0179	0.0215	–0.0149	0.0114
	(–0.49)	(2.93)	(–2.22)	(0.12)	(0.37)	(–1.34)	(4.08)	(–4.26)	(1.03)
DEM/USD	–0.0440	0.1252	–0.0098	0.0056	0.0770	–0.0907	0.0611	–0.0140	0.0435
	(–0.51)	(3.00)	(–0.36)	(0.04)	(0.82)	(–1.90)	(3.49)	(–1.26)	(1.10)
JPY/USD	–0.0059	0.1064	–0.0102	0.1115	0.2017	–0.0663	0.0314	0.0036	0.0314
	(–0.07)	(2.58)	(–0.39)	(0.88)	(2.20)	(–1.41)	(1.80)	(0.33)	(0.80)
HML return	–0.3798	0.0377	–0.0831	0.5179	0.0926	–0.0041	–0.0089	–0.0198	0.0328
	(–6.92)	(1.39)	(–4.76)	(6.22)	(1.55)	(–0.14)	(–0.76)	(–2.55)	(1.35)
SMB return	0.1919	–0.0002	0.0433	–0.2057	0.0294	–0.0364	–0.0015	0.0200	0.0179
	(3.24)	(–0.01)	(2.33)	(–2.29)	(0.47)	(–1.18)	(–0.12)	(2.46)	(0.70)

Notes

The table reports stock and bond market betas with a number of fundamental factors, f. See equation (6). t-stats are reported between brackets. Sample period is 1954:6–2000:12, 1959:1–2000:12 for money growth M1, M2, M3, real consumption (nondurables and services), and the leading, coincident and lagging business cycle indicators, 1971:1–2000:12 for DEM and JPY exchange rates.

Series are taken from St. Louis Federal Reserve Economic Data (FRED). HML and SMB denote Fama-French high minus low (book-to-market) and small minus big (size) portfolio returns. All series are ARIMA filtered according to best (and most parsimonious) fit (based on Akaike and Schwartz information criteria).

Table 8. **Stock and bond market beta decomposition: Europe**

	Stocks $\beta\varepsilon_{e,f} \equiv \beta\eta_{d,f} - \beta\eta_{\pi,f} - \beta\eta_{r,f} - \beta\eta_{e,f}$					Bonds $\beta\varepsilon_{x,f} \equiv -\beta\eta_{\pi,f} - \beta\eta_{r,f} - \beta\eta_{x,f}$			
	$\beta\varepsilon_{e,f}$	$\beta\eta_{\pi,f}$	$\beta\eta_{r,f}$	$\beta\eta_{e,f}$	$\beta\eta_{d,f}$	$\beta\varepsilon_{x,f}$	$\beta\eta_{\pi,f}$	$\beta\eta_{r,f}$	$\beta\eta_{x1,f}$
Discount rate	–0.845	1.332	0.311	–2.287	–1.489	–0.069	0.486	0.147	–0.564
	(–0.82)	(2.91)	(2.08)	(–2.30)	(–1.71)	(–3.58)	(3.20)	(1.66)	(–5.35)
real M1 growth	0.149	–0.106	0.094	–0.071	0.065	0.0037	–0.0702	0.0779	–0.0113
	(0.44)	(–0.71)	(1.97)	(–0.22)	(0.23)	(0.58)	(–1.42)	(2.80)	(–0.32)
real M2 growth	0.070	–0.392	0.227	0.370	0.274	0.0065	–0.2261	0.1987	0.0209
	(0.10)	(–1.25)	(2.27)	(0.54)	(0.47)	(0.48)	(–2.20)	(3.42)	(0.28)
real M3 growth	0.367	–0.475	0.266	0.191	0.347	–0.0022	–0.2312	0.2063	0.0270
	(0.49)	(–1.46)	(2.56)	(0.27)	(0.58)	(–0.15)	(–2.16)	(3.41)	(0.35)
Inflation	–1.435	4.559	–0.577	–7.257	–4.709	–0.030	2.038	–0.797	–1.212
	(–0.81)	(6.14)	(–2.26)	(–4.37)	(–3.20)	(–0.88)	(8.74)	(–5.54)	(–6.94)
Ind. production	0.013	–0.056	0.041	–0.174	–0.175	–0.0018	–0.0184	0.0220	–0.0018
	(0.09)	(–0.81)	(1.86)	(–1.17)	(–1.35)	(–0.60)	(–0.80)	(1.68)	(–0.11)
Output gap	–0.135	0.009	0.025	–0.087	–0.189	–0.0027	0.0026	0.0123	–0.0122
	(–0.87)	(0.13)	(1.09)	(–0.57)	(–1.43)	(–0.89)	(0.11)	(0.92)	(–0.73)
Leading ind.	6.901	–2.744	0.095	1.455	5.708	0.073	–0.851	0.107	0.672
	(4.58)	(–4.01)	(0.42)	(0.95)	(4.43)	(2.46)	(–3.72)	(0.79)	(4.11)
Unempl. rate	–6.784	1.466	–0.793	3.768	–2.342	–0.052	0.406	–0.439	0.086
	(–0.92)	(0.48)	(–0.79)	(0.58)	(–0.45)	(–0.39)	(0.40)	(–0.74)	(0.12)
Oil price USD	–0.082	0.063	–0.012	–0.053	–0.084	–0.0011	0.0245	–0.0102	–0.0133
	(–2.17)	(3.80)	(–2.24)	(–1.42)	(–2.61)	(–1.46)	(4.44)	(–3.15)	(–3.31)
Oil price Euro	–0.053	0.059	–0.010	–0.074	–0.078	–0.0012	0.0232	–0.0090	–0.0130
	(–1.46)	(3.65)	(–1.91)	(–2.07)	(–2.53)	(–1.72)	(4.36)	(–2.90)	(–3.35)
EUR/USD	0.208	–0.001	0.015	–0.261	–0.040	–0.0024	0.0044	0.0060	–0.0080
	(1.81)	(–0.03)	(0.87)	(–2.34)	(–0.41)	(–1.09)	(0.26)	(0.60)	(–0.64)
JPY/EUR	–0.154	0.010	–0.013	0.136	–0.021	–0.0002	0.0016	–0.0073	0.0059
	(–1.35)	(0.19)	(–0.79)	(1.22)	(–0.22)	(–0.10)	(0.09)	(–0.75)	(0.48)
HML	–0.305	0.084	–0.023	0.151	–0.093	–0.0021	0.0198	–0.0094	–0.0083
	(–2.18)	(1.32)	(–1.10)	(1.10)	(–0.78)	(–0.78)	(0.93)	(–0.77)	(–0.54)

Notes

The table reports betas with a number of fundamental factors (transformed into ARIMA innovations by best practice). Money aggregates are ECB data (inflation adjusted). Other series were aggregated from country data (using GDP weights; sources: OECD, IFS). Output gap is Hodrick-Prescott filtered industrial production (λ=14 400). Oil price is log change in West Texas Intermediate (source: Fed St. Louis-Dow Jones Energy Services) entered in USD and euro. HML is the EU-return differential between the MSCI value and growth portfolio (1-month returns), value: low price/book value, growth: high price/book value securities.

Sample period is 1979:12–2000:12. Unemployment series 1982:1–2000:12 (OECD standardised rates). Industrial production and Output gap 1979:12–2000:9.

The beta decomposition follows from equation (2c), (5) and (6). t-stats are reported in parentheses.

Table 9. **Correlation of stock and bond factors with observed inflation, real interest rate and production growth**

Correlation with:	US, 1954:6–2000:12 Total US	Ultra short	Short Term	Med Term	Long Term	Europe, 1979:1–2000:12 Total EU	Ultra short	Short Term	Med Term	Long Term
Inflation factor –stocks (η_π)										
Inflation (m)	0.335	0.697	0.458	0.199	0.092	0.242	0.527	0.199	0.205	0.196
Inflation (m1)	0.146	0.178	0.160	0.135	0.074	0.057	0.106	0.045	0.052	0.048
Inflation (yr)	0.096	0.170	0.144	0.098	0.016	0.042	0.051	0.037	0.038	0.039
Inflation (yr1)	0.181	0.232	0.235	0.201	0.065	0.087	0.070	0.084	0.086	0.082
Inflation factor –bonds (η_π)										
Inflation (m)	0.546	0.699	0.463	0.217	0.082	0.323	0.529	0.200	0.205	0.198
Inflation (m1)	0.180	0.177	0.161	0.138	0.102	0.072	0.105	0.045	0.051	0.050
Inflation (yr)	0.159	0.170	0.145	0.103	0.042	0.047	0.051	0.037	0.038	0.039
Inflation (yr1)	0.251	0.232	0.235	0.206	0.117	0.092	0.070	0.084	0.086	0.083
Real rate factor – stocks (η_r)										
Real rate (m)	0.001	–0.007	–0.001	0.021	–0.001	–0.002	–0.004	–0.002	–0.001	0.001
Real rate (m1)	0.047	0.003	–0.014	0.081	0.053	0.015	0.222	–0.017	–0.062	–0.083
Real rate (yr)	0.017	0.016	0.018	0.029	0.007	–0.019	0.034	–0.023	–0.030	–0.035
Real rate (yr1)	0.055	–0.084	–0.020	0.136	0.090	0.126	–0.024	0.128	0.139	0.129
Real rate factor – bonds (η_r)										
Real rate (m)	0.000	–0.007	–0.001	0.022	0.017	–0.003	–0.004	–0.002	–0.001	0.001
Real rate (m1)	0.019	0.003	–0.015	0.075	0.107	0.075	0.221	–0.015	–0.059	–0.088
Real rate (yr)	0.083	0.112	0.070	–0.029	–0.070	–0.007	0.034	–0.022	–0.030	–0.033
Real rate (yr1)	0.174	0.147	0.179	0.107	0.040	0.107	–0.023	0.127	0.139	0.132
Dividend factor – stocks (η_d) full accounting										
Production (m)	0.031	–0.088	–0.123	0.011	0.080	–0.052	–0.008	0.016	–0.031	–0.045
Production (m1)	0.046	–0.095	–0.127	–0.052	0.107	0.058	–0.007	–0.020	–0.009	0.086
Production (yr)	0.090	–0.086	–0.092	0.038	0.110	–0.081	–0.116	–0.048	–0.045	0.002
Production (yr1)	0.011	0.059	0.027	–0.121	0.010	–0.014	–0.038	–0.013	0.037	–0.020

Notes

(m) monthly level (inflation, real interest rate) or growth rate (industrial production), (m1) one-month lead of series level or growth rate, (yr) annual level or growth rate of series, (yr1) one-year lead of series level or growth rate.

Significance level (two-sided) of correlations: for US at 1%: 0.109, 5%: 0.083, 10%: 0.070, for Europe at 1%: 0.158, 5%: 0.121, 10%: 0.102.

Table 10. **Correlation of stock and bond cumulative factors with observed inflation, real interest rates and production growth**

Correlation with:	US, 1954:6–2000:12 Total US	Ultra short	Short Term	Med Term	Long Term	Europe, 1979:1–2000:12 Total EU	Ultra short	Short Term	Med Term	Long Term
Inflation factor –stocks (η_π)										
Inflation (m)	0.234	0.242	0.194	0.134	0.187	0.755	0.398	0.766	0.761	0.746
Inflation (m1)	0.202	0.200	0.159	0.117	0.175	0.727	0.220	0.746	0.737	0.724
Inflation (yr)	0.333	0.360	0.297	0.219	0.208	0.900	0.436	0.915	0.908	0.890
Inflation (yr1)	0.187	0.210	0.127	0.069	0.201	0.854	0.228	0.875	0.864	0.852
Inflation factor –bonds (η_π)										
Inflation (m)	0.209	0.243	0.195	0.139	0.127	0.761	0.397	0.765	0.762	0.747
Inflation (m1)	0.174	0.201	0.160	0.121	0.116	0.720	0.218	0.746	0.739	0.725
Inflation (yr)	0.317	0.361	0.299	0.227	0.176	0.904	0.435	0.914	0.909	0.892
Inflation (yr1)	0.158	0.212	0.128	0.075	0.067	0.845	0.227	0.875	0.866	0.852
Real rate factor – stocks (η_r)										
Real rate (m)	0.376	–0.308	0.052	0.503	0.488	0.439	–0.117	0.428	0.465	0.513
Real rate (m1)	0.383	–0.307	0.055	0.507	0.495	0.434	–0.106	0.423	0.460	0.507
Real rate (yr)	0.403	–0.327	0.059	0.547	0.519	0.120	–0.313	0.080	0.160	0.293
Real rate (yr1)	0.245	–0.424	–0.102	0.484	0.458	–0.010	–0.310	–0.042	0.025	0.128
Real rate factor – bonds (η_r)										
Real rate (m)	–0.098	–0.309	0.041	0.499	0.517	0.404	–0.120	0.426	0.463	0.504
Real rate (m1)	–0.096	–0.308	0.044	0.503	0.521	0.401	–0.109	0.421	0.458	0.498
Real rate (yr)	–0.102	–0.328	0.046	0.544	0.557	0.063	–0.316	0.076	0.154	0.274
Real rate (yr1)	–0.257	–0.424	–0.113	0.475	0.504	–0.057	–0.312	–0.046	0.021	0.111
Dividend factor – stocks (η_d) full accounting										
Production (m)	0.056	0.097	0.073	–0.100	0.020	0.001	0.018	0.001	0.023	–0.023
Production (m1)	0.053	0.111	0.083	–0.103	0.010	0.016	0.026	0.004	0.037	–0.003
Production (yr)	0.089	0.182	0.139	–0.201	0.022	0.039	0.058	–0.004	0.228	–0.097
Production (yr1)	0.065	0.263	0.224	–0.093	–0.070	0.025	0.375	0.083	0.229	–0.308

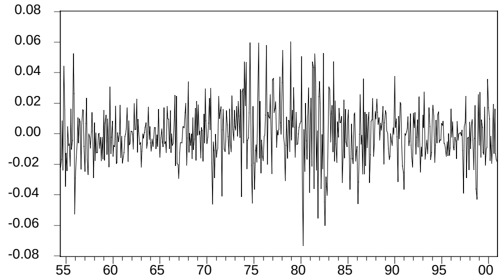
Notes

(m) monthly level (inflation, real interest rate) or growth rate (industrial production), (m1) one-month lead of series level or growth rate, (yr) annual level or growth rate of series, (yr1) one-year lead of series level or growth rate.

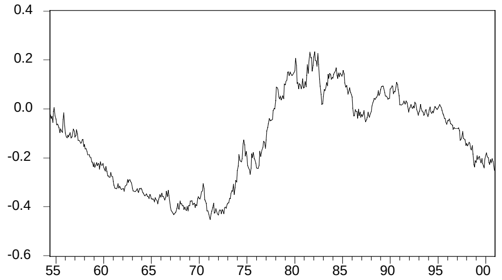
Significance level (two-sided) of correlations: for US at 1%: 0.109, 5%: 0.083, 10%: 0.070, for Europe at 1%: 0.158, 5%: 0.121, 10%: 0.102.

Figures of the Constituent Stock Return Factors: United States

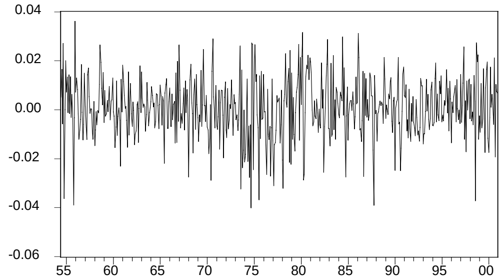
Inflation News (η_π)



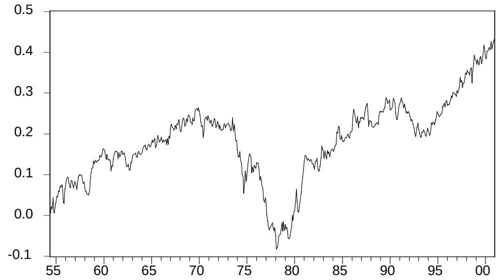
Cumulative Inflation



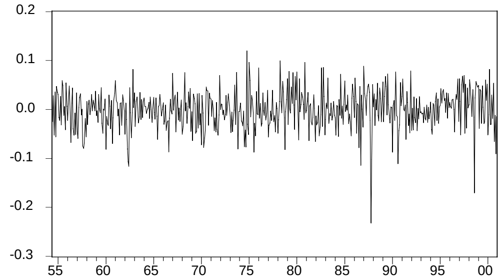
Real Rate News (η_r)



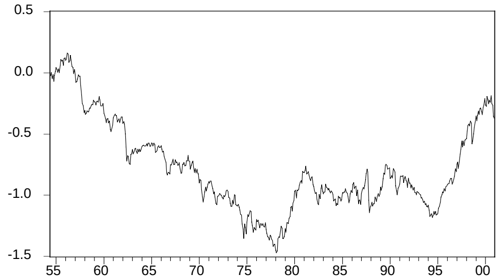
Cumulative Real Rate



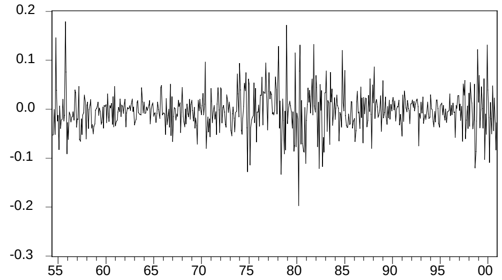
Excess Return Innovations (ε_e)



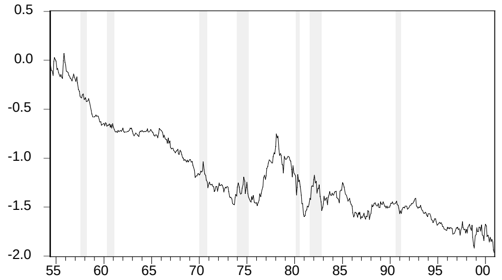
Cumulative Excess Return
(Equity Premium)



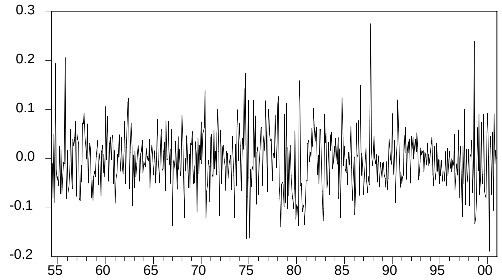
Dividend Growth News(η_d)



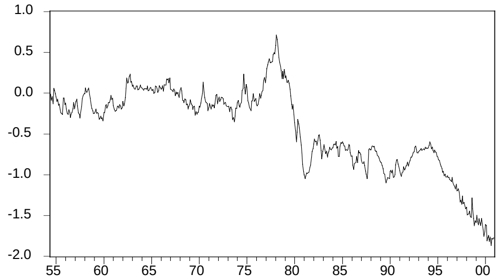
Cumulative Dividend Growth



Future Excess Return News (η_e)

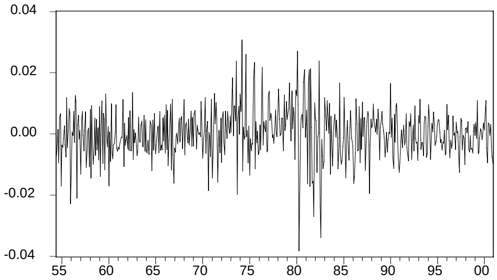


Cumulative Future Excess Return



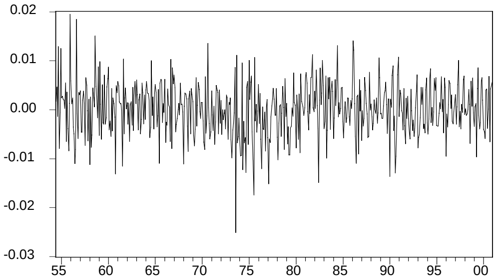
Figures of the Constituent Excess Bond Return Factors: United States

Inflation News (η_π)

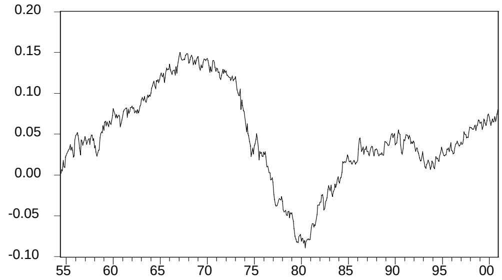


Cumulative Inflation

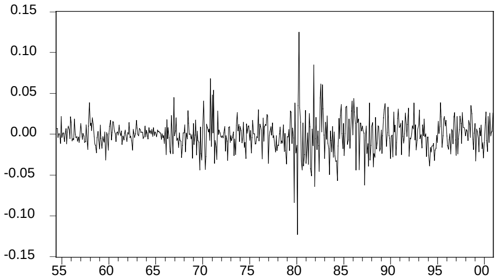
Real Rate News (η_r)



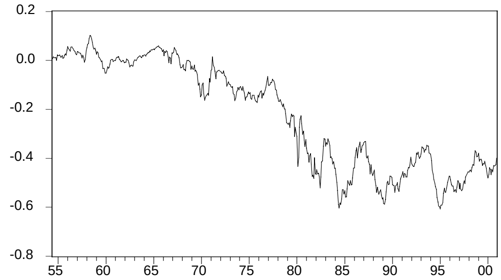
Cumulative Real Rate



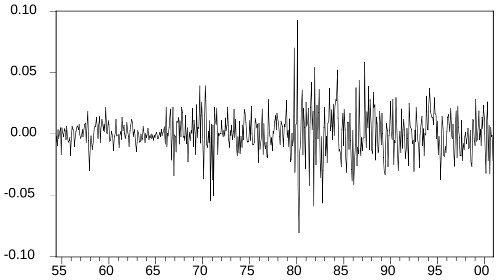
Excess Return Innovations (ε_x)



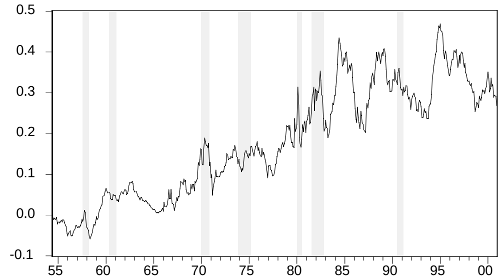
Cumulative Excess Return (Term Premium)



Future Excess Return News (η_x)

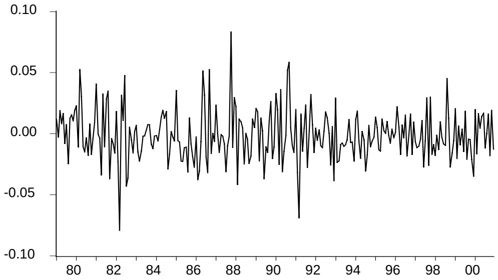


Cumulative Future Excess Return



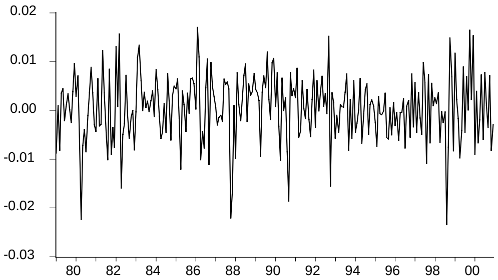
Figures of the Constituent Stock Return Factors: Europe

Inflation News (η_π)



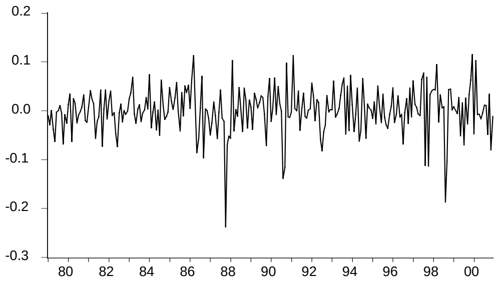
Cumulative Inflation

Real Rate News (η_r)



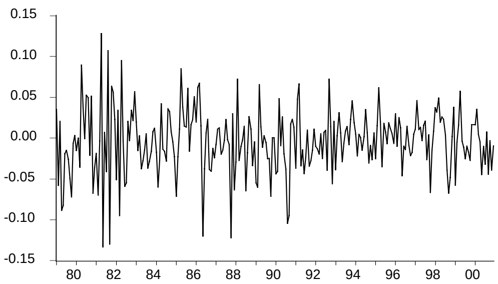
Cumulative Real Rate

Excess Return Innovations (ε_e)



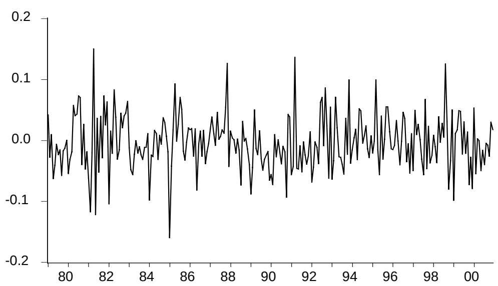
Cumulative Excess Return (Equity Premium)

Dividend Growth News (η_d)



Cumulative Dividend Growth

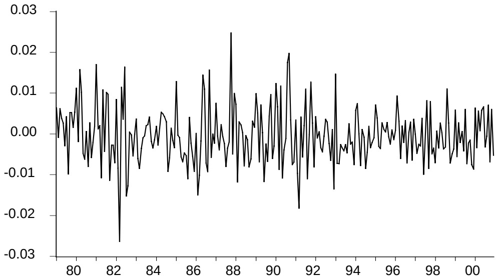
Future Excess Return News (η_e)



Cumulative Future Excess Return

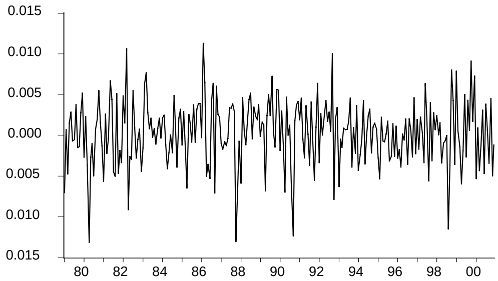
Figures of the Constituent Excess Bond Return Factors: Europe

Inflation News (η_π)



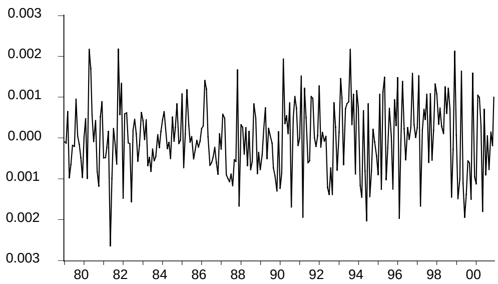
Cumulative Inflation

Real Rate News (η_r)



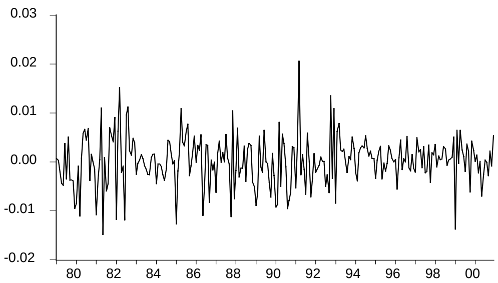
Cumulative Real Rate

Excess Return Innovations (ε_x)

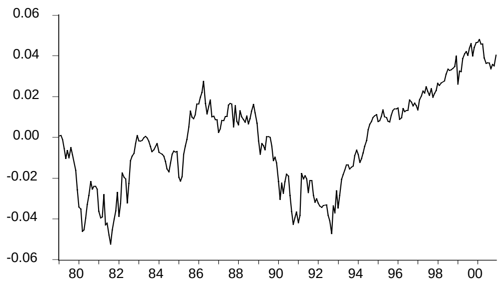


Cumulative Excess Return (Term Premium)

Future Excess Return News (η_x)



Cumulative Future Excess Return



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