Equity Yields*

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Abstract

We use a new data set of prices of traded dividends with maturities up to 10 years to uncover expected dividend growth rates across three major regions around the world: the US, Europe, and Japan. We use these asset prices to derive equity yields, analogous to bond yields, and decompose these yields into expected growth rates of dividends and a risk premium component. We find that both risk premia and expected growth rates exhibit substantial variation over time. Further, we find that equity yields may help predict other measures of economic growth such as consumption growth. We relate the dynamics of growth expectations to recent events such as the financial crisis and the earthquake in Japan.

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There exists a large literature studying fluctuations of, and the information contained in, the term structures of nominal and real interest rates.[1] At each point in time, these term structures summarize pricing information of either nominal or real claims with different maturities. In this paper, we study a novel term structure of assets that are direct claims to future cash flows paid by firms to shareholders. The prices are available at a daily basis and the assets have maturities of up to 10 years, with 1-year increments. Based on these dividend assets, we construct a term structure of equity yields that are analogous to real and nominal bond yields. The key difference between dividend assets and either nominal or real bonds is that the final payoff of dividend assets is variable whereas the payoff of nominal and real bonds is fixed in nominal or real terms, respectively. In this paper, we explore the information contained in equity yields across three major equity markets: the US, Europe, and Japan.

As a starting point, we show that equity yields are risk-adjusted expected growth rates of dividends. That is, they are the difference between expected dividend growth rates and a risk premium component. This makes equity yields natural candidates to forecast dividend growth across various maturities. Since the cyclical components of dividends, consumption (and GDP) are highly correlated, in particular during severe economic downturns, some of the predictive power of equity yields for dividend growth extends to other measures of economic growth.

As dividend assets started trading around the turn of the millennium, our sample is shorter than other commonly-used leading economic indicators, such as the yield spread, credit spreads, and the dividend-to-price ratio.[2] To formally assess the value equity yields may add relative to other predictors, we take the perspective of an economic agent forming beliefs about economic activity given the information available at a given point in time using a Bayesian model averaging (BMA) approach.[3] The BMA approach trades off a longer time series (and hence a higher accuracy of the predictive relationship) of other, more commonly used, predictor variables, against the shorter time series of equity yields that appear to predict economic growth well.

The BMA approach suggests that including two lagged equity yields as the regressors,

[1]See Singleton (1980), Singleton (1983), Fama and Bliss (1987), Piazzesi (2001), Ang and Piazzesi (2003), Ang and Monika Piazzesi (2006), Cochrane and Piazzesi (2005), Ludvigson and Ng (2009), Duffee (2011), among many others.

[2]See Stock and Watson (1989), Stock and Watson (2000), Stock and Watson (2003), Ang and Monika Piazzesi (2006), Faust, Gilchrist, Wright, and Zakrajsek (2011) and many others.

[3]See among others Min and Zellner (1993), Fernandez, Ley, and Steel (2001), Cremers (2002) and Wright (2008).

provides the best forecast of dividend growth, assigning to this model a posterior probability of nearly 90%. Using this model for expected dividend growth, we also uncover the risk premium component from each equity yield. This risk premium component is time varying and differs by maturity. This complements a large literature in macro-finance documenting that the equity risk premium fluctuates over time.[4] The risk premium on the aggregate stock market is a weighted average of risk premia on all the dividend assets with different maturities. This allows us to analyze whether the equity risk premium fluctuates due to risk premium variation for short-term or long-term dividend assets.

Our main results can be summarized as follows. First, equity yields strongly fluctuate over time, for all maturities and for all geographic regions. We find that these fluctuations are both due to expected growth variation as well as to risk premium variation. Particularly during the great recession, equity yields turn strongly negative, with values as low as -35%. We find that during this period expected growth rates were low and risk premia were high. Second, we find that equity yields predict dividend growth rates with high R-squared above 50%. In the BMA approach, equity yields are preferred as predictors of dividend growth despite their shorter sample. Third, we find that risk premia embedded in equity yields vary substantially over time in a counter-cyclical fashion. Our estimates suggest that the risk premium on the 2-year equity yield increases more during the great recession than the 5-year equity yield. Finally, we find that equity yields can be useful as predictors of consumption growth even in addition to commonly used predictors.

One reason for why equity yields may add value in forecasting economic growth, compared to, for example, bond yields, is that there may be instabilities in the relationship between bond yields and economic growth. When bond yields hit the zero lower bond, economic growth expectations become disconnected from bond yields. By contrast, equity yields can and frequently do become negative.

To construct the prices of dividend assets and equity yields, we use a new data set on dividend futures with maturities up to 10 years. An index dividend future is a standardized contract where at a future time T, the owner pays the futures price, which is determined today, and receives the index dividends paid during calendar year T. Our daily data set covers the time period between October 2002 and April 2011 and comes from BNP Paribas and Goldman Sachs who are important players in the market for dividends. These banks have provided us with their proprietary dividend databases, which they use

[4]See Campbell and Shiller (1988), Cochrane (1991b), Lettau and Ludvigson (2001), Cochrane (2008), Binsbergen and Koijen (2010) and the references therein.

firm-wide both as a pricing source and to mark the internal trading books to the market. Before 2008, index dividend futures and swaps were traded in over-the-counter (OTC) markets. Since 2008, dividend futures are exchange traded for several major indexes in an increasingly liquid market.

Our paper relates to Binsbergen, Brandt, and Koijen (2010) (BBK) who use options on the S&P500 index (LEAPS) to study the asset pricing properties of short-term dividend strips. Using put-call parity, they uncover the prices of short-term dividend strips. An advantage of using index options is that these derivatives have been exchange-traded since 1996, and hence this approach results in a longer time series. BBK document several return properties for short-term dividend strips in comparison with the aggregate stock market, in particular that the average return on short-term dividend strips seems to be higher than those of the market. An important disadvantage, however, is that index options have fairly short maturities of up to three years. The advantage of our data set is that dividend futures contracts have maturities up to ten years and that we use data from three major markets.

1 Defining Equity Yields

An index dividend future is a standardized contract where, at maturity, the buyer pays the futures price, which is determined today, and the seller pays the dollar amount of dividends during a certain calendar year. Take for example the 2019 dividend future on the DJ Eurostoxx 50 index, which on October 13th 2010 traded for 108.23 Euros. On the third Friday of December 2019, the buyer of the futures contract will pay 108.23 Euros, and the seller of the futures contract will pay the cash dividend amount on the Eurostoxx 50 index that has been paid out between the third Friday in December of 2018 and the third Friday in December of 2019.

Let D_{t+n} denote the stochastic dividend paid out in n years from today's date t. Further, let $\mu_t^{(n)}$ denote the appropriate per-period discount rate for that dividend. Then the present value $P_{t,n}$ of D_{t+n} is given by:

$$P_{t,n} = \frac{E_t\left(D_{t+n}\right)}{\left(1+\mu_{t,n}\right)^n}. \tag{1}$$

Splitting up the discount rate into the interest rate for period n, denoted by $r_{t,n}$, and the risk premium for maturity n, denoted by $\theta_{t,n}$, we can rewrite equation (1) as:

$$P_{t,n} = \frac{E_t\left(D_{t+n}\right)}{((1+r_{t,n})(1+\theta_{t,n}))^n}. \quad (2)$$

Further, by defining $g_{t,n}$ as the per-period expected growth rate of dividends over the next n periods:

$$g_t = E_t\left[\left(\frac{D_{t+n}}{D_t}\right)^{\frac{1}{n}}\right] - 1, \quad (3)$$

we can rewrite expression (2) as:

$$P_{t,n} = D_t\left(\frac{1+g_{t,n}}{(1+r_{t,n})(1+\theta_{t,n})}\right)^n.$$

We then define the equity yield $g^{\star}_{t,n}$ as follows:

$$g^{\star}_{t,n} \equiv \frac{1+g_{t,n}}{1+\theta_{t,n}} - 1 \approx g_{t,n} - \theta_{t,n}. \quad (4)$$

From equation 20, it can be seen that the equity yield, which has a time subscript t and a maturity subscript n, can be interpreted as a risk-adjusted expected growth rate, as it describes the difference between the per-period expected growth rate $g_{t,n}$ and a per-period risk premium $\theta_{t,n}$. We can compute $g^{\star}_{t,n}$ using two observables, the price-dividend ratio of dividend strip n and the risk free interest rate for period n:

$$g^{\star}_{t,n} = \left(\frac{P_{t,n}}{D_t}\right)^{\frac{1}{n}}(1+r_{t,n}). \quad (5)$$

In reality, the way the contract is quoted, is not in terms of the "spot" price $P_{t,n}$, but in terms of the futures price, which we will denote by $F_{t,n}$. Under no arbitrage, the spot price and the futures price are linked through the risk free rate:[5]

$$F_{t,n} = \frac{P_{t,n}}{(1+r_{t,n})^n}.$$

[5]Note that this formula holds for non-dividend paying assets. At first sight this may be confusing, as the focus of the paper is on dividends. Note that the index does indeed pay dividends, and therefore futures on the index are affected by these dividend payments. However, the futures contracts we study are not index futures, but dividend futures. These dividend futures have the dividend payments as their underlying, not the index value. As dividends themselves do not pay dividends, the formula below is the appropriate formula.

This implies that the equity yields follow directly from the futures prices and the risk free rate is no longer required as an input:

$$g^{\star}_{t,n} = \left(\frac{F_{t,n}}{D_t}\right)^{\frac{1}{n}} - 1. \tag{6}$$

Note that the equity yield $g^{\star}_{t,n}$ is the per-period risk adjusted expected growth rate for the next n-years. As such it represents an average expected growth rate. However, when considering a 10-year horizon, for example, it may also be interesting to compute the expected growth rate between periods 5 and 10, which we will call the forward growth rate. The forward equity yield between period n_1 and n_2, where $n_2 > n_1$, is defined as:

$$f_{t,n_1,n_2} \equiv \left(\frac{F_{t,n_2}}{F_{t,n_1}}\right)^{\frac{1}{n_2-n_1}} - 1. \tag{7}$$

Finally, we derive what return strategy (or investment strategy) is required to earn the risk premium $\theta_{t,n}$. It can be earned by buying the n-period futures contract at time t, holding it until maturity $t+n$ and collecting the dividends at period $t+n$. The n-period return on this strategy is given by:

$$R^D_{t+n} = \frac{D_{t+n}}{F_{t,t+n}} = \frac{D_{t+n}/D_t}{F_{t,t+n}/D_t} \tag{8}$$

Because the futures price is paid at time $t+n$, this is a zero cost strategy, which implies that no money is exchanged at time t. The expected return on this strategy is given by:

$$E_t\left[R^D_{t+n}\right] = E_t\left[\frac{D_{t+n}}{F_{t,t+n}}\right] = E_t\left[\left(\frac{D_{t+n}}{D_t}\right)\left(\frac{D_t}{F_{t,t+n}}\right)\right] = \left(\frac{1+g_t}{1+g^*_t}\right)^n = (1+\theta_{t,n})^n$$

As with all futures contracts, the replicating strategy of this derivative is to borrow in the n-year bond market, buy the asset (dividend strip) in the spot market (supposing for the sake of the argument that this spot market exists), collect the payoff (dividend) at maturity and use the proceeds to pay off the bond. Because this replicating strategy involves shorting the n-year bond, this strategy involves paying (as opposed to earning) the n-year bond risk premium. This will lead to a different risk premium $\theta_{t,n}$ compared to the risk premium that an investor would earn in the dividend strip spot market, as studied in Binsbergen, Brandt, and Koijen (2010). A second difference with Binsbergen, Brandt, and Koijen (2010) is that $\theta_{t,n}$ is the risk premium earned when the investment horizon is equal to the maturity of the futures contract n, whereas Binsbergen, Brandt, and Koijen (2010) study the risk premium on monthly returns of dividend strips with an average maturity of 1.5 years. So, for example, if n equals two years, then $\theta_{t,n}$ is the average risk premium earned when buying and holding the futures contract for 2 years and collecting the dividend at maturity.

2 Data and Summary Statistics

2.1 Choice of Stock Indices

We focus our analysis on the dividends of three major stock indices representing three world regions: the US, Europe and Japan. For Europe, we use the EURO STOXX 50 Index. This index is a leading blue-chip index for the Eurozone. The index covers 50 stocks from 12 Eurozone countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain traded on the Eurex. In February 2011, the index has a market capitalization of 2 Trillion Euros (2.8 Trillion dollars) and captures approximately 60% of the free float market capitalization of the EURO STOXX Total Market Index (TMI), which in turn covers approximately 95% of the free float market capitalization of the represented countries. As such, the index seems fairly representative for the euro area despite the fact that it only includes 50 stocks. For Japan, we focus on the Nikkei 225 index, which is the major stock index for the Tokyo Stock Exchange in Japan. The Nikkei 225 has a market capitalization of over 2 Trillion dollars. It is comprised of 225 blue chip stocks on the Tokyo Stock Exchange. Finally, we use the S&P500 index for the US. The S&P 500 is a capitalization-weighted index of the prices of 500 large-cap common stocks actively traded in the United States. The stocks included in the S&P 500 are those of large publicly held companies that trade on one of the two largest American stock market exchanges; the NYSE and the NASDAQ. The market capitalization is just over 12 Trillion dollars. As a comparison, the S&P1500 index, which also includes mid-cap and small-cap companies, has a market capitalization of about 13 Trillion dollars, suggesting that the S&P500 index is a representative index for the US economy.

2.2 Equity Yields

The market for dividend products is relatively young and started around the turn of the century. With increased trading activities in options, forwards, and structured products, dividend exposures increased on investment banks' balance sheets. This exposes banks to dividend risk, the risk between anticipated and actual dividends. Other than investment banks, hedge funds and pension funds are important participants in this market. Most of the trading in dividends occurs in the over-the-counter (OTC) market. Since mid 2008, however, exchange-traded dividend futures markets have started; first in Europe (SX5E) and later in Japan (NKY).[6]

The current size of the exchange traded dividend future market is substantial, particularly in Europe, with a total open interest of $10 billion for the DJ Eurostoxx 50 index. This is in addition to a large OTC market. For example, by mid October 2010, the open interest in the exchange-traded Dec 2010 dividend future on the DJ Eurostoxx 50 was 1.7 billion dollars. The open interest in the Dec 2011 contract was 2.5 billion dollars. The open interest decreases for longer maturity contracts, but even the Dec 2019 contract has a 200 million dollar open interest.

The pay-off of a contract is the sum of the declared ordinary gross dividends on index constituents that go ex-dividend during a given year. Special or extraordinary dividends are excluded.[7] Contracts are cash-settled at the expiration date and there are no interim cash flows. So, for example, the payoff of the 2019 dividend futures contract on the Dow Jones Eurostoxx 50 index are the declared ordinary gross dividends on index constituents that go ex-dividend between the third Friday of December of 2018 and the third Friday of December in 2019.

To compute daily dividends, we obtain daily return data with and without distributions (dividends) from S&P index services for the S&P500 index. We use Global Financial Data and Bloomberg to obtain the same objects for the DJ Eurostoxx50 index and the Nikkei 225 index. Cash dividends are then computed as the difference between the return with distributions and the return without, multiplied by the lagged value of the index. As the dividend futures prices are based on a full calendar year of divide nds,

[6]Exchange-traded dividend futures are also available for the FTSE 100 index in the United Kingdom, the HSI and HSCEI indices in Hong Kong, for the AEX index in the Netherlands and for Russian energy companies. Finally, individual dividend futures are also available for all constituents of the Euro Stoxx 50 index and 13 UK underlyings.

[7]Over time, the share of special dividends as a fraction of total dividends, has decreased and is negligible for the sample period that we consider, see DeAngelo, DeAngelo, and Skinner (2000).

we use the past year of dividends as the denominator in equation (6). For example, if we want to compute the equity yields on October 15th 2010, we use as the denominator the sum of the dividends paid out between October 16th 2009 and October 15th 2010. This also reduces concerns related to seasonalities, as both the future dividend price as the current dividend level refer to a whole year of dividends.

2.2.1 Equity yields of the S&P 500

The equity yields for the S&P 500 index between October 2002 and April 2011 are plotted in Figure 1. The four lines (in color) in each graph represent the equity yields for four horizons: 1, 2, 5, and 7 years. The graph shows that between 2003 and 2007, short-maturity equity yields were higher than long-maturity equity yields. During the financial crisis this pattern reversed and short-maturity equity yields plummeted compared to long-maturity equity yields. However, long-maturity equity yields also decreased substantially.

The 1-year equity yield for the S&P500 index displays a double dip, the first occurring on December 15th 2008 and the second occurring on March 4th of 2009, with values of -25.4% and -29.9%, respectively. The S&P 500 index level also exhibits a double dip, but the troughs occurred on November 20th 2008, with a level of 752.44 and March 5th with an index level of 682.55. The 2, 5, and 7 year equity yields do not exhibit a double-dip pattern and coincide with the second dip of the 1-year growth rate on March 4th, with values of -25.6%, -10.0% and -6.7% respectively. Finally, a very steep decline in the one-year rate occurred in October 2008 when the rate dropped from -6.3% on October 1st to -24.4% on October 30th. Interestingly, the S&P 500 index level during this period only dropped from 1161.1 on October 1st to 954.1 on October 30th, which is substantially higher than its two troughs of 752.44 and 682.55. Long-maturity equity yields decline further between October 30th 2008 and November 20th 2008 when the index dropped another 22% from 968.8 to 752.44, but short maturity equity yields, stay roughly constant.

In Figure 2, we plot the forward equity yields for maturities between 1 and 2 years ($n_1 = 1$ and $n_2 = 2$), 2 and 5 years ($n_1 = 2$ and $n_2 = 5$), and 5 and 7 years ($n_1 = 5$ and $n_2 = 7$). Interestingly, forward equity yields between 2 and 5 years and 5 and 7 years initially did not decrease during the crisis but increased instead, which suggests that market participants priced in a relatively fast recovery after the initial steep decline.

2.2.2 Equity yields of the Eurostoxx 50 Index

In Figure 3, we plot the equity yields for the Eurostoxx 50 index. As before, the four lines (in color) in each graph represent the equity yields for four horizons: 1, 2, 5, and 7 years. The trough of the one-year rate occurs on March 31st 2009 with an equity yield of -41.1%. Similar to the S&P 500 index, the trough of the 1-year rate occurred after the trough of the index, with the latter occurring on March 9th 2009, when the index value hit 1810 Euros. Compared to the troughs of the S&P500 index, the troughs of the Eurostoxx 50 index occurred later, both for the index and for the 1-year expected growth rate.

As with the S&P500 index, there is one particular period of very steep decline for the one-year rate. Between October 1st and October 24th 2008 the one-year equity yield decreased from -8.4% to -39.7%. In Figure 4, we plot the forward equity yields. Similar to the expected forward growth rates of the S&P500 index, forward rates between 2 and 5 years and 5 and 7 years did not decrease during the crisis but increased instead.

2.2.3 Equity yields of the Nikkei 225

In Figure 5, we plot the equity yields for the Nikkei 225 index. The trough of the one-year rate occurs on March 25th 2009 with an equity yield of -44.3%. The index reached its trough on March 10th 2009 with an index level of 7055.0, which as with the other two indexes is before the 1-year growth rate reached its trough.

Between October 1st and October 30th 2008, the one-year equity yield decreased from -5.4% to -25.6%. Apart from this steep decline, there is no particular period over which the growth rate declined abruptly and the growth rate drifts downward gradually to its trough of -44.3%.

In Figure 6, we plot the forward equity yields. As for the S&P500 and the Eurostoxx 50 index, forward equity yields between 2 and 5 years and 5 and 7 years did not decrease during the crisis but increased instead.

2.2.4 Summary Statistics of the Equity Yields of All Three Markets

In Table 1 we report the summary statistics of the equity yields for all three indexes and for all ten maturities. The average 1-year equity yield is highest for Japan (5.31%) and lowest for Europe (-1.2%). The average 1-year equity yield for the US is 3.4%. The average 7-year equity yield 2.6% for the US and Japan and -0.6% for Europe.

The volatilities of the equity yields decline monotonically with maturity for all three indices, reminiscent of bond yields (see for instance Dai and Singleton (2003)). The volatility of equity yields is highest for Japan and lowest for the US at all maturities. Further, over this sample period the equity yields are negatively skewed, which is induced by the large negative numbers during the financial crisis.

2.3 Bond yields

We use monthly Fama-Bliss bond yields with maturities of 1,. . . , 5 years from the Center for Research in Security Prices (CRSP). We use the data from Gurkaynak and Wright (2008), which is updated until March 2011.[8]

2.4 Consumption growth

We construct seasonally-adjusted real consumption growth from the NIPA tables of the Bureau of Economic Analysis using a chain-weighted index of non-durable consumption and services.

3 Dividends and economic activity

Dividend markets provide us with a term structure of expected dividend growth. One may wonder to what extent aggregate dividends and aggregate dividend growth are related to more common measures of economic activity such as real consumption and GNP growth. To illustrate this relationship, we plot in Figure 7 the cyclical residuals of the Hodrick-Prescott filtered series for annual real consumption (levels), annual real GNP, and annual dividends, at a quarterly frequency. We set the smoothing parameter to $\lambda = 1,600$.

The graph shows that for many periods of expansions and recessions, the cyclical components of dividends, GNP, and consumption align. However, they are not perfectly aligned. Sometimes dividends lead consumption and GNP, and sometimes consumption and GNP lead dividends. The series align for the recent financial crisis as well as the recession in the early 2000s.

To illustrate the correlation between the cyclical components of consumption, GNP, and dividends, we compute the 10-year rolling time-series correlation between the series. The results are reported in Figure 8. First, the figure indicates that the correlation

[8]The data is available from `http://www.federalreserve.gov/econresdata/researchdata.htm`.

between the cyclical components of consumption and dividends or GNP and dividends are very similar. The time series of the rolling correlations strongly co-move. Second, apart from the early sixties and the nineties, the time-series correlation appears well above 0.5 and peaks in periods with deep recessions. This suggests that dividends and other measures of economic activity are strongly related. The last data point in the figure shows that the correlation between consumption and dividends over the past ten years, which roughly corresponds to our sample period, is above 0.8.

4 Dividend Growth Predictability and Risk Premia

In this section we explore to what extent equity yields can be used to predict dividend growth of the S&P 500 index. This approach follows a long tradition in macro-finance using yield-based variables to forecast either returns or cash flows. Examples include Campbell and Shiller (1988), Cochrane (1991a), and Binsbergen and Koijen (2010) for the aggregate stock market, Fama (1984) for currency markets, and Fama and Bliss (1987), and Campbell and Shiller (1991), and Cochrane and Piazzesi (2005) for bond markets.

As equity yields are equal to expected dividend growth minus a risk premium component, they are natural candidates to predict dividend growth. We use a Bayesian Model Averaging (BMA) approach to compare the performance of equity yields to a set of linear prediction models that are commonly used in the empirical literature to predict economic growth. Once we obtain an estimate of expected dividend growth, it is then straightforward to back out the risk premium component.

4.1 Dividend Growth Predictability and Equity Yields

First, we run a set of univariate regressions to explore the predictability of dividend growth by equity yields. In the next subsection, we will explore bivariate regressions. The main reason to include two (or more) equity yields is that equity yields do not only move because of expected dividend growth variation but also because of risk premium variation. This risk premium variation can negatively affect the predictive power of each individual equity yield. If the risk premium variation across equity yields of different maturities is correlated, including multiple yields will improve the forecasting power.

We focus on annual dividend growth to avoid the impact of seasonal patterns in corporate payout policies, but we use overlapping monthly observations to improve the power of our tests. We thus run the following regressions for $n = 1, .., 5$:

$$\dot{d}_{t+12} = \alpha + \beta g^{\star}_{t,n} + \varepsilon_{t+12} \tag{9}$$

where

$$\dot{d}_{t+12} = \frac{\sum_{i=1}^{12} D_{t+i}}{\sum_{i=1}^{12} D_{t-12+i}} - 1 \tag{10}$$

The growth rate $\dot{d}$ is based on the summed dividends within the year, which is also the measure of aggregate annual dividends the futures contract is based upon.[9]If the risk premium on the one-year equity yield is constant, then it holds that $\beta_1 = 1$. If there is time variation in the risk premium that is not perfectly correlated with expected dividend growth, this is reflected by a deviation of β_1 from one.

The results are presented in panel A of Table 2. The first column reports the point estimate. The second column reports the Hansen Hodrick standard errors. The final column reports the R-squared value. We find that all equity yields have strong predictive power for future dividend growth. The R-squared values are high and vary between 48% for the 5-year yield and 76% for the 1-year yield. This suggests that dividend growth rates, at least during this sample period, are strongly predictable. The R-squared value of the regression monotonically decrease with the maturity of the equity yield. As we are predicting one-year dividend growth, it is not surprising that the one-year equity yield has the highest R-squared value and the 5-year equity yield has the lowest.

Second, we find that the predictive coefficients are monotonically increasing in maturity. As a point of reference, it may be useful to derive what these coefficients look like under two, admittedly strong, assumptions. Namely, if we assume that the risk premium on short-dividend strips is constant and expected dividend growth is an AR(1) process with autoregressive coefficient ρ, then it is straightforward to show that:

$$\beta_n \simeq \frac{n(1-\rho)}{1-\rho^n}. \tag{11}$$

This expression directly implies $\beta_1 = 1$, as discussed before. We can also solve for ρ for $n = 5$ given $\beta_5 = 2$. This corresponds to an annual autoregressive coefficient of $\rho = 0.64$.[10]

[9]Summing the dividend within the year is also done by Fama and French (1988). Alternatively, one could reinvest dividends at the 1-month T-bill as in Binsbergen and Koijen (2010). The resulting aggregate dividend series is very similar for both reinvestment policies.

[10]This calculation approximately results in the persistence of the equity yield if the persistence of expected returns and expected growth rates is identical.

4.2 Bayesian Model Averaging

We now compare the performance of equity yields as a predictor of US dividend growth with several other common predictors of economic growth using a Bayesian Model Averaging (BMA) approach. The main advantage of BMA in our setting, is that it trades off a longer time series of other common predictor variables, which is more informative about the predictive relationship, against the shorter time series of equity yields that appear to predict growth more accurately. We follow Fernandez, Ley, and Steel (2001) and Wright (2008) and the references therein, and consider a set of k linear models $M_1, ...M_k$. We will predominantly focus on models with two forecasting variables. Let the i^{th} linear model be given by:

$$\dot{d}_{t+12} = \beta_i z_{i,t} + \varepsilon_{t+12} \tag{12}$$

where z_i is the matrix of regressors for model i. The econometrician knows that one of these models is the true model, but does not know which one.

Let $\pi(M_i)$ denote the prior probability of model i being the true model. Conditional on seeing the data up to time s, (denoted by X_s) for dividend growth and the predictor variables, the posterior probability of model i being the true model is given by:

$$\pi(M_i|X_s) = \frac{\pi(X_s|M_i)\,\pi(M_i)}{\sum_{i=1}^{k} \pi(X_s|M_i)\,\pi(M_i)} \tag{13}$$

In January 1954, we start with a flat prior over all models, in the sense that we assign equal probability to each model:

$$\pi(M_i) = \frac{1}{k} \tag{14}$$

We make the following assumptions regarding the prior distributions of the parameters. For β, we take the natural conjugate g-prior specification (Zellner (1986)), so that the prior for β conditional on the variance of the error term σ^2 is $N(0, \phi\sigma^2(X'X)^{-1})$, where ϕ is a shrinkage parameter. For σ, we assume the improper prior that is proportional to $1/\sigma$. Finally, we take into account the fact that we use overlapping data, by modeling an MA-structure for ε_t:

$$\text{cov}(\varepsilon_t, \varepsilon_{t-j}) = \sigma^2 \frac{h-j}{h} \tag{15}$$

where h measures the amount of overlap in the data, i.e., $h = 12$ for monthly data, $h = 4$ for quarterly data. Under these assumptions, the likelihood of the data up until time s, denoted by X_s, given the model, is given by:

$$\pi\left(X_s|M_i\right) = \frac{\Gamma(s/2)}{\pi^{0.5}}(1+\phi)^{-p/2}H_i^{-s/h} \tag{16}$$

where $\Gamma(.)$ is the gamma function, p is the number of regressors, and H_i^2 is given by:

$$H_i^2 = \dot{d}'\dot{d} - \dot{d}'z_i(z_i'z_i)^{-1}z_i'\dot{d}\frac{\phi}{1+\phi} \tag{17}$$

where $\dot{d}$ is the vector of realized dividend growth rates up until time s (the subscript s is dropped for ease of notation), and z_i is the matrix with the regressors of model i up until time s.

The parameter p can be interpreted as a penalty on the number of regressors, and a higher number of p will lead to a lower likelihood value, even if the predictive power is the same. We set the shrinkage parameter ϕ to 1.

Without loss of generality, we demean all variables on the right hand side of the equation. If for a certain value of s the sample is such that the predictors do not exist in the beginning of the sample, but do exist later in the sample, the parameter p is set to 2, and a maximum mean-squared error is added to the likelihood for the missing observations. The latter is equivalent to setting the value of the predictor variables equal to 0 for these periods. In this way we take a conservative approach towards the value added of equity yields when predicting dividend growth. Put differently, this assumption works against the model for equity yields, and relaxing this assumption would make our findings stronger.

We consider five different models using data between 1954 and 2011. The first four models have 2 predictor variables and the fifth model has no predictor variables, that is, under model 5, dividend growth follows a random walk. The first model has two equity yields as the predictors (the 2-year and the 5-year equity yield), the second model has two bond yields (the 2-year yield and the 5-year bond yield), the third model has the 2-year bond yield and the credit spread, and the fourth model has the dividend yield and the credit spread. Adding two real bond yields as a model leaves our results unaffected and the posterior probability of this model converges to 0. For ease of presentation, we focus on the five models above.

For models 2, 3, 4, the data exists for every value of s. For equity yields, the data starts in October 2002, indicated by the vertical black line. Even though for equity yields there are many subsamples X_s where no data is available, we still set $p = 2$ for every value of s. In other words, equity yields do receive the penalty for 2 regressors, despite the fact that for all subsamples before 2002 no data is available.[11] Finally, for the fifth model where dividend growth follows a random walk, we set $p = 0$ as there are no regressors for any subsample. Because the random walk model does not receive a penalty for including regressors, it can outperform the other models despite having a larger mean-squared error.

The figure shows that an economic agent who in 1954 assigns a probability of 0.20 to each of the four models, in 2011 has a updated probability of about 0.9 that the model with 2 equity yields is the right model to predict dividend growth with, despite its very short sample and hence its large uncertainty regarding the predictive relationship.

Finally, we compare the model without predictors (a random walk for dividends) with the model of two equity yields. That is, we perform the thought experiment where a real-time investor has to choose between a model in which dividend growth is unpredictable, and a model where dividend growth is predictable by two equity yields. The investor knows that one of these two models is the true model. The results are presented in Figure 10. The vertical line shows the point at which data for equity yields becomes available (October 2002). Because the penalty parameter p is set to a value of 2 for the model with equity yields and to 0 for the random walk model, and the prediction error is equal for both models up until 2002, the posterior probability for the random walk model is higher than that for the equity yields model to the left of the black line. However, as soon as data for equity yields becomes available, this model quickly takes over. At the end of our sample the posterior probability of the model with two equity yields approaches the upper bound of 1.

4.3 Risk Premia

Using the estimates of expected dividend growth from the previous section, we can now uncover the risk premium component present in the yields. Given that the posterior probability of using 2 equity yields as the predictors is above 0.9, we use this model as our model for dividend growth.[12] If one has a prior that other predictors should be added

[11]As before, this assumption works against the model for equity yields. Relaxing this assumption would make our findings stronger.

[12]Alternatively, we could include the predictions from the other models as well, weighted by their posterior probabilities. However, given that the probabilities of each of the other individual models is so small compared to the equity yield specification, it seems reasonable to proceed with just equity yields.

to the predictive relationship, than those predictors can be used to enhance the estimate of expected growth and hence the estimate of the risk premium.

Let x denote the vector of the 2-year and 5-year equity yields:

$$x_t = \left[g^{\star}_{t,2} \ \ g^{\star}_{t,5}\right]'. \tag{18}$$

Our model for expected dividend growth is then given by:

$$g_{t,n} = E_t\left(\dot{d}_{t+12}\right) = \psi_0 + \psi_1' x_t \tag{19}$$

where we estimate the coefficients ψ_0 and ψ_1 by OLS. Recall that equity yields relate to expected growth rates and the risk premium component as follows:

$$g^{\star}_{t,n} \equiv \frac{1+g_{t,n}}{1+\theta_{t,n}} - 1. \tag{20}$$

Rewriting this equation we find:

$$\theta_{t,n} = \frac{1+g_{t,n}}{1+g^{\star}_{t,n}} - 1. \tag{21}$$

To compute the $n-$year expectations (where n¿1), we model the time-series dynamics of equity yields as a first-order vector autoregressive (VAR) model:

$$x_{t+1} = \mu + \Gamma x_t + \varepsilon_{t+1}. \tag{22}$$

The monthly VAR model implies and annual VAR model:

$$x_{t+12} = \mu_A + \Gamma_A x_t + \varepsilon_{A,t+12},$$

where:

$$\mu_A \equiv \left(\sum_{i=0}^{11} \Gamma^i\right)\mu,\ \Gamma_A \equiv \Gamma^{12},\ \varepsilon_{A,t+12} \equiv \sum_{i=1}^{12} \varepsilon_{t+i}.$$

We estimate the parameters using ordinary least squares (OLS). To use as much information as possible, we use overlapping data.

Using the joint dynamics for dividend growth from (19) and the equity yields (22), we can compute the conditional expectation of one-year dividend growth as:

$$\begin{aligned} E_t\left(\dot{d}_{t+12}\right) &= \psi_0 + \psi_1' x_t \\ &\equiv \gamma_{0(1)} + \gamma_{1(1)}' x_t. \end{aligned}$$

and the expectation of annual dividend growth n years ahead ($n > 1$) as:

$$\begin{aligned} E_t\left(\dot{d}_{t+12n}\right) &= E_t\left(\psi_0 + \psi_1' x_{t+12(n-1)}\right) \\ &= \psi_0 + \psi_1'\left(\left[\sum_{i=0}^{n-2}\Gamma_A^i\right]\mu_A + \Gamma_A^{(n-1)} x_t\right) \\ &\equiv \gamma_{0(n)} + \gamma_{1(n)}' x_t. \end{aligned}$$

The equity yield can now be written as:

$$\begin{aligned} g_{t,n}^{\star} &= (1+g_{t,n})(1+\theta_{t,n}) - 1 \\ &= \left(\frac{1}{n}\sum_{i=1}^{n}\left(\gamma_{0(n)} + \gamma_{1(n)}' x_t\right)\right)(1+\theta_{t,n}). \end{aligned}$$

We observe the left-hand side, $g_{t,n}^{\star}$, and we estimate the first term on the right-hand side, using the VAR, resulting in an estimate for the risk premium for all maturities n.

The results are presented in the top panel of Figure of 11. The graphs shows that risk premium varies over time, and increases during the recent financial crisis. The average risk premium for the 2-year and 5-year yield are equal and about 3.2% per year for the 2-year yield and 3.5% per year for the 5-year yield.

We find that the risk premium estimates fluctuate substantially over time. In fact, the estimates imply that the short-term risk premium component in fact fluctuates more than the longer-maturity component.[13] Perhaps most interestingly, we find that the term structure of risk premia is more inverted during the recession. The results in Binsbergen, Brandt, and Koijen (2010) already suggest that the risk premium component on the short-maturity dividend claims is on average higher than on the long-maturity dividend claims.[14] We extend this evidence by showing that the steepness of the decline in the

[13]The two-year risk premium component turns somewhat negative during the period 2006-2007, which is attributable to the short sample we have available. As an extension, one can consider to estimate the model under the condition that the risk premium component needs to be positive, see also Campbell and Thompson (2007).

[14]This is consistent with the models developed in Lettau and Wachter (2007), Lettau and Wachter

term structure of risk premia is counter-cyclical.

In Figure 12, we decompose the 2-year equity yields into expected growth rates and risk premia. The plot shows that both risk premia and expected growth rates vary substantially over time. Furthermore, during the financial crisis, expected growth rates went down, whereas risk premia sharply increased.

4.4 Predictability and Risk Premia in Europe and Japan

We then repeat the same analysis for Europe (the DJ Eurostoxx 50) and Japan (the Nikkei 225). All the results are consistent with the results found for the S&P500 index. The univariate predictability results are presented in panels B and C of Table 2. As for the S&P 500 index, dividend growth seems strongly predictable, with R^2 values above 50%. The risk premia, shown in the second and third panel of figure 11, vary strongly over time and are always positive. The average value of the risk premia is high and higher than for the US. For Europe the average risk premium is 10.9% for the 2-year contract and 10.6% for the 5-year contract. For Japan, the average risk premium is 7.2% for the 2-year contract and 6.7% for the 5-year equity yield.[15] We do stress again that the sample period is rather short, which makes the estimation of these unconditional means imprecise.

The decomposition of the equity yields into expected growth rates and risk premia is presented in Figures 13 and 14. As for the S&P 500 index, equity yields seem to vary both due to risk premium fluctuations as well as due to variation in expected dividend growth.

5 Consumption Growth

5.1 Reduced Form Regressions

The previous results show that our newly-constructed data set of equity yields is useful in forecasting future dividend growth. We now extend these results for the US and show that S&P500 equity yields also predict future annual consumption growth. We study the

(2010), Croce, Lettau, and Ludvigson (2009), Barro, Nakamura, Steinsson, and Ursua (2011), Lynch and Randall (2011), and Buraschi, Porchia, and Trojani (2010).

[15]Note also that the average risk premia on the 2-year and 5-year equity yield are higher than the average excess return on the corresponding index, as also pointed out by Binsbergen, Brandt, and Koijen (2010)

same type of forecasting regressions as before:

$$\dot{c}_{t+12} = \frac{\sum_{i=1}^{4} C_{t+i}}{\sum_{i=1}^{4} C_{t-4+i}} - 1, \tag{23}$$

where C_t is now quarterly consumption.[16]

We present the results in Panel A of Table 3. The structure of the table is the same in Table 2. Consistent with our results for dividend growth predictability, we uncover predictability of one-year consumption growth as well, using overlapping quarterly data. The coefficients are much smaller in this case, which follows from the fact that dividend growth is more volatile than consumption growth during our sample period. As expected, the coefficients are increasing with maturity as long-term equity yields are less exposed to fluctuations in short-term expected growth rates.

As a point of reference, we use in Panel B of Table 3 nominal bond yields to forecast annual consumption growth. We use either the 1-year or the 5-year bond yield, or the yield spread between the 5-year and 1-year bond yields. Even though the 5-year bond yield is a fairly strong predictor of consumption growth, it is not nearly as powerful as the equity yields as reported in Panel A. In Panel C, we show that even using real bond yields, we do not uncover strong predictability.

There is a long literature studying the predictability of consumption growth using bond yields, see for instance Harvey (1988) and Kandel and Stambaugh (1991). The reason why our bond yields may be superior predictors of growth may be due to the fact that the link between short-term interest rates and expected inflation has been unstable, see for instance Clarida, Gali, and Gertler (2000), Cogley and Sargent (2005), and Ang, Boivin, Dong, and Loo-Kung (2010). In addition, the sample period that we are studying may be special in that the nominal short rate is close to zero for some part of the sample. The zero lower bound on interest rates may introduce non-linear relations between growth and both nominal and real bond yields, see for instance Christiano, Eichenbaum, and Rebelo (2011).

5.2 Bayesian Model Averaging

We then apply the BMA approach to consumption growth. We use the exact same setup as in section 4.2, but now use consumption growth as the left-hand-side variable. As

[16] We use real personal consumption expenditures (PCE) on nondurables and services.

before, we take a conservative approach with respect to equity yields as predictors of consumption growth by setting the penalty parameter $p = 2$ even for subsamples where no data is available.

First, we compare the model without predictors (a random walk for consumption) with the model of two equity yields. That is, we perform the thought experiment where a real-time investor has to choose between a model in which consumption growth is unpredictable, and a model where consumption growth is predictable by two equity yields. The investor knows that one of these two models is the true model. The results are presented in Figure 15. As before, the vertical black line shows the point at which data for equity yields becomes available (2002). Because the penalty parameter p is set to a value of 2 for the model with equity yields and to 0 for the random walk model, and the prediction error is equal for both models up until 2002, the posterior probability for the random walk model is higher than that for the equity yields model before 2002. However, as soon as data for equity yields becomes available, this model takes over. At the end of our sample the posterior probability of the model with two equity yields increases from 0.33 to 0.56, and the random walk model changes from a probability of 0.77 to 0.44. Note that this change is not as large as the change for dividend growth in the previous section, but it does suggest that equity yields have some value in predicting consumption growth.

We then include the other three models with two regressors (two bond yields, credit spread and short-term bond yield, and credit spread and dividend yield). The results are presented in Figure 16. Recall that for all the other predictors the data exists for the whole sample period. The figure shows that for the early part of the sample, the posterior probability of the other models increases substantially, and the probability that the equity yields model is the correct one decreases to as low as 4.9%. After 2002, this probability almost doubles to 9.1%. It thereby outperforms both the model with 2 bond yields as well as the random walk model, but does "worse" with respect to the models that include the credit spread in the sense that these models are assigned a higher posterior probability.

6 Do equity yields contain other information than bond yields?

To assess whether equity yields contain information beyond and above the information contained in bond yields, we compute the principal components of nominal and real bond yields and regress each of the equity yields on these principal components. In all cases, the first principal component explains more than 95% of the variation in either equity, nominal bond or real bond yields. Table 4 reports the R^2 values of these regressions. We only report results for the first two principal components for nominal and real bonds, because adding the third component leads to almost identical results as using two principal components. Furthermore, nearly all variation in nominal and real bond yields is captured by their first two principal components.

The table shows that the R^2-values when including the first two principal components of nominal yields are between 30 and 39%. The R^2 values are increasing in the maturity. The largest share of the variation is explained by the first principal component, and the second principal component does not seem to add much. When using the principal components of real yields, we find very low R^2 values, never exceeding 5%. However when we include the first two principal components of real yields and the first two principal components of nominal yields in one regression, the R^2 values jump up to 73% for the 1-year equity yield, and 60% for the 5-year equity yield. This still leaves a substantial fraction of the variation in equity yields that is unexplained by the term structure of interest rates.

To further assess the relation between bond yields and equity yields, Table 5 describes the correlations between the first two principal components of equity yields, the first two principal components of bond yields and the first two principal components of real yields. We find that equity yields seem generally positively correlated with nominal bond yields, but negatively correlated with real yields, both in levels as in innovations.

7 Applications

7.1 Economic outlook around the world

Next, we use the framework we develop in Section 4.3 to compute longer-term growth expectations. As before, instead of using a single equity yield, we use two equity yields with maturities equal to 2 and 5 years, respectively. We use multiple equity yields as there may be separate factors driving expected growth rates and the risk premium component, as suggested by the models of Bansal and Yaron (2004), Lettau and Wachter (2007), Lettau and Wachter (2010), and Menzly, Santos, and Veronesi (2004).[17]

[17]Other examples include Croce, Lettau, and Ludvigson (2009) and Bekaert, Engstrom, and Xing (2009).

In Figures 17 and 18, we plot the 2-year and 5-year expected growth rates across regions. First, the troughs of the financial crisis for the 2-year expected growth rate were more severe for Japan and Europe than for the US. Second, 2-year expected growth rates decline substantially to -30% in Europe in the bottom of the crisis. Even during a 5-year period (Figure 18), there is a double digit decline in expected growth. The figures also show a marked decline in both 2-year and 5-year growth expectations in Japan following the earthquake.

7.2 Growth expectations and the financial crisis

In this section we study the term structure of growth during the financial crisis. We focus on particular months in which there was a large decline in either the short-term or the long-term growth rates (or both). Our main focus is on the S&P500 index.

7.2.1 November 2007

Between October 31st and November 29th 2007, the one-year equity yield (risk-neutral growth rate) for the S&P500 index decreased from 9.4% to 2.7%. The 5-year equity yield dropped from 5.5% to 3.6%, the 10-year equity yield dropped from 4.1% to 3.2% and the index value changed from 1549.4 to 1469.7, a drop of 5%. During this period several major events occurred. First, on October 31st, Meredith Withney, an analyst at Oppenheimer and Co. predicted that Citigroup had so mismanaged its affairs that it would have to cut its dividends or go bankrupt.[18] By the end of that day, Citigroup shares had dropped 8%, and four days later, Citigroup CEO Chuck Prince resigned. Also, on October 31st, the FOMC lowered the target rate by 25bp to 4.5%. Second, on November 2nd, the Fed approved the Basel II accord. Third, on November 27th, Citigroup raised $7.5 billion from the Abu Dhabi investment authority. Finally, the St. Louis Fed crisis time line notes for November 1st 2007: "Financial market pressures intensify, reflected in diminished liquidity in interbank funding markets."

7.2.2 September 2008

The month of September 2008 was a very turbulent month for financial markets. For example, on September 7th, the Federal Housing Finance Agency (FHFA) placed Fannie Mae and Freddie Mac in government conservatorship, and on September 15th, Lehman

[18] See "The Big Short" by Michael Lewis.

Brothers Holdings Incorporated files for Chapter 11 bankruptcy protection. Perhaps surprisingly, growth expectations for the US did not change all that much in September for all maturities. As an illustration, the 1-year yield was -6.2% on September 1st and -6.1% on September 30th, and the volatility of the 1-year equity yield was low. For the US, most of the drop in short- and long-term expectations occurred in October. Growth expectations in Japan and Europe on the other hand, did substantially drop in September as well as in October. For Europe, between September 1st and September 30th, the 1-year yield dropped from -3.9% to -7.9%, and the 10-year yield dropped from -0.8% to -1.8%. For Japan, the 1-year yield dropped from 5.6% to -4.6% and the 10-year yield dropped from 2.0% to 0%.

7.2.3 October 2008

During the month October the 1-year yield dropped from -6.3% on October 1st to -24.4% on October 30th. Over the same period, the 2-year yield dropped from -3.4% to -16.9%, the 5-year yield dropped from -0.5% to -5.8%, and the 10-year rate dropped from 0% to -1.4%. Several major events happen during this time period. Interestingly we find that the one of the largest drops in the one-year equity yield occurred around the time when former Federal Reserve chairman Alan Greenspan testifies before the House Committee of Government Oversight and Reform.

7.3 Growth expectations and the earthquake in Japan

The earthquake and subsequent tsunami in Japan in mid March of 2011 have had a significant impact on implied growth in Japan for all maturities. Growth rates for all maturities fell each day from Monday 14 to Thursday 17 March, to recover slightly on the joint G-7 intervention on Friday 18. The one-year equity yield dropped from almost 3% to more than -6.6% in the first four days, to rebound to -5% on Friday. Similarly, the 2-year equity yield dropped from 1.4% to -4.7% to settle at -4.2%. Even the 7-year equity yield changed from 0% to -2.3% and eventually settled at -1.8%. This indicates that financial markets expected long-lasting influence on Japanese economy. The US and Europe were much less affected by the Japanese situation, which illustrates that financial markets view these events as Japan-specific, rather than having an impact on global growth.

We use the same approach as before to extract the expected growth component from equity yields. The growth expectations for Europe seem unaltered by the events. During this period, the short-term growth expectations of the US slightly lowered, but the long-term growth expectations are unaffected. It is unclear whether this can be attributed to the crisis in Japan. For Japan, by contrast, we see that the short-term growth expectations are adjusted downwards by as much as 5%.

8 Conclusion

We use a new data set on traded dividends of three major stock indices with maturities up to 10 years to uncover expected dividend growth rates across three major regions around the world: the US, Europe, and Japan. We use these asset prices to derive equity yields, analogous to bond yields, and decompose these yields into expected growth rates of dividends and a risk premium component. We find that both risk premia as well as expected growth rates exhibit substantial variation over time. Further, we find that equity yields are strong predictors of dividend growth and may also be helpful when predicting consumption growth. We relate the dynamics of growth expectations to recent events related to the financial crisis and the recent turmoil following the earthquake in Japan.

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Maturity in years	1	2	3	4	5	6	7
S&P500 Index (Oct 2002 - Apr 2011)							
Mean	0.0337	0.0295	0.0288	0.0285	0.0277	0.0267	0.0263
Stdev	0.0964	0.0768	0.0571	0.0468	0.0402	0.0358	0.0329
Median	0.0639	0.0523	0.0417	0.0392	0.0341	0.0298	0.0251
Min	-0.2986	-0.2559	-0.1727	-0.1272	-0.1002	-0.0806	-0.0671
Max	0.1736	0.1385	0.1380	0.1134	0.1073	0.1008	0.0932
DJ Eurostoxx 50 Index (Oct 2002 - Apr 2011)							
Mean	-0.0116	-0.0206	-0.0156	-0.0119	-0.0089	-0.0083	-0.0063
Stdev	0.1435	0.1251	0.0921	0.0716	0.0582	0.0495	0.0424
Median	0.0208	-0.0038	-0.0032	-0.0077	-0.0082	-0.0097	-0.0092
Min	-0.4179	-0.4211	-0.3122	-0.2421	-0.1963	-0.1640	-0.1390
Max	0.2698	0.2120	0.1630	0.1333	0.1150	0.1053	0.0900
Nikkei 225 Index (Jan 2003 - Apr 2010)							
Mean	0.0531	0.0351	0.0303	0.0289	0.0282	0.0271	0.0260
Stdev	0.1780	0.1452	0.1107	0.0901	0.0761	0.0656	0.0570
Median	0.0375	0.0256	0.0184	0.0130	0.0101	0.0091	0.0095
Min	-0.4429	-0.4147	-0.3072	-0.2305	-0.1810	-0.1458	-0.1206
Max	0.3471	0.2545	0.2136	0.1822	0.1610	0.1406	0.1231

Table 1: Summary statistics equity yields

Panel A: S&P500

n	β_n	t-statistic	R-squared
1	0.91	7.52	75%
2	1.11	5.84	68%
3	1.36	5.02	57%
4	1.59	4.45	51%
5	1.75	3.90	45%

Panel B: Eurostoxx 50

n	β_n	t-statistic	R-squared
1	1.04	8.01	74%
2	1.15	7.24	70%
3	1.55	6.93	68%
4	1.95	6.47	64%
5	2.29	6.13	61%

Panel C: Nikkei 225

n	β_n	t-statistic	R-squared
1	0.67	5.06	65%
2	0.83	5.56	65%
3	1.08	5.66	64%
4	1.32	5.56	64%
5	1.56	5.43	63%

Table 2: Predictability of dividend growth by equity yields

Panel A: Consumption growth predictability by equity yields

	Estimate	T-statistic	R-squared
5-year	0.16	2.48	18.9%
4-year	0.16	2.86	23.2%
3-year	0.14	3.29	28.6%
2-year	0.12	3.97	36.9%
1-year	0.10	4.24	40.0%

Panel B: Consumption growth predictability by nominal bond yields

	Estimate	T-statistic	R-squared
1-year	0.20	1.18	4.9%
5-year	0.64	2.20	15.2%
5-1-year	-0.01	-0.02	0.0%

Panel C: Consumption growth predictability by real bond yields

2-year	-0.14	-0.49	1.1%
5-year	-0.15	-0.32	0.4%
5-2-year	0.66	1.16	5.8%

Table 3: Predictability of consumption growth by equity yields (Panel A) and bond yields (Panel B).

Maturity	n=1	n=2	n=3	n=4	n=5
Right hand side variables					
PC1 nominal bonds	0.3030	0.2995	0.3413	0.3703	0.3768
PC1 + PC2 nominal bonds	0.3163	0.3105	0.3413	0.3728	0.3831
PC1 real bonds	0.0371	0.0372	0.0129	0.0041	0.0012
PC1 + PC2 real bonds	0.0458	0.0442	0.0150	0.0042	0.0013
PC1 + PC2 nominal and PC1 + PC2 real bonds	0.7483	0.7059	0.6585	0.6473	0.6071

Table 4: R^2 values of contemporaneous regressions of equity yields, with maturities n=1,...5 years on principal components of nominal and real bond yields. We use the first two principal We use monthly observations between October 2002 and March 2011.

Correlations

Panel A: Levels

	PC1 Eq	PC2 Eq	PC1 Nom B.	PC2 Nom B.	PC1 Real B.	PC2 Real B.
PC1 Equity	1	0	0.60	-0.05	-0.06	-0.04
PC2 Equity		1	-0.06	-0.36	-0.50	-0.27
PC1 Nom Bonds			1	0	0.59	-0.26
PC2 Nom Bonds				1	0.14	0.86
PC1 Real Bonds					1	0
PC2 Real Bonds						1

Panel B: Innovations

	PC1 Eq	PC2 Eq	PC1 Nom B.	PC2 Nom B.	PC1 Real B.	PC2 Real B.
PC1 Equity	1	-0.05	0.40	-0.23	-0.28	-0.14
PC2 Equity		1	0.03	0.07	-0.30	0.03
PC1 Nom Bonds			1	-0.76	0.28	-0.65
PC2 Nom Bonds				1	-0.31	0.74
PC1 Real Bonds					1	-0.17
PC2 Real Bonds						1

Table 5: Correlations between principal components. The Panel A describes correlations in levels, and Panel B describes the correlation in innovations of a VAR(1) model of all six variables.

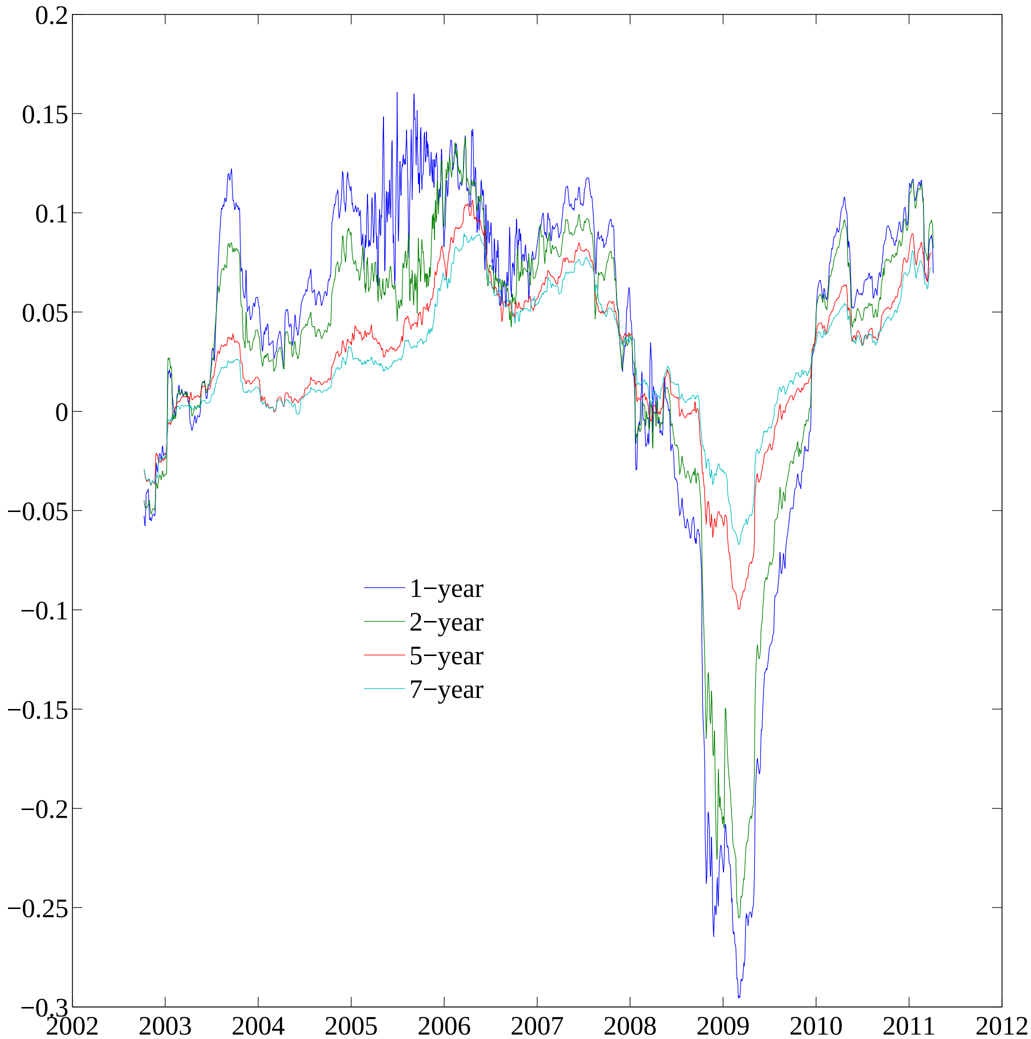

Figure 1: Equity yields: S&P500 Index
The graph displays the equity yields $g^{\star}_{t,n}$ for $n = 1, 2, 5, 7$ years for t varying between October 7th 2002 and April 8th 2011.

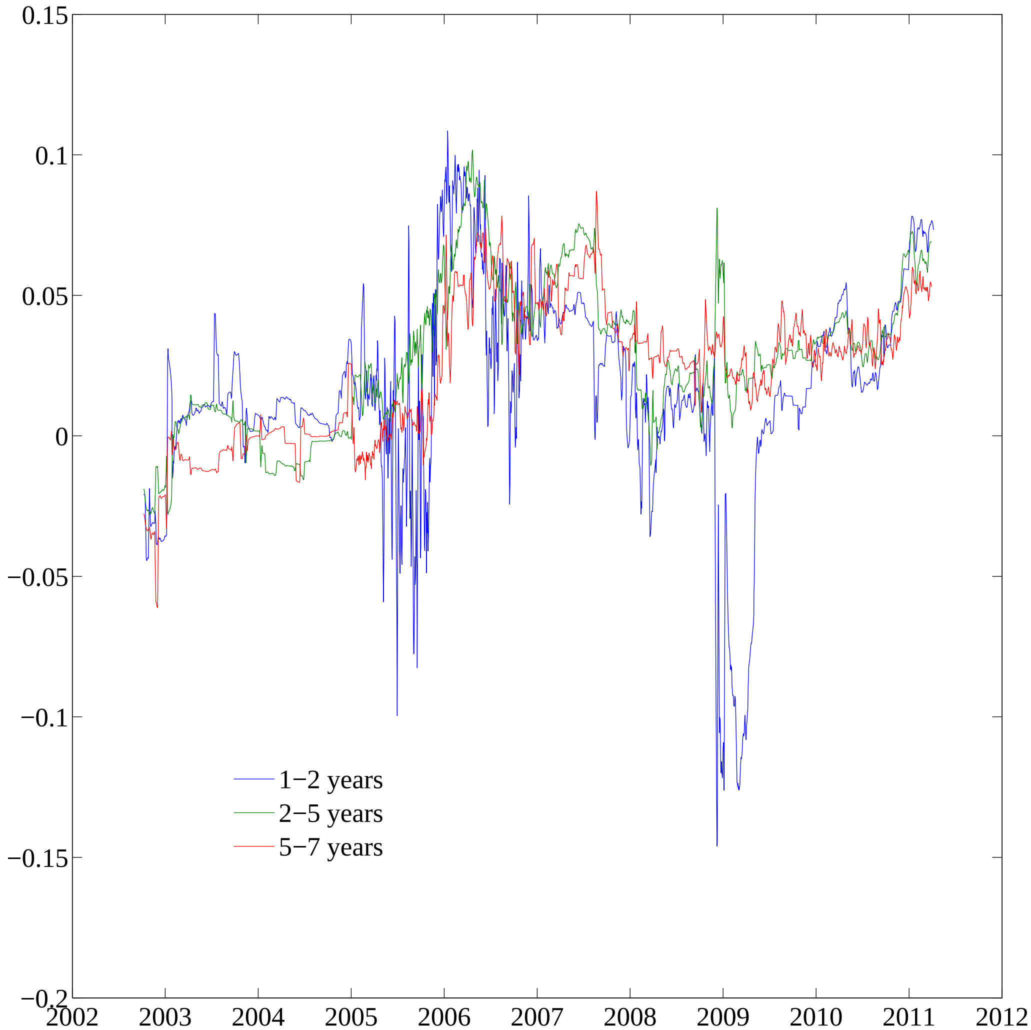

Figure 2: Forward equity yields: S&P500 Index
The graph displays the forward equity yields $f_{t,n1,n2}$ for $n_1 = 1, 2$ and 5 years and $n_2 = 2, 5$ and 7 years.

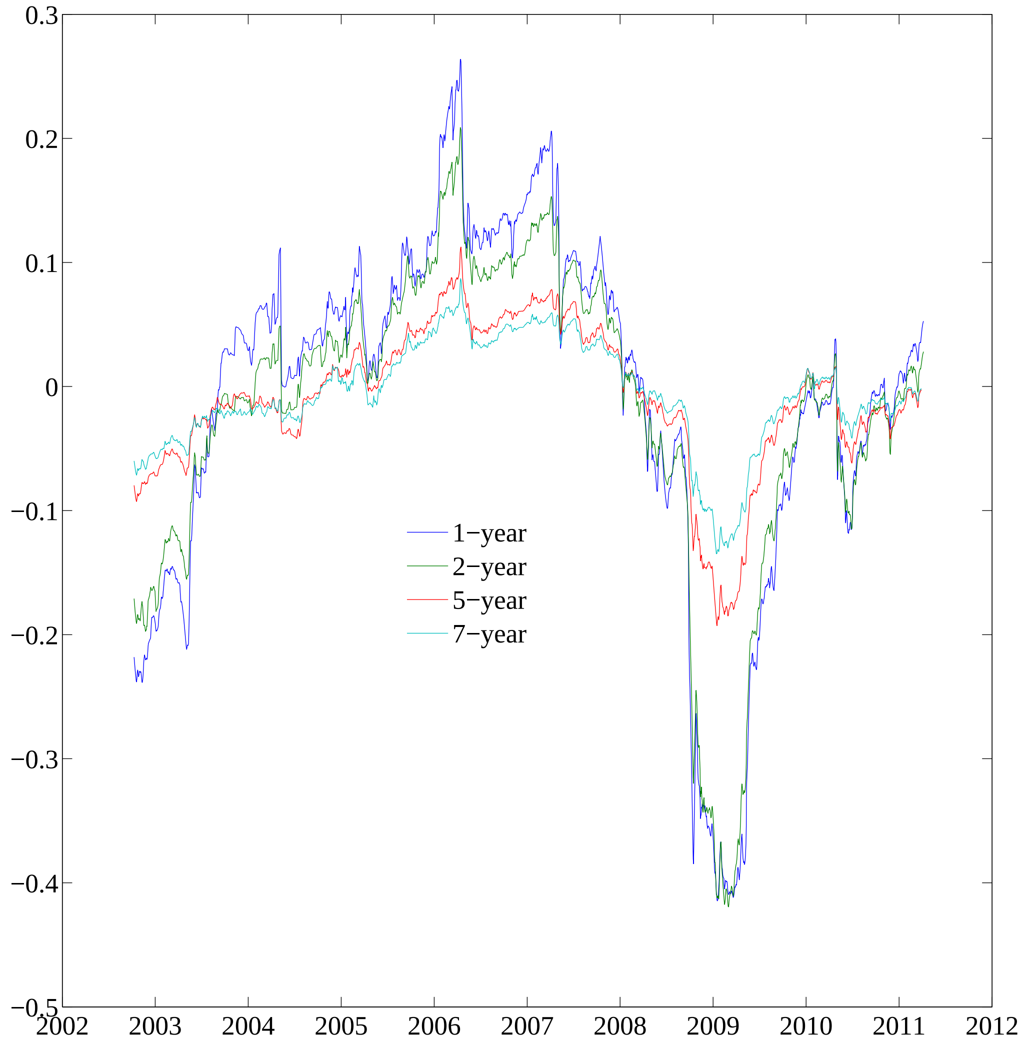

Figure 3: Equity yields: DJ Eurostoxx 50 Index
The graph displays the equity yields $g^{\star}_{t,n}$ for $n = 1, 2, 5$ and 7 years for t varying between October 7th 2002 and April 8th 2011.

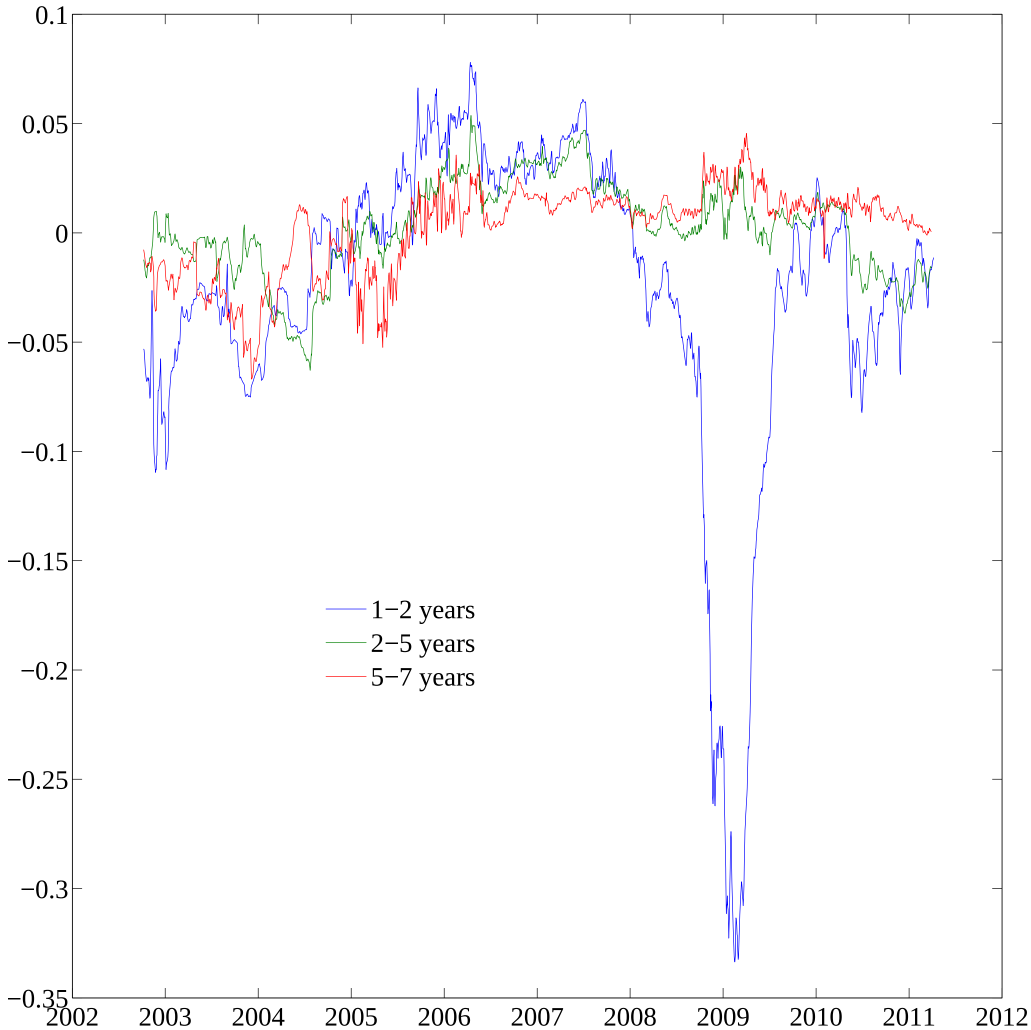

Figure 4: Forward equity yields: DJ Eurostoxx 50 Index
The graph displays the forward equityyields $f_{t,n1,n2}$ for $n_1 = 1, 2$ and 5 years and $n_2 = 2, 5$ and 10 years.

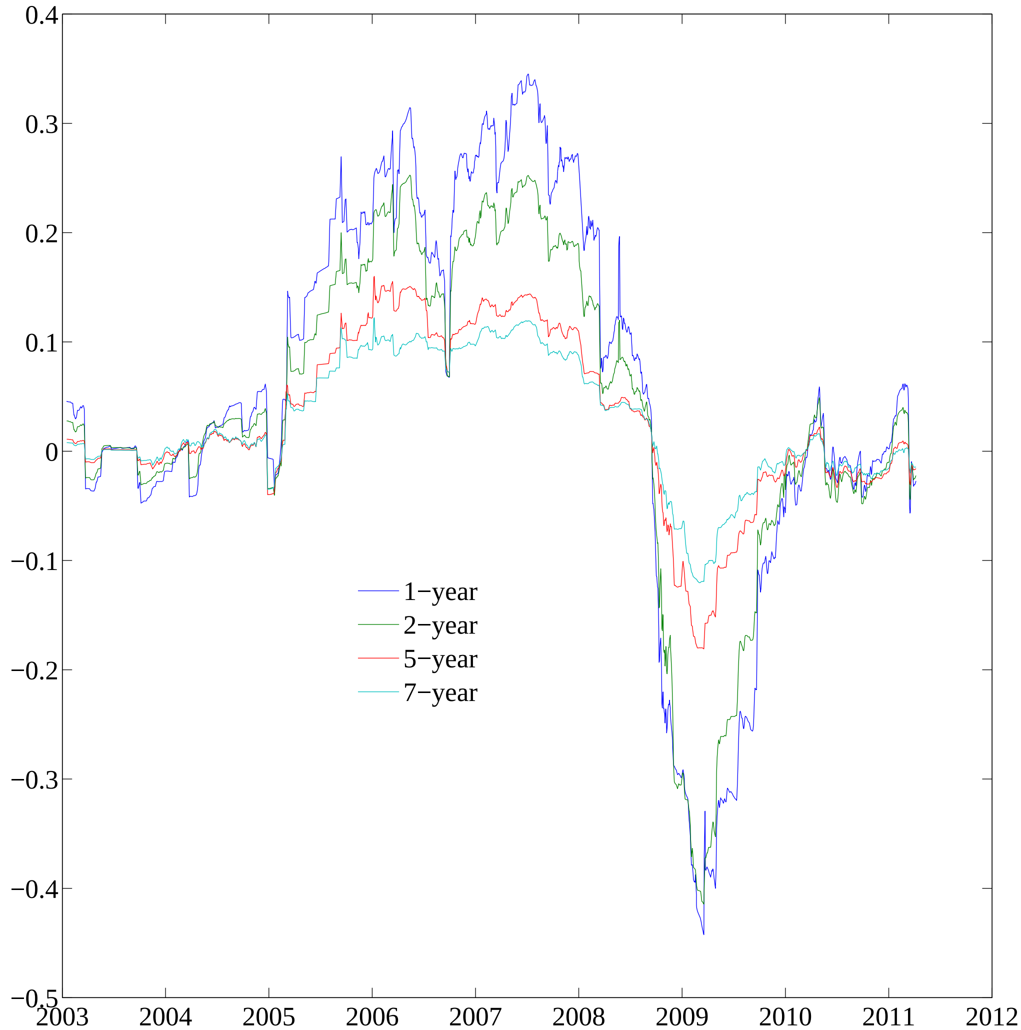

Figure 5: Equity yields: Nikkei 225 Index
The graph displays the equity yields $g^{\star}_{t,n}$ for $n = 1, 2, 5$ and 10 years for t varying between October 7th 2002 and April 8th 2011.

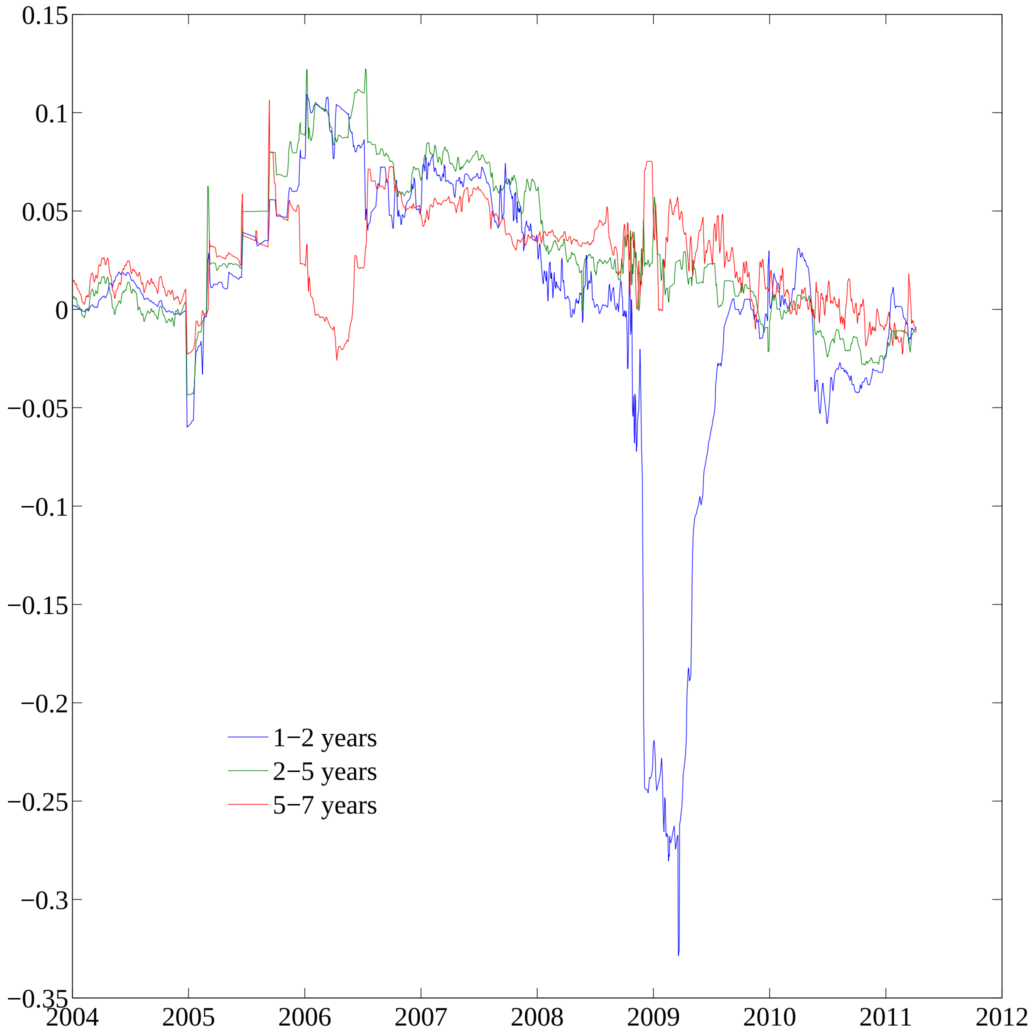

Figure 6: Forward equity yields: Nikkei 225 Index
The graph displays the forward equity yields $f_{t,n1,n2}$ for $n_1 = 1, 2$ and 5 years and $n_2 = 2, 5$ and 10 years.

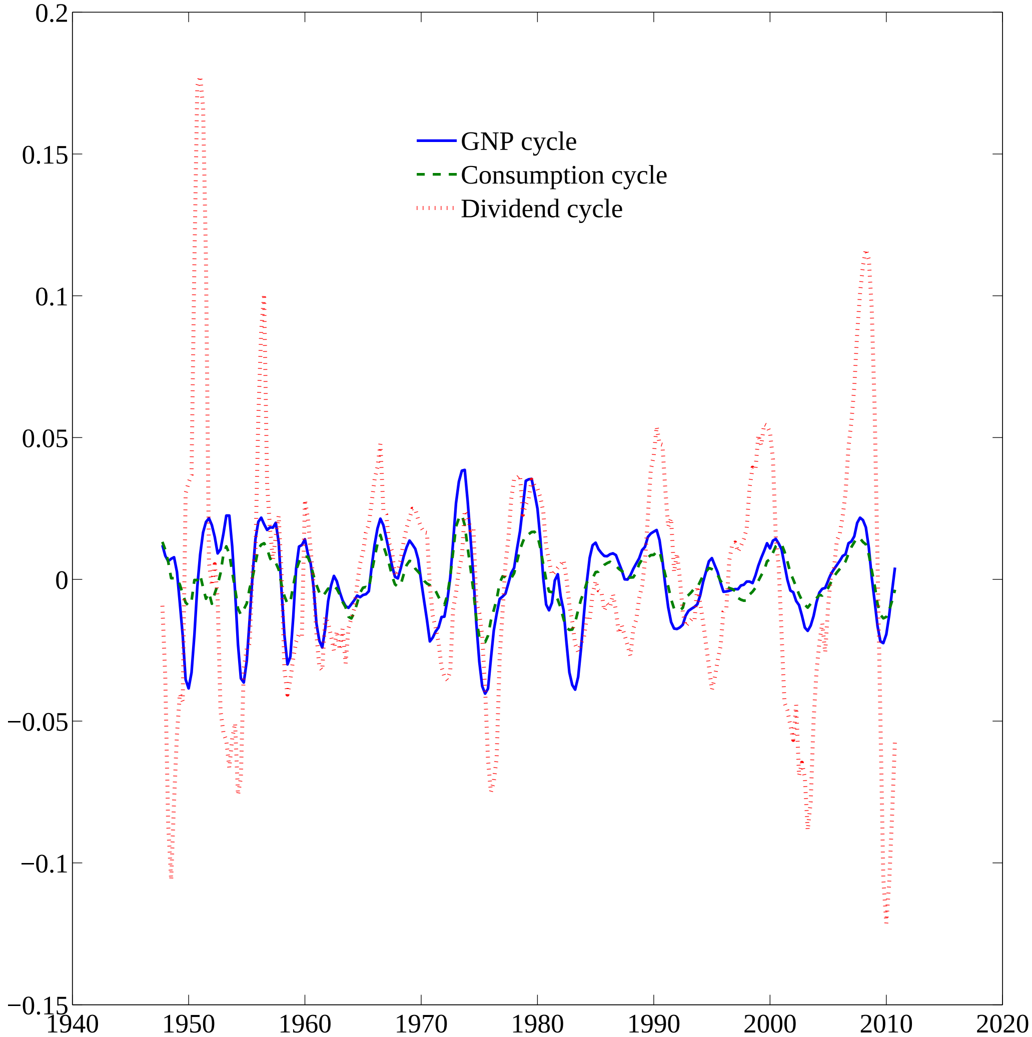

Figure 7: Cyclical components of GNP, consumption, and dividends
The graph displays the cyclical residue of Hodrick-Prescott filtered series for real GNP, real consumption (nondurables and services) and dividends.

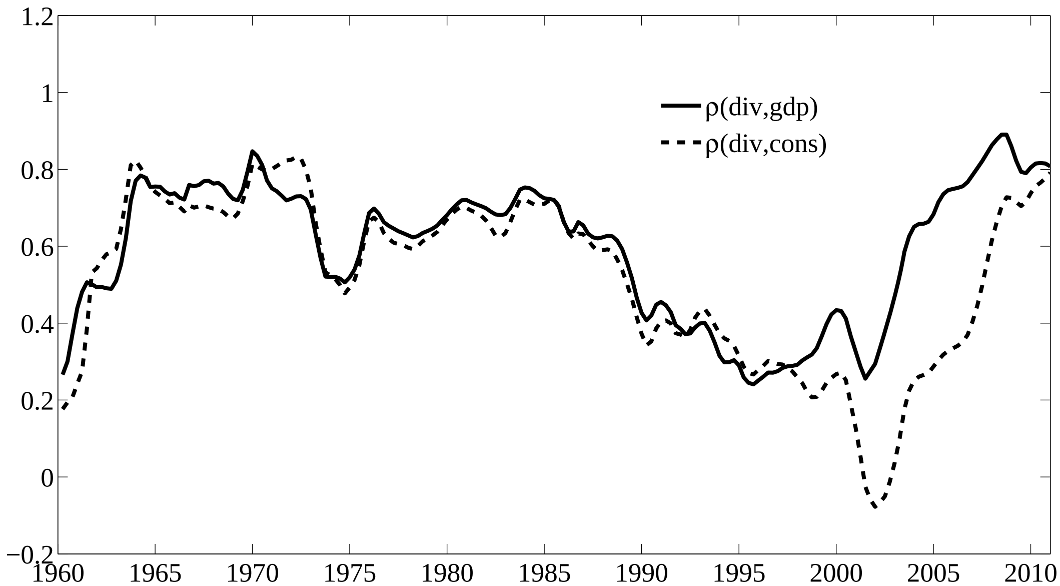

Figure 8: Rolling correlations between the cyclical components of consumption, GNP, and dividends

The graph displays the rolling correlation between the cyclical residue of Hodrick-Prescott filtered series for real GNP, real consumption (nondurables and services) and dividends. We use a 10-year window to construct the correlations.

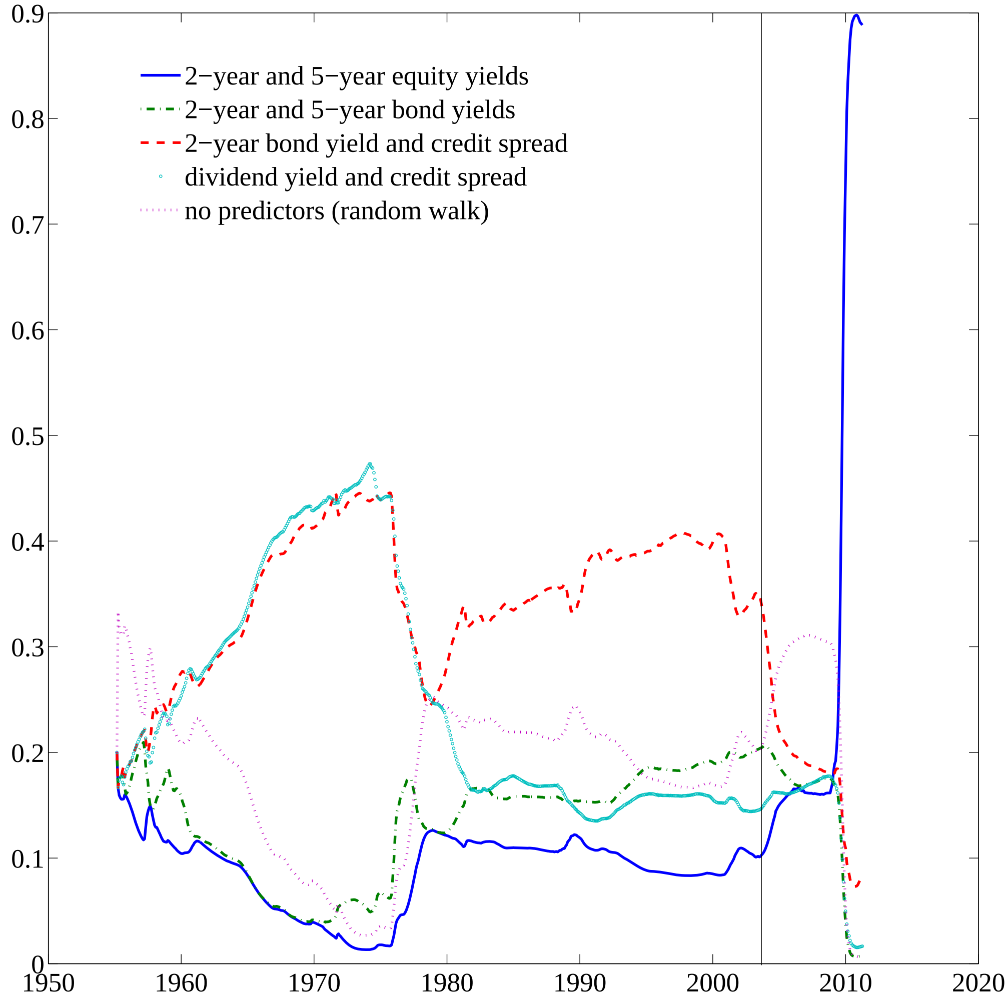

Figure 9: Posterior probabilities of the Bayesian model averaging approach: Dividends
The graph displays the posterior probabilities of five predictive models of annual dividend growth, using monthly data. The first four models all have two predictor variables ($p = 2$). The first model uses two equity yields (2-year and 5-year) to predict dividend growth, the second model uses two bond yields, the third model has the 2-year bond yield and the credit spread, and the fourth model uses the dividend yield and the credit spread. The fifth model has no predictor variables ($p = 0$), which implies a random walk for dividends.

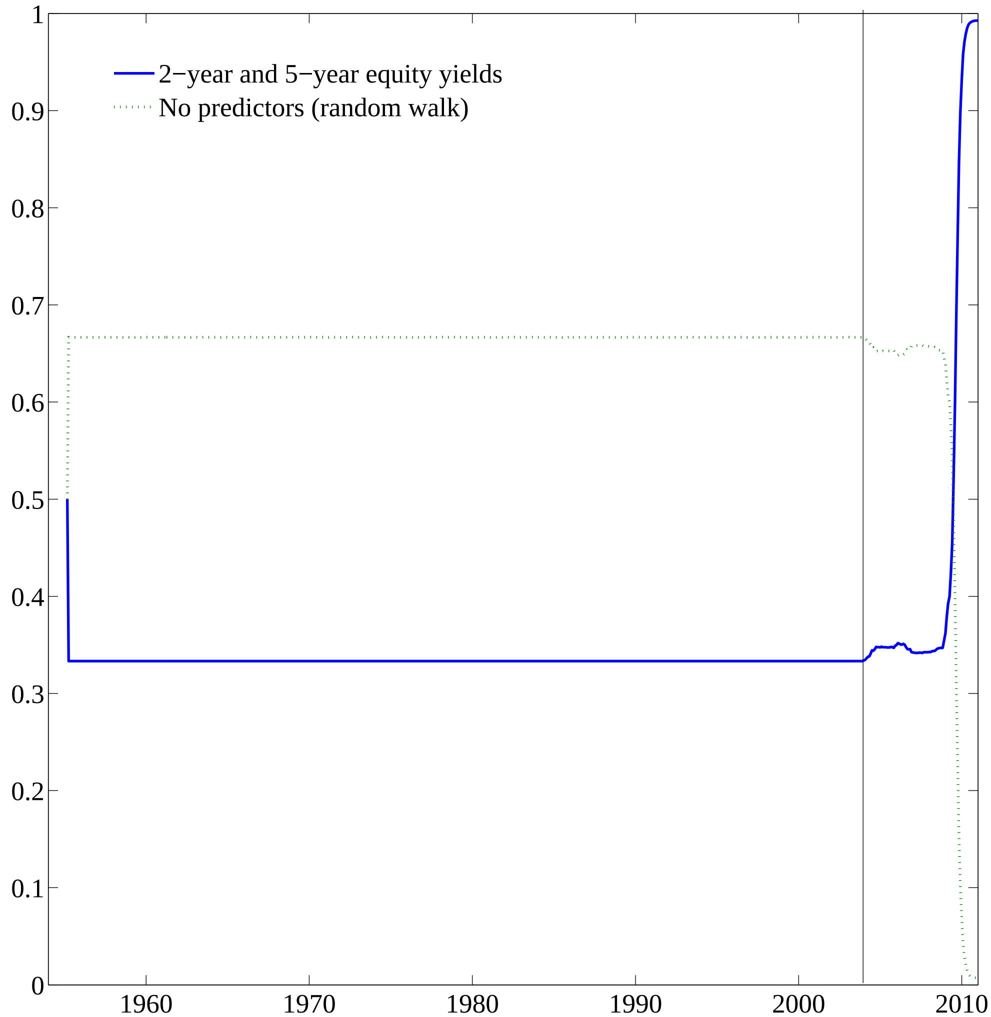

Figure 10: Posterior probabilities of the Bayesian model averaging approach: Dividends
The graph displays the posterior probabilities of two predictive models of annual dividend growth, using monthly data. The first model uses two equity yields (2-year and 5-year) to predict dividend growth ($p = 2$). The second model has no predictor variables ($p = 0$), which implies a random walk for dividends.

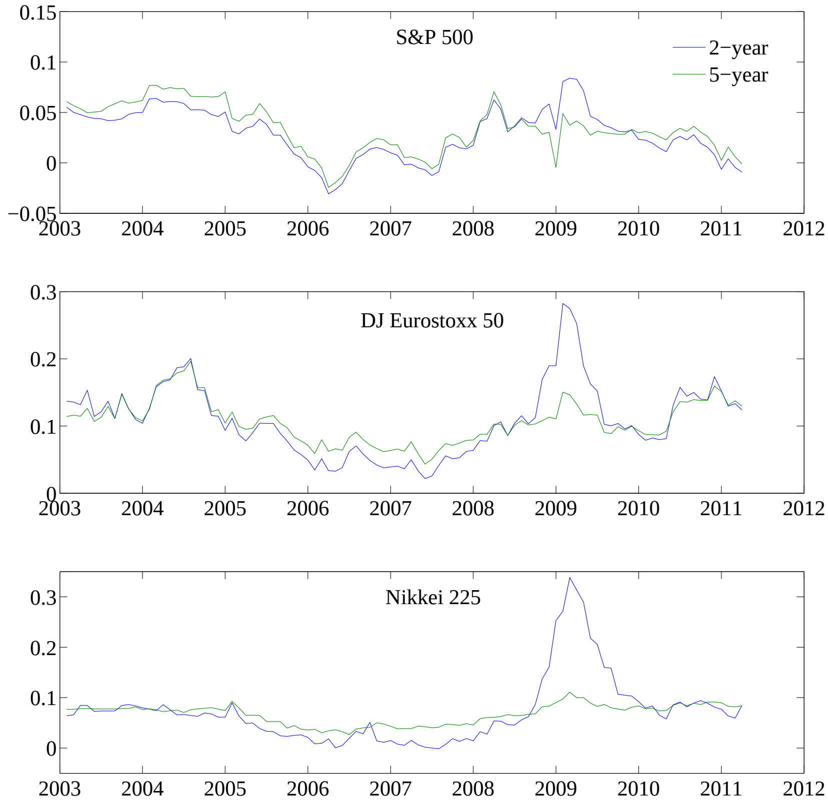

Figure 11: Risk-premium dynamics across maturities
The graph displays the risk premium component for 2-, and 5-year equity yields for all three regions.

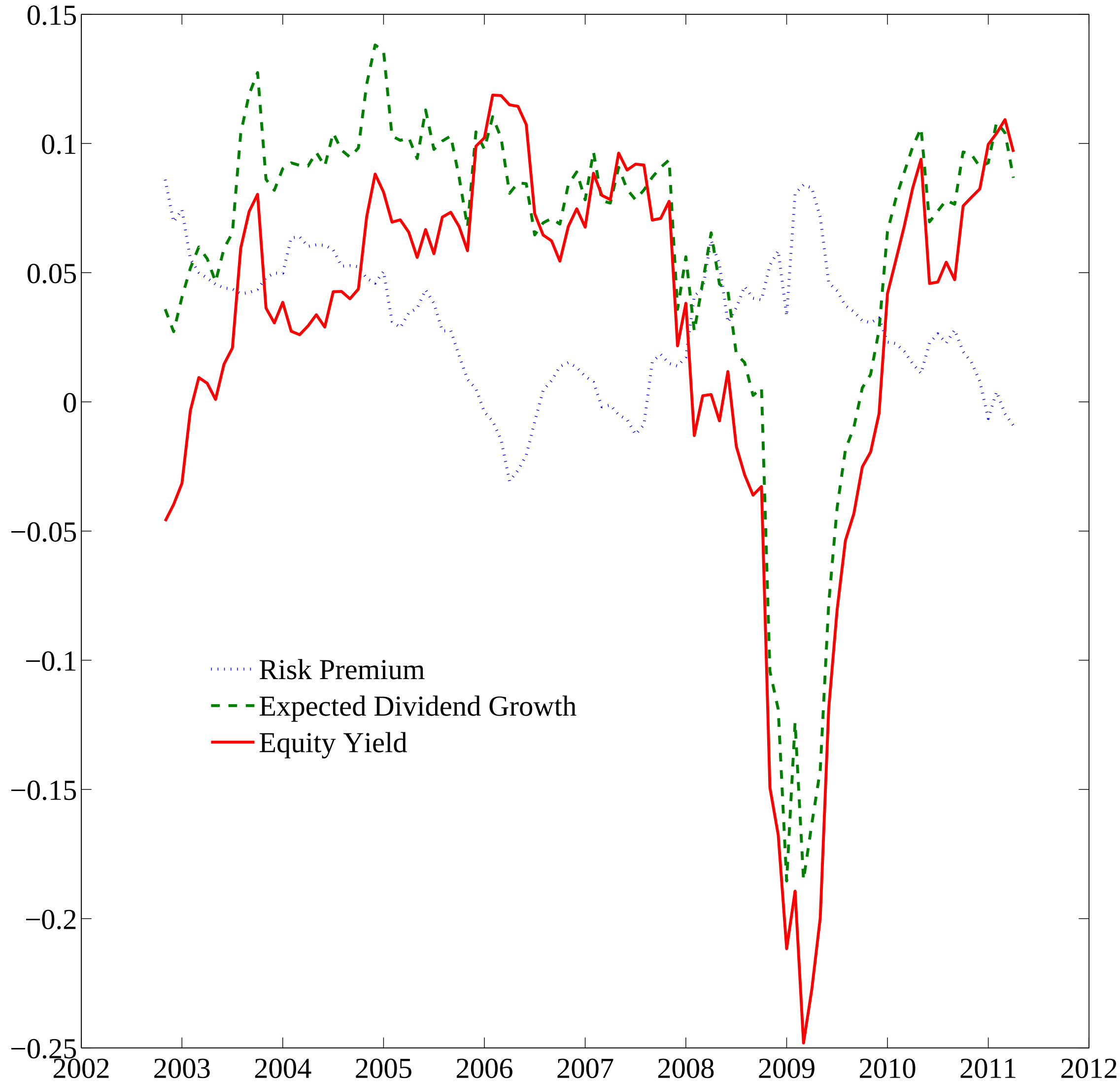

Figure 12: Decomposition of 2-Year Equity Yields
The graph decomposes the 2-year equity yield of the S&P500 index into expected dividend growth and a risk premium component.

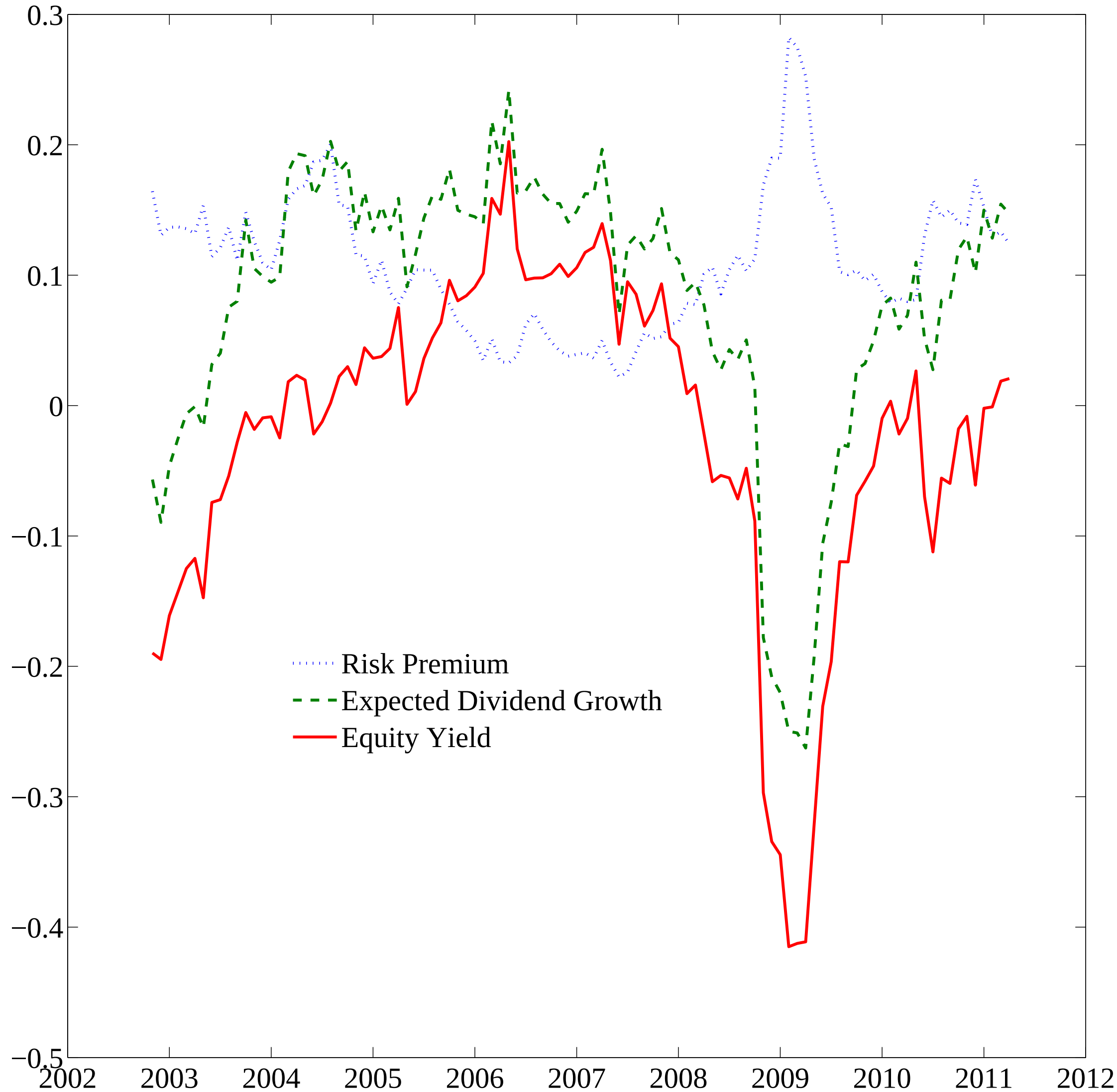

Figure 13: Decomposition of 2-Year Equity Yields
The graph decomposes the 2-year equity yield of the Eurostoxx 50 index into expected dividend growth and a risk premium component.

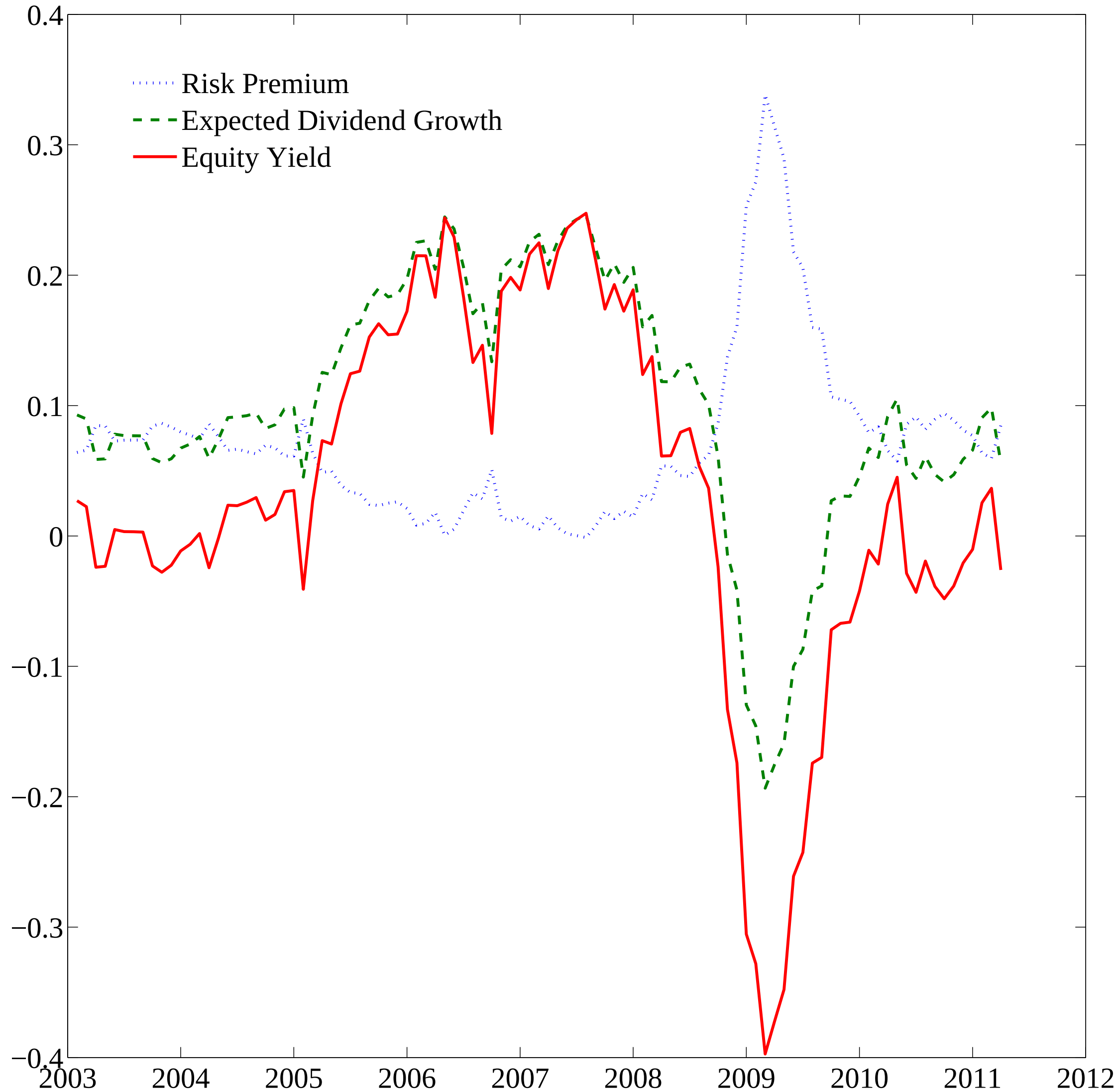

Figure 14: Decomposition of 2-Year Equity Yields
The graph decomposes the 2-year equity yield of the Nikkei index into expected dividend growth and a risk premium component.

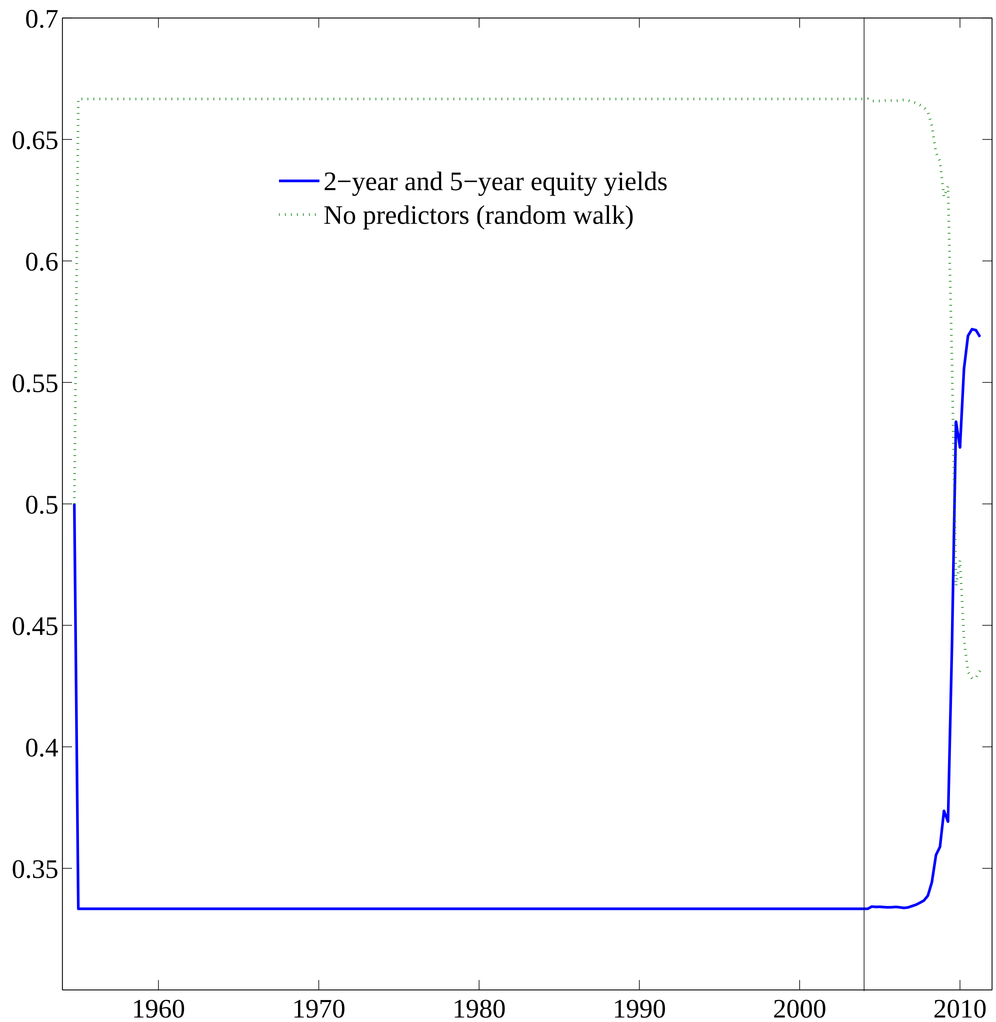

Figure 15: Posterior probabilities of the Bayesian model averaging approach: Consumption The graph displays the posterior probabilities of two predictive models of annual consumption growth, using monthly data. The first model uses two equity yields (2-year and 5-year) to predict dividend growth ($p = 2$). The second model has no predictor variables ($p = 0$), which implies a random walk for consumption.

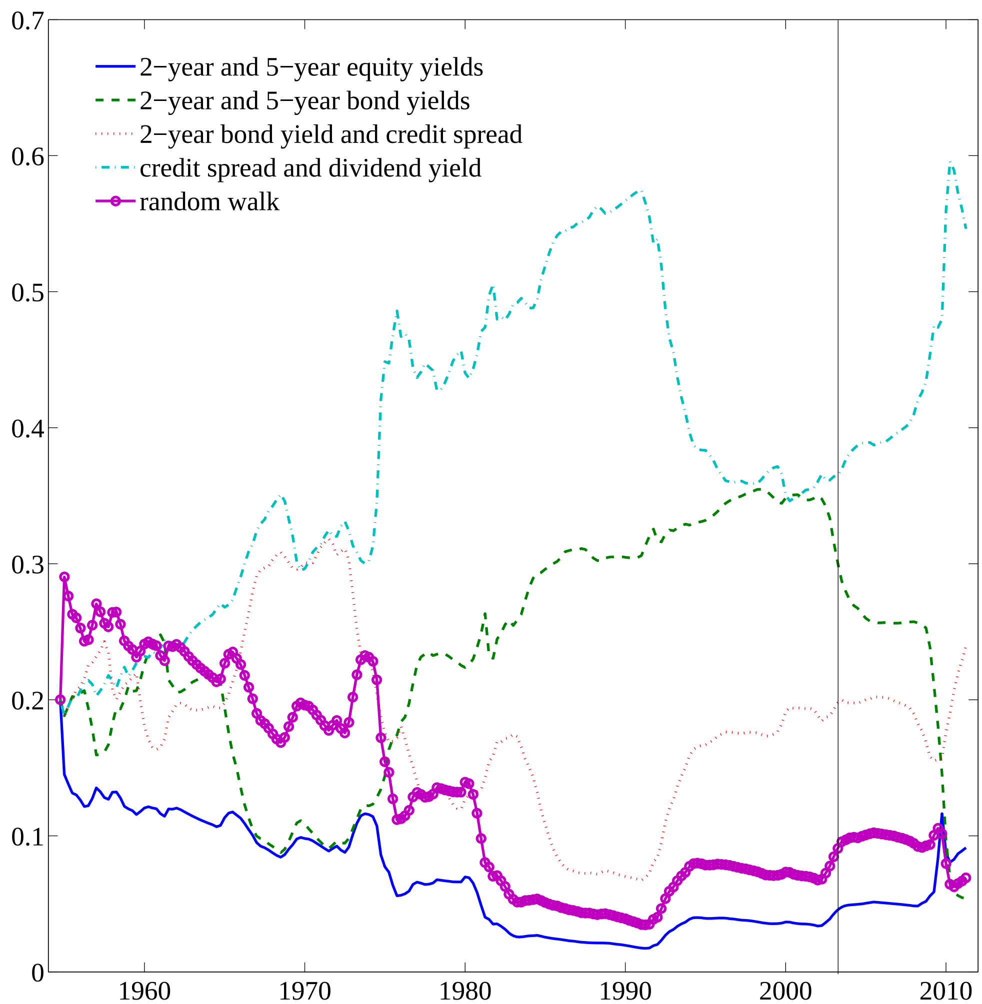

Figure 16: Posterior probabilities of the Bayesian model averaging approach: Consumption The graph displays the posterior probabilities of five predictive models of annual consumption growth, using monthly data. The first four models all have two predictor variables ($p = 2$). The first model uses two equity yields (2-year and 5-year) to predict consumption growth, the second model uses two bond yields, the third model has the 2-year bond yield and the credit spread, and the fourth model uses the dividend yield and the credit spread. The fifth model has no predictor variables ($p = 0$), which implies a random walk for consumption.

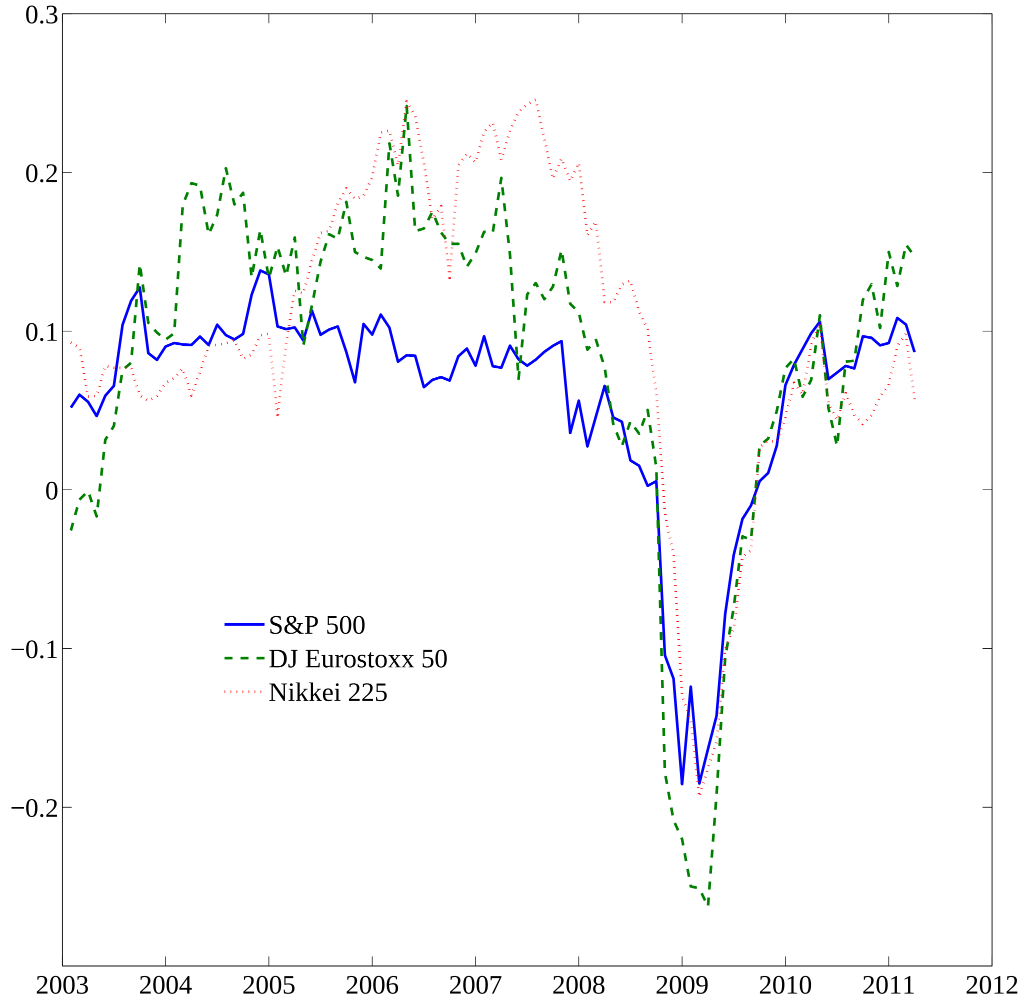

Figure 17: 2-year expected dividend growth across regions
The graph displays the expected growth rate $g_{t,n}$ for $n = 2$ years for t varying between January 14th 2003 and April 8th 2011 for three regions: the US (as represented by the S&P500 Index), Europe (as represented by the DJ Eurostoxx 50 index), and Japan (as represented by the Nikkei 225 index).

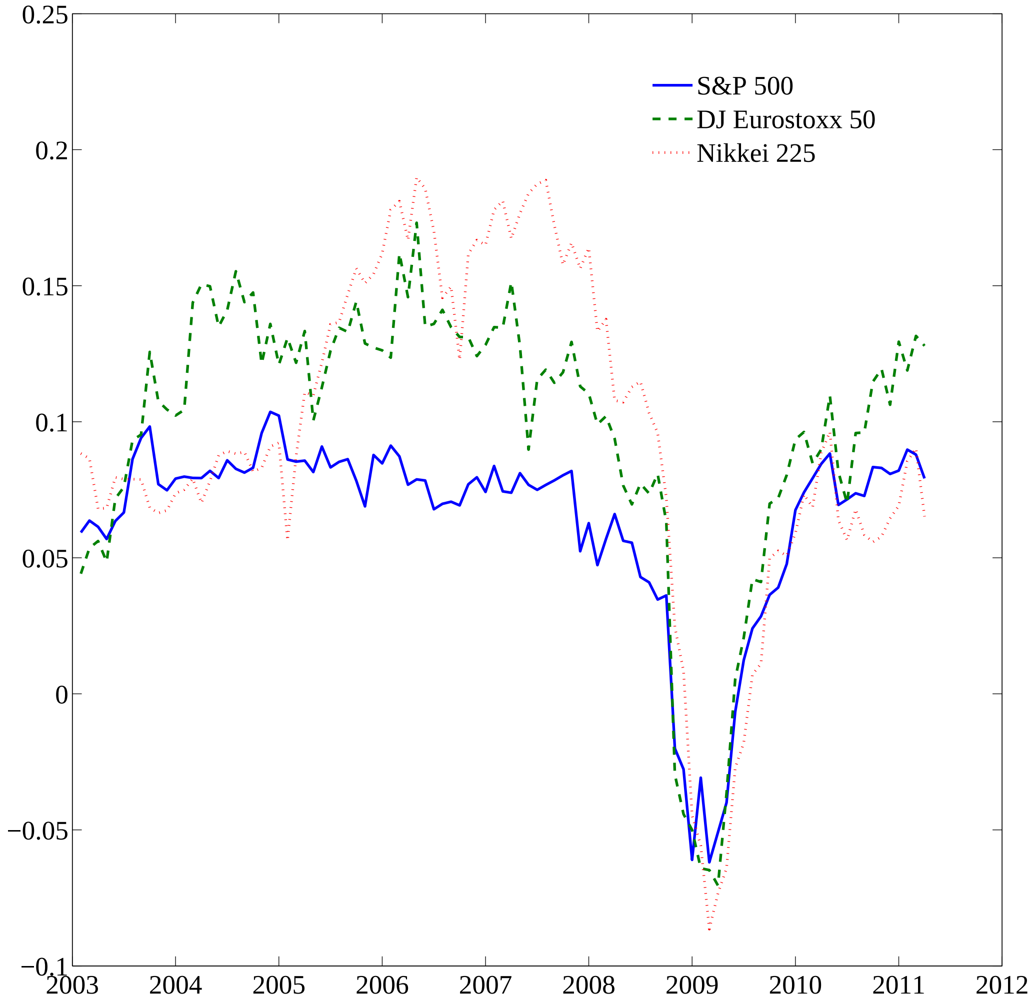

Figure 18: 5-year expected dividend growth across regions
The graph displays the expected growth rate $g_{t,n}$ for $n = 5$ years for t varying between January 14th 2003 and April 8th 2011 for three regions: the US (as represented by the S&P500 Index), Europe (as represented by the DJ Eurostoxx 50 index), and Japan (as represented by the Nikkei 225 index).