# Dividend Risk Premia*

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**Abstract**

This paper studies time variation in expected excess returns of traded claims on dividends, bonds, and stock indices for international markets. We introduce a novel dividend risk factor which complements the well-known bond risk factor of Cochrane and Piazzesi (2005) for the U.S., the U.K., the Eurozone and Japan, and run predictive regressions of one-year annual excess returns on both risk factors. Employing our dividend risk factor and the bond risk factor jointly we are able to fit the variation in local stock index returns well. By aggregating over the factors of the four core regions, we create global dividend and bond risk factors which capture excess returns of most of the developed market MSCI country indices as well as a variety of other assets including high yield bonds and a volatility selling strategy. Our findings highlight the value of the information contained in the dividend and bond forward curves and suggest substantial comovement in international risk premia.

**Keywords:** Dividend derivatives; dividend risk factor; Cochrane-Piazzesi factor; term structure of equity risk premia; global risk factors.

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# 1 Introduction

The introduction of traded claims on dividends (i.e. dividend derivatives) with several maturities allows to construct equity yields analogous to bond yields. Binsbergen, Hueskes, Koijen, and Vrugt (2013) were the first to analyze the term structure of equity yields and to show that the term structure of dividend risk premia is pro-cyclical, whereas the term structure of expected dividend growth is counter-cyclical. We utilize the findings of Cochrane and Piazzesi (2005, thereafter CP) that a single return-forecasting factor describes time-variation in the expected excess returns of bonds of all maturities and apply the same rationale to the term structure of equity yields. Our results confirm that the dynamics of dividend risk premia of several maturities are captured by a common return-forecasting factor, just as the CP factor does for government bonds.

We provide international evidence for the joint dynamics of dividend risk premia with maturities from one to five years by analyzing four different regions (U.S., U.K., Japan and the Eurozone). Moreover, we estimate a two-factor model to explain the variation in excess returns of stock indices, dividend derivatives and bonds, using both the dividend factor and the bond factor. The results show that the dividend factor is positively related to subsequent excess returns of dividend derivatives and stock indices, while the bond factor is significant with a negative sign. The latter finding is consistent with the negative relation of stocks and bonds since 2000, a fact that can be attributed to output-focused monetary policy and elevated macroeconomic uncertainty (see for instance Campbell, Pflueger, and Viceira, 2015). As can be expected, only the bond factor is important in explaining excess bond returns.

We then move on to construct global dividend and bond risk factors by aggregating the local risk factors of our four core regions. We find that the variation in local asset returns is well captured by these global risk factors, suggesting substantial comovement in international risk premia. Building on this finding, we explain the return dynamics of a broad set of test assets with the global dividend and bond factors. This global two-factor model works well for most developed market MSCI country indices and even for other test assets such as high yield bonds or a volatility selling strategy. As the global risk factors are constructed using only four core regions, this results justifies the validity of our factors. Similar to the local two-factor model, the global dividend factor relates positively to international equity index returns and equity like assets, while the global bond factor is positively associated to bond returns but negatively to equity returns, the volatility selling strategy and high yield bonds.

Our results are statistically robust as we follow recent empirical studies in basing inference on block bootstrapped standard errors. Further, we evaluate the empirical models in terms of a CW measure for predictability (Clark and West, 2007) and a GW measure for conditional predictability (Giacomini and White, 2006). To shed light on economic robustness, we challenge our approach by including well known equity index return predictors such as the cyclically adjusted price earnings ratio (CAPE) and the term spread. Employing robust methods to compare various models, we find that the global dividend and bond factors are not subsumed by other predictors. Neither local nor global versions of the control variables make the factors redundant. Relating the dividend factor to other explanatory variables, we find it to be significantly related to high but decreasing implied volatility as well as increasing inflation expectations. While the bond factor has similar exposure to volatility risk, it is positively related to liquidity risk as measured by the TED spread.

The remainder of the paper is organized as follows. In section 2 we discuss the literature related to this paper, and in section 3 we present in detail the data and notation used throughout the paper. We present our approach of modeling dividend risk premia in section 4, and then describe the constructed risk factors to develop an empirical two-factor asset pricing model in section 5. Section 6 concludes. Appendix A delineates the criteria to assess model accuracy and the bootstrapping methodology. We provide additional results, including further application of the model in an international setup, and robustness checks in the internet appendix IA.

# 2 Related Literature

Brennan (1998) claimed that creating tradeable dividend strips similar to treasury strips would increase allocative efficiency by allowing investors. Shortly after publication of his paper, and underpinned by hedging demands of banks arising from positions in long-dated index derivatives, OTC markets for index dividend swaps emerged. These derivatives allow investors gain exposure to and trade cumulative dividends paid over a specific maturity year. Manley and Mueller-Glissmann (2008) provide institutional details on traded dividend derivatives. The introduction of exchange-listed dividend futures with several (annual) maturities in mid-2008 increased the attention to traded claims on index dividends substantially. While Binsbergen, Brandt, and Koijen (2012) show that the term structure of equity risk premia is downward-sloping by extracting expected dividends from index options, Binsbergen, Hueskes, Koijen, and Vrugt (2013) employ a data set on OTC dividend swaps to investigate the properties of equity yields constructed similarly to bond yields. Cejnek and Randl (2016) analyze the performance of short-duration dividend strategies and show that it is related to downside risk. Furthermore, they extract ex-ante risk premia using a carry model and relate them to ex-post realized returns on dividend derivatives.

In a paper closely related to the present work, Kragt, de Jong, and Driessen (2015) model the term structure of dividends with a two-factor affine model, in which the first factor mean reverts to the second factor over the short run, while the second factor reverts to a constant over the business cycle horizon. Their model fits the term structure of dividend swap prices well, and the model-implied price-dividend ratio together with current dividend levels matches the valuation of the stock market nicely. While both, our paper and Kragt, de Jong, and Driessen (2015) highlight the importance of the information that can be inferred from dividend forward curves, the papers differ in both methodology and objectives. By extracting a single return-forecasting factor from the dividend term structure, we focus on explaining excess returns on dividend derivatives and other assets rather than modeling the dividend term structure. Using a consistent approach for traded dividends and bonds allows us to compare the degree of time variability and predictability in excess bond and dividend derivative returns. We use the resulting bond and dividend risk factors jointly as predictors, and are able to capture variation in excess returns on a multitude of assets (stocks, bonds, credit, fx carry, a volatility selling strategy) on a global scale. Further, we distinguish between local and global bond and dividend factors that drive risk premia internationally. In contrast to a market specific approach, our global dividend factor helps to explain variation in excess returns even in markets which do not have traded dividend claims.

The literature on fixed income securities provides extensive evidence on time-varying bond risk premia as well as predictability of excess bond returns. Fama and Bliss (1987) show that, in contrast to the expectation hypothesis, $n$-year forward spreads predict excess returns on $n$-year bonds. Cochrane and Piazzesi (2005) show that a single return-forecasting factor constructed from five $n$-year/1-year forward rates predicts excess returns on bonds of all maturities. Dahlquist and Hasseltoft (2013) and Kessler and Scherer (2009) provide international evidence on the robustness of the CP factor. Mylnikov (2014) develops a more parsimonious version of the CP factor, with favorable statistical properties, and focuses on the economic value added by forecasts. The increasing importance of credit risk in sovereign bond returns leads Dockner, Mayer, and Zechner (2013) to augment a default risk-free bond factor with a credit risk factor extracted from the term structure of CDS spreads. This highlights the important role of information contained in forward curves. By relating excess returns of value stocks to cash flow risk and output risk proxied by the CP bond factor, Koijen, Lustig, and van Nieuwerburgh (2015) extend the evidence on the predictability of the bond term structure to the domain of stocks. The authors implement a three-factor pricing model for stocks and bonds using the CP factor, shocks to the level of the bond term structure and the market return as a proxy for the equity risk premium. Our paper improves upon their proxy for cash flow risk by utilizing information on the whole term structure of equity risk premia (the dividend factor) and provides additional test assets (returns on dividend derivatives). De Moor and Sercu (2013) claim that information related to dividend yields is valuable in identifying missing factors driving stock returns internationally (in their case especially the size effect). This provides further indication that extracting a global dividend risk factor might prove essential in capturing excess asset returns on a global scale.

Finally, the drivers of the correlation between bond and stock returns are of vital relevance to this work. Campbell, Pflueger, and Viceira (2015) identify monetary policy regimes and macroeconomic uncertainty as the driving force behind the stock-bond correlation. Ilmanen (2003) finds low inflation expectations and financial crises to be the drivers for negative stock-bond correlations. David and Veronesi (2013) explain the covariation of stocks and bonds using learning dynamics, where in a deflationary regime stocks and bonds tend to move in opposite directions.

# 3 Data and Notation

Our main data source for dividend swaps is a sample of OTC mid-market prices obtained from Goldman Sachs.[1] The data ranges from December 30, 2005 to May 15, 2015 and covers dividend swaps for maturities up to 5 years for the underlying indices S&P 500 index, FTSE 100, Nikkei 225, and Euro Stoxx 50.[2] We use a weekly data frequency. To obtain bond yields, we retrieve bootstrapped zero coupon curves from Bloomberg. Index and ETF price and total return time series, as well as data on term spreads and ted spreads are also from Bloomberg, whereas cyclically adjusted price earnings ratios (CAPE) are retrieved from Global Financial Data.

**Bonds:** We denote zero coupon bond yields by $Y_t^{bonds,(n)}$, where numbers in parentheses indicate the maturity $n \in \{1, 2, 3, 4, 5\}$, measured in years, while the subscript $t$ denotes time measured at weekly frequency. We compute zero coupon bond prices as follows:[3]

[1] Our sample on OTC dividend swaps is similar to the sample in Binsbergen, Hueskes, Koijen, and Vrugt (2013), Cejnek and Randl (2016) and Kragt, de Jong, and Driessen (2015).

[2] Given that dividend swaps always have their maturity date in December, our data allows us to construct a term structure of up to 4 years for the period we analyze.

[3] We use capital letters to indicate that we use discrete returns and yields throughout the paper. We prefer discrete returns which is suggested as appropriate for analysis of trading rules in the appendix of Cochrane and Piazzesi (2005).

$$P_t^{bonds,(n)} = \frac{N}{\left(1 + Y_t^{bonds,(n)}\right)^n}\,, \tag{1}$$

where $N$ is the face value of the bond. For $n \geq 2$, we calculate the $n$-year/1-year forward rate (one-year rate ending in $n$ years) as

$$F_t^{bond,(n)} = \frac{\left(1 + Y_t^{bonds,(n)}\right)^n}{\left(1 + Y_t^{bonds,(n-1)}\right)^{n-1}} - 1\,. \tag{2}$$

Returns on zero coupon bonds are given by

$$R_{t+52}^{bond,(n)} = \frac{P_{t+52}^{bonds,(n-1)}}{P_t^{bonds,(n)}} - 1\,, \tag{3}$$

and excess bond returns by

$$RX_{t+52}^{bond,(n)} = R_{t+52}^{bond,(n)} - Y_t^{bond,(1)}\,. \tag{4}$$

We denote across-maturity average excess returns generally by $\overline{RX}$ and calculate them for bonds as

$$\overline{RX}_{t+52}^{bond} = \frac{1}{4}\sum_{n=2}^{5} RX_{t+52}^{bonds,(n)}\,. \tag{5}$$

**Dividends:** To construct the corresponding variables for dividend markets we first calculate dividend swap prices with $n \in \{1, 2, 3, 4\}$ years maturity, $P_t^{dividends,(n)}$, by linear interpolation of OTC prices of dividend swaps which have their maturities in December. Note that dividend swaps are unfunded financial contracts with a fixed and a floating leg, where the latter is based on the dividends paid out on an index during a specific time period. Typically the time period is one year with a single payment made at maturity (see Manley and Mueller-Glissmann, 2008, for an in-depth description of the market for dividends). Thus, dividend swap prices are forward prices.[4] Consistent with the definition of bond market forward rates, we define $n$-year forward equity forward rates $F_t^{dividends,(n)}$ as follows:[5]

$$F_t^{dividends,(n)} = \begin{cases} \frac{D_t}{P_t^{dividends,(1)}} - 1\,, & n = 1 \\ \frac{P_t^{dividends,(n-1)}}{P_t^{dividends,(n)}} - 1\,, & n \geq 2\,, \end{cases} \tag{6}$$

where $D_t$ is the current value of aggregate index dividends (which is interpolated from previous calendar year's realized dividends and current year's dividend swap level) and $P_t^{dividends,(n)}$ is the price of the $n$-year dividend swap at time $t$. In contrast to bond forward rates which typically have been positive in the past, there is no typical sign for forward equity forward rates. This is because forward equity forward rates defined as in equation 6 have two components: expected dividend growth from year $n-1$ to year $n$ and a maturity specific risk premium. A forward equity forward yield will be positive (negative) if the risk premium exceeds (is lower than) the expected growth rate of dividends. While Binsbergen, Hueskes, Koijen, and Vrugt (2013) and Cejnek and Randl (2016) model expected dividend growth to infer the maturity specific dividend risk premia, we use the total forward equity forward rate to construct a dividend return-forecasting factor similar to the CP bond factor. One major advantage of using equity forward rates to predict returns of buy-and-hold dividend derivatives strategies is that the prediction does not require a dividend forecast.

We calculate excess returns of dividend investments as follows:

[4] Dividend swap prices as used in the present paper and dividend strip prices as discussed in Brennan (1998) are related via the appropriate risk-free bond yield: $P_t^{dividends,(n)} = S_t^{dividends,(n)}(1 + Y_t^{bonds,(n)})^n$, where $S$ denotes spot dividend strips.

[5] Binsbergen, Hueskes, Koijen, and Vrugt (2013) define $n$-year forward equity yields, which can be written in a discrete time version as $Y_t^{dividends,(n)} = \sqrt[n]{\frac{D_t}{P_t^{dividends,(n)}}} - 1$. In contrast to forward equity *yields*, our measure is not only constructed from swap (i.e., forward) rates, but is in addition forward starting for $n \geq 2$. This is the reason why we denote $F_t^{dividends,(n)}$ as forward equity *forward rates*.

$$RX_{t+52}^{dividends,(n)} = \frac{P_{t+52}^{dividends,(n-1)}}{P_t^{dividends,(n)}} - 1\,. \tag{7}$$

Note that we do not need to subtract the risk-free bond yield here. One can enter a long position in a dividend swap maturing in $n$ years time, hold it for 52 weeks and then sell it as an $(n-1)$ year swap. This does not require any cash outlay and, thus, the resulting return can be interpreted as an excess return directly. Across-maturity average excess returns on dividend investments are given by

$$\overline{RX}_{t+52}^{dividends} = \frac{1}{4}\sum_{n=1}^{4} RX_{t+52}^{dividends,(n)}\,. \tag{8}$$

**Stocks:** We use total return stock indices to calculate equity returns. For the U.S. we use the S&P 500 total return index, for the U.K. the FTSE 100 total return index, for Japan the Nikkei 225 total return index and for the Eurozone the Euro Stoxx 50 total return index. Additionally, we employ all MSCI country indices in developed markets. Levels of equity total return indices are denoted by $P_t^{stocks}$ and used to compute equity index returns

$$R_{t+52}^{stocks} = \frac{P_{t+52}^{stocks}}{P_t^{stocks}} - 1 \tag{9}$$

and corresponding excess returns:

$$RX_{t+52}^{stocks} = R_{t+52}^{stocks} - Y_t^{bond,(1)}\,. \tag{10}$$

The following tables provide summary statistics on excess returns. Table 1 contains excess returns on dividend swaps corresponding to equation 7, table 2 shows excess bond returns for equation 4, and table 3 provides excess returns of stock indices for the main markets (equation 10). To compute excess returns we subtract the one-year bond yield of the appropriate country or currency zone and the one-year U.S. bond yield for portfolios of countries (like the MSCI EM). Further summary statistics on zero coupon bond yields, forward bond yields and forward equity forward rates can be found in the internet appendix.

# 4 An Empirical Model for Dividend Risk Premia

The extensive literature on fixed income securities provides clear evidence on time variation in bond risk premia and predictability of excess bond returns. Two seminal contributions in this respect are Fama and Bliss (1987) and Cochrane and Piazzesi (2005). Fama and Bliss (1987) show that in contrast to the expectation hypothesis, forward spreads predict subsequent excess bond returns, while Cochrane and Piazzesi (2005) provide clear evidence that a linear combination of forward rates captures risk premia of bonds of all maturities. Bonds with different maturities differ in their exposure to the single return-forecasting factor, though. Recent evidence on the performance of dividend swaps (Cejnek and Randl, 2016; Binsbergen and Koijen, 2016) shows substantial time variation in dividend risk premia as well as predictability of dividend excess returns. Hence, we expect that extracting information from the whole term structure of forward equity forwards captures the dynamics of dividend risk premia and increases predictability of excess returns on dividend swaps. We construct a return-forecasting factor from the term structure of forward equity forwards and show that this factor captures dividend risk premia. The method is inspired by standard methods from the fixed income literature.

**Dividend regressions:** We follow the two-step procedure in Cochrane and Piazzesi (2005). In the first step we explain for each region the across-maturity average excess returns of dividends using the term structure of forward equity forward yields to obtain a dividend factor. In the second step, we estimate factor loadings of the individual $n$-year contracts on the dividend factor. Cochrane and Piazzesi (2005) suggest that risk premia are slow-moving processes which warrant a multiple lag structure in the predictive regressions. We implement this by using three lags in addition to the contemporaneous independent variables for all unrestricted regressions and for the across-maturity average regressions. In all tables we report the sum of the coefficients on all lags and the reported $p$-values are calculated using a Wald test for the joint significance of all lags of a specific variable.[6] Our results do not change qualitatively if we exclude the lags, though.

For each market (U.S., U.K., Japan, Eurozone), we regress across-maturity average excess returns on all forward equity forward rates as follows:

$$\overline{RX}_{t+52}^{dividends} = \gamma^T \mathbf{F_t^{dividends}} + \bar{\epsilon}_{t+52}\,, \tag{11}$$

where $\mathbf{F_t^{dividends}} \equiv \left[1\ F_t^{dividends,(1)}\ F_t^{dividends,(2)}\ F_t^{dividends,(3)}\ F_t^{dividends,(4)}\right]^T$ and $\gamma^T$ are vectors.

The results of table 4 clearly indicate predictability of dividend swap excess returns.[7] Results are weakest for the U.S. market. Especially important is the joint significance of the coefficients. Testing for $\gamma^T = \mathbf{0}$ is rejected for all markets, including the U.S. $R^2$ is in the range between 0.15 (U.S.) and 0.65 (U.K.).

As a second step, we use the estimated parameters $\hat{\gamma}$ to estimate the factor loadings of swap contracts of various maturity on the dividend factor. We therefore estimate constrained regressions of the following form, utilizing a single (market specific) return-forecasting dividend risk factor ($\hat{\gamma}^T \mathbf{F_t^{dividends}}$):

$$RX_{t+52}^{dividends,(n)} = b_n(\hat{\gamma}^T \mathbf{F_t^{dividends}}) + \epsilon_{t+52}^{(n)} \tag{12}$$

[6] For instance, the full regression equation for the across-maturity average regression reads as

$$\overline{RX}_{t+52}^{dividends} = \gamma_0^T \mathbf{F_t^{dividends}} + \gamma_1^T \mathbf{F_{t-1}^{dividends}} + \gamma_2^T \mathbf{F_{t-2}^{dividends}} + \gamma_3^T \mathbf{F_{t-3}^{dividends}} + \bar{\epsilon}_{t+52}$$

and we report $\sum_{k=0}^{3} \gamma_k^T$ as the coefficient and the p value of a Wald test for the joint significance of $\gamma_0\ \gamma_1\ \gamma_2\ \gamma_3$. This method is based on Dimson (1979).

[7] The coefficients of the forward equity forward rates do not exhibit the tent-shaped pattern of Cochrane and Piazzesi (2005) for bonds. This is not surprising, however, as the tent-shaped relation of bond excess returns and forward rates also vanishes if one updates the bond sample to the present time. The tent shape is not required for the existence of return predictability, though.

The results are displayed in table 5 and provide even clearer evidence for return predictability. Given that in the regressions we use overlapping returns, we take care in accounting for possible autocorrelation and heteroscedasticity. We therefore report standard errors computed with the method proposed by Newey and West (1987). Given the structure of our data with overlapping 52 weeks returns, we select 52 lags. To ensure robustness of our results, we obtain standard errors from bootstrapping with a block structure of 52 periods. Based on bootstrapped standard errors, we denote in the tables the one percent significance level with three asterisks, five percent level with two, and 10 percent level with one asterisk. This is a conservative approach as the bootstrapped standard errors tend to be slightly larger than the Newey-West standard errors. Further we calculate the test statistic proposed by Clark and West (2007) to compare the unconditional predictive precision of nested models, and the test statistic by Giacomini and White (2006) to test for conditional predictive performance. We follow Sarno, Schneider, and Wagner (2012) in their analysis of foreign exchange risk premiums, and use in-sample predictions for model evaluation. In the appendix, we provide the details on the measures and the bootstrap in sections A.1 and A.2.

In table 5, three out of four markets have significant coefficients on the dividend factor, with $R^2$ ranging from 0.12 to 0.62. The coefficient is not significant in the U.S. based on block bootstrapped standard errors (based on Newey-West standard errors with 52 lags we would find statistical significance). This result is not too surprising, given that Cejnek and Randl (2016) have documented that U.S. dividend claims perform worse relative to the underlying index than in the other three core markets. It is noteworthy that the U.S. is the only market in our core analysis that does not have a market for listed dividend futures. Thus in terms of dividend markets the Eurozone, U.K. and Japan are more liquid and perhaps more important as a source of forward-looking information than the U.S. Constructing the U.S. dividend risk factor is still important, as it useful in predicting U.S. equity returns. Dividend excess returns of all maturities show significant exposure to the divided risk factor. Thus, we arrive at the conclusion that a linear combination of forward equity forward rates predicts excess returns on dividend strategies just as has earlier been documented for predictability of bonds using a linear combination of bond forward rates. The loadings on the dividend factor increase in maturity, with the steepest increase from the one-year contract to the two-year contract. This pattern is also evident in the corresponding fixed income literature. The goodness of fit of the constrained regressions tends to drop marginally in maturity, except for the shortest maturity claims which exhibit the lowest values of $R^2$.

**Bond regressions:** In addition to creating a dividend risk factor, we apply the method of Cochrane and Piazzesi (2005) to zero coupon bond yields in the corresponding four regions and for the same sample period. This allows to spot similarities between our dividend risk factor and the CP bond risk factor, and more importantly, we use both risk factors jointly to capture time variation in excess equity index returns later in the paper. Again, we follow a two step-procedure. Table 6 reports results for the following across-maturity average regressions:

$$\overline{RX}_{t+52}^{bonds} = \gamma^T \mathbf{F_t^{bonds}} + \bar{\epsilon}_{t+52} \,, \tag{13}$$

where $\mathbf{F_t^{bonds}} \equiv \left[1 \; Y_t^{bonds,(1)} \; F_t^{bonds,(2)} \; F_t^{bonds,(3)} \; F_t^{bonds,(4)} \; F_t^{bonds,(5)}\right]^T$ and $\gamma^T$ are vectors of coefficients.

We find significant coefficients for all four markets.[8] While the dividend regressions for the U.K. market exhibit the highest value of $R^2$, for the bond regressions it is the model for Japan that fits best. Finally, we use the estimated CP bond risk factor $(\hat{\gamma}^T \mathbf{F_t^{bonds}})$ in the following maturity specific regressions:

$$RX_{t+52}^{bonds,(n)} = b_n(\hat{\gamma}^T \mathbf{F_t^{bonds}}) + \epsilon_{t+52}^{(n)} \tag{14}$$

As is evident from table 7, the variation in excess bond returns of all maturities and all four countries is significantly captured by the corresponding forward yields. The coefficients show the expected pattern, strictly increasing in maturity. Thus, longer-duration bonds are more

[8] As already discussed, the tent-shaped pattern of the coefficients is not present over our sample period.

exposed to the bond risk factor.

Based on the constrained regressions for dividends and bonds, it seems that the term structure of forward equity forwards contains equally important forward-looking information for dividend claims as does the forward yield curve for bonds. Levels of $R^2$ across maturities and regions are in the same ball park for both asset classes, as are the magnitudes of the coefficients. The increase in factor loadings in maturity also applies to both asset classes; however, most of the increase is between the one-year and the two-year dividend claims, while the increase is more gradual for bonds.

**Robustness checks:** We follow Cochrane and Piazzesi (2005) and also estimate unconstrained one-step regressions. This allows to compare the shape of the return forecasting factors for different maturities and to compare it the results from the constrained regressions. The unconstrained regressions for bond excess returns of all maturities on all forward yields read as:

$$RX_{t+52}^{bonds,(n)} = \alpha + \beta_1 Y_t^{bonds,(1)} + \beta_2 F_t^{bonds,(2)} + \beta_3 F_t^{bonds,(3)} + \beta_4 F_t^{bonds,(4)} + \beta_5 F_t^{bonds,(5)} + \epsilon_{t+52}^{(n)} \tag{15}$$

The detailed results are presented in tables 20 and 21 the internet appendix. We also regress excess dividend swap returns of all maturities on all forward equity forward rates in the multivariate regression stated in equation 16.

$$RX_{t+52}^{dividends,(n)} = \alpha + \beta_1 F_t^{dividends,(1)} + \beta_2 F_t^{dividends,(2)} + \beta_3 F_t^{dividends,(3)} + \beta_4 F_t^{dividends,(4)} + \epsilon_{t+52}^{(n)} \tag{16}$$

While there is heterogeneity across markets, the pattern across maturities for each market is remarkably similar. Detailed results for this exercise can be found in section IA.2 in the internet appendix, tables 18 and 19.

As a robustness check for our method of creating a dividend risk factor we follow the line of thought of Mylnikov (2014), who argues that a more parsimonious return-forecasting model – which can essentially be viewed as a compromise between Fama and Bliss (1987) and Cochrane and Piazzesi (2005) – has favorable statistical properties and adds economic value in terms of implementing trading rules. We replicate the corresponding results for bonds and extend the model to the domain of dividend derivatives. All results are to be found in section IA.6 in the internet appendix.

After having elaborated on our method to construct a dividend risk factor we move on two employ this factor together with a bond risk factor to predict excess equity index returns.

# 5 Explaining Equity Index Returns

## 5.1 A Two Factor Model

Cochrane and Piazzesi (2005) argue that stocks have characteristics of very long-term bonds and, thus, the CP bond risk factor should also forecast excess equity index returns. It is obvious that our dividend risk factor is even more directly related to equity risk. Hence, in this section we tie together the dividend risk factor and the CP factor for bonds to capture time variation in excess equity index returns in the four core regions.

We test whether the dividend factor is still significant in predicting excess returns on dividend derivatives if we include the bond factor as well. For robustness we also relate bond returns to both risk factors. We do not expect the dividend factor to have a substantial impact on bond prices, though. Table 8 provides results on the following set of regressions, in which we relate stock index returns to both, the bond risk factors and dividend risk factors constructed before for each of the four regions.

$$RX_{t+52}^{stocks} = a + b^{bonds}(\hat{\gamma}^{T,bonds}\mathbf{F_t^{bonds}}) + b^{dividends}(\hat{\gamma}^{T,dividends}\mathbf{F_t^{dividends}}) + \epsilon_{t+52} \tag{17}$$

The dividend risk factor and the bond factor are significant in explaining stock index returns, with values of $R^2$ around 0.4. While the dividend risk factor is positively associated with subsequent equity returns, the bond factor is negatively related to subsequent stock returns. As shown in table 22 in the internet appendix, the bond factor also has a negative sign on a stand-alone basis. This is in contrast to the results reported in Cochrane and Piazzesi (2005). Their sample, however, ends in 2003. Campbell, Pflueger, and Viceira (2015) claim that the relation of stocks and bonds moves substantially over time due to different monetary policy regimes and time-varying macroeconomic uncertainty. They show that stocks and bonds were positively related in the years from 1960 to 2011 (with the highest positive relation in the 1980s), whereas the relation was negative in the 2000s, the period that coincides most with our sample period.[9] Our sample period contains the financial crises and a period of very low inflation expectations, both of which are drivers of a negative stock-bond correlation as claimed by Ilmanen (2003) and David and Veronesi (2013).

While the bond risk factor is significantly related to subsequent excess equity returns in three out of four markets (not in the U.K.), the dividend factor is significant in all four markets including the U.S. This result highlights the importance of future curves (term structures) in predicting excess equity returns. Moreover it shows that augmenting the CP bond factor with a factor more directly related to equity risk results in substantially higher predictability as measured in terms of $R^2$. While the bond factor on a stand-alone basis predicts excess equity returns with values of $R^2$ in the range of 0.01 (Eurozone) to 0.37 (Japan) the corresponding values for the two-factor model are 0.33 and 0.47. The dividend factor alone has a higher goodness of fit than the bond factor alone, but lower than the two-factor model underpinning the notion that there is significant value in employing the two factors jointly.

In the appendix we show that both factors are important drivers of excess returns on dividend swaps, while only the bond factor is useful in predicting excess bond returns.

[9] Using our method and code with the original dataset of CP which ends in 2003 we also find a positive coefficient on the bond factor confirming the validity of our analyses.

## 5.2 A Global Factor Model

Having shown the vital relevance of the dividend risk factor together with the CP bond risk factor we want to extend the analysis to a wider range of regions and even asset classes. As there is only reliable data on the term structure of forward equity forwards for the four core regions, we construct a global dividend risk factor along with a global bond risk factor by aggregating the four local bond factors and four local dividend factors, respectively. We aggregate the local factors on an equally weighted basis.[10] Figure 1 displays the global factors over time. Time variation is most pronounced for the dividend factor, which has the highest realizations in the recession period from late 2008 to mid 2009. Building on empirical evidence on global co-movement of risk premia as well as international tests of the CP factor for bonds in Kessler and Scherer (2009) and Dahlquist and Hasseltoft (2013), we expect the global versions of the factors to price assets that are not in the four regions that we used to construct the factors in the first place.

As a first step we test if the two factor model presented before is still valid if we replace the local factors by the aggregated (global) bond factor $BF_t^{global}$ and dividend factor $DF_t^{global}$

$$BF_t^{global} = \sum_{m=1}^{4} (\hat{\gamma}^{T,bonds,m} \mathbf{F_t^{bonds,m}}) \,, \tag{18}$$

$$DF_t^{global} = \sum_{m=1}^{4} (\hat{\gamma}^{T,dividends,m} \mathbf{F_t^{dividends,m}}) \,, \tag{19}$$

where $m \in \{$S&P 500, FTSE 100, Nikkei 225, Euro Stoxx 50$\}$. Thus, we estimate the following regressions:

[10] This implies equal weighting of the regional risk factors. Dahlquist and Hasseltoft (2013) use GDP-weighted international bond factors. They also report, however, that results are largely unaffected by using equal-weighted international factors. Note that while the U.S. is the world's largest stock market, numbers reported by Mixon and Onur (2014) show that Europe is the largest market for dividend derivatives.

$$RX_{t+52}^{stocks,i} = a + b^{bonds,global} BF_t^{global} + b^{dividends,global} DF_t^{global} + \epsilon_{t+52}^{stocks,i} \tag{20}$$

The results in table 9 confirm that the global factors work even better than the local factors as $R^2$ increases. The magnitude of the coefficients is comparable to the local model (note that we summed over the four local factors and, hence, the magnitude of the coefficient have to by multiplied by 4 to be comparable with the table before). In the appendix we regress excess equity returns of the four core regions on both the local dividend and bond factors as well as international dividend and bond factors (which are constructed by summing over all local factors except the one corresponding to the region of the excess return on the left hand side of the regression). It can bes seen that the international factors are more important than the local factors as most of the local factors become insignificant after controlling for the international factors. Additionally, the levels of $R^2$ increase only marginally as compared to the global model. This provides reasonable justification to employ the global model for the analyses that follow.

The major advantage of employing global versions of the two risk factors is that we can use them to price any asset that we think should be driven by global equity and bond risk premia. This approach is especially interesting for assets that we did not use to construct the global risk factors. Remember that we implicitly use dividend derivatives and bonds in the U.S., U.K., Japan and the Eurozone to construct the risk factors. Using excess returns on a variety of assets not used to fit the models, we actually implement out-of-sample tests for our empirical strategy:

$$RX_{t+52}^{asset,i} = a + b^{bonds,global} BF_t^{global} + b^{dividends,global} DF_t^{global} + \epsilon_{t+52}^{asset,i} \tag{21}$$

The assets we use for this purpose are as follows: MSCI world, MSCI emerging markets, MSCI frontier markets indices, and all individual country MSCI indices in developed markets; U.S. style indices (value, growth, small value, small growth, momentum), an index rolling short positions in VIX futures contracts, U.S., Euro, and emerging markets (high yield) bond indices, and Deutsche Bank currency strategies (G10 carry, momentum, value, and global carry) as well as longer-term bonds and dividend derivatives. Tables 10 and 11 provide the detailed results which reveal that innovations in the global dividend risk factor have a significant and positive effect on excess returns of most test assets, with the exception of a negative sign for currency momentum. Evidence is mixed but in line with expectations for the bond factor: negative and significant for most equity markets, positive for bonds, and insignificant for most currency strategies. The evidence for MSCI country indices, presented in table 10, is clear, with nearly every single market having negative exposure to the global bond factor and highly significant positive exposure to the global dividend factor. Figure 2 provides a graphical overview over the fit of the two-factor global model for MSCI country indices. The fact that the risk factors explain excess returns of various asset classes, countries and regions is a good indication on both, the robustness of our empirical asset pricing model and the substantial global comovement in risk premia.

## 5.3 Robustness

As mentioned earlier we follow Sarno, Schneider, and Wagner (2012) and base the statistical inference about the significance of single coefficients on block bootstrapped standard errors (and we report Newey-West standard errors with 52 lags in addition). The joint significance is evaluated using the $CW$ and $GW$ measures as laid out in detail in the appendix.

**Known predictors.** In addition to technical robustness checks, we strive to evaluate if our global two factor model is superior to well known predictive variables. The term spread as defined as the difference between the yield on a ten year bond and a one-year bond as well as the cyclically adjusted price earnings ratio (CAPE) are two factors that have historically captured the time variation in excess equity index returns with decent accuracy. Thus we estimate a version of the global model, where we add a global term spread and a global CAPE to the dividend and the bond factor:

$$RX_{t+52}^{asset,i} = a + b^{bonds,global}BF_t^{global} + b^{dividends,global}DF_t^{global} + b^{term,global}TERM^{global} + b^{CAPE,global}CAPE^{global} + \epsilon_{t+52}^{asset,i} \tag{22}$$

To assess the value of our dividend and bond factors, we evaluate if this four factor model is superior to a two factor model which uses only the term spread and CAPE. The corresponding results are displayed in table 12. The statistical measures we use to assess the predictive accuracy of a model are the change in the hit ratio, $\Delta HR$, the change in the predictive power, $R2$, which is based on the ratio of the mean squared errors of the model and the benchmark, respectively, and the $p$-values of a $CW$ and a $GW$ test. Note that in contrast to the tables so far in this paper, the alternative model for the $CW$ and $GW$ test is not the no-predictability case but a two factor model with term spread and CAPE. We provide full details of the measures in section A.1 of the appendix, and describe bootstrapping for the $CW$ and $GW$ tests in section A.2. Thus, $p$-values smaller than 0.10 indicate that the four factor model is superior to a model using the term spread and CAPE only, which implicitly confirms that our dividend and bond factor model adds significant value.

Most of the hit ratios increase, adjusted $R^2$ increase and basically all $CW$ and $GW$ $p$-values are substantially below 0.10. This is convincing evidence in favour of our factors. To challenge our results even more, we repeat the same exercise but use local term spreads and CAPEs instead:

$$RX_{t+52}^{asset,i} = a + b^{bonds,global}BF_t^{global} + b^{dividends,global}DF_t^{global} + b^{term,local}TERM^{local} + b^{CAPE,local}CAPE^{local} + \epsilon_{t+52}^{asset,i} \tag{23}$$

Although the results get somewhat weaker (for instance the $CW$ and $GW$ $p$-values for the U.S., Canada and Norway are not significant anymore) as could be expected, the overall picture does still confirm the validity of our the global dividend and bond factors in capturing risk premia.

**Economic drivers.** Digging deeper into the drivers of the global dividend factor and the global bond factor, we regress those factors on a set of variables usually related to equity index performance: the level of implied volatility as well as the change in implied volatility, the level of and the change in the ted spread, the level of and the change in inflation expectations (computed from inflation swaps) and the level of CAPE and the term spread. All variables are aggregated over the four core markets to be global variables. As shown in table 14, the global dividend factor can be explained with an $R^2$ 0.6. Put differently, the global dividend factor explains 40% more than traditional predictive variables. The dividend factor seems to be related to high but decreasing volatility, positive changes in inflation expectations and lower levels of CAPE, while it is not significantly related to liquidity risk or the steepness of the yield curve. The same set of variables explains the global bond factor with a $R^2$ of 0.78. Thus, the innovation of the dividend factor over known predictors appears to be greater than the innovation of the bond factor. This is consistent with our earlier finding that the dividend factor improves the prediction of equity excess returns substantially over the bond factor. While the bond factor has similar exposure to volatility risk, it is also positively related to liquidity as measured by the TED spread. Inflation expectations are not significantly related to the bond factor, whereas it is positively and significantly related to the term spread, which appears to be intuitive.

# 6 Conclusion

This paper investigates risk premia in the market for traded claims on dividends (i.e. dividend derivatives), stocks, and bonds. Dividend derivatives of several maturities allow to construct a term structure of equity forward rates in a way analogous to bond yields. We extend the well-known bond model of Cochrane and Piazzesi (2005) to suit the market for dividends and utilize the method to create a novel dividend risk factor. While we confirm earlier evidence that excess returns on dividend derivatives investments are time-varying, we shed light on a number of related research questions that have not been explored to the present date:

(1) We find strong international evidence for predictability in excess returns of dividend derivatives, with $R^2$ in the ballpark of predictive regressions for fixed income securities.

(2) We show that a common return-forecasting factor drives the variation in excess returns on dividend derivatives of all maturities. Similar to the fixed income literature, very short maturity claims are least exposed to this dividend risk factor, while longer maturities have higher exposures to the same factor. However, the increase in exposure with increasing maturity is somewhat less pronounced than for bonds.

(3) We tie together our findings on a unique dividend risk factor and the existing evidence for a corresponding bond risk factor to price dividend derivatives, bonds and stocks using both factors at a time. The dividend risk factor is positively and significantly related to subsequent excess returns on dividend derivatives and stocks, whereas it has only marginal importance for pricing bonds. The bond factor is positively related to subsequent excess bond returns while it is significantly negatively related to dividend derivatives and excess stock returns. This is consistent with the output-focused monetary policy, elevated macroeconomic uncertainty and low inflation expectations over our sample period, all facts that have been documented in the literature to give rise to a negative stock-bond correlation. Using both, the dividend factor and the bond factor, in the predictive regressions increases the values of $R^2$ substantially. In predicting excess returns of stock indices, for instance, the two-factor model increases the $R^2$ by 0.25 as compared to a model that uses the bond factor only, and by 0.17 as compared to a single-factor model using the dividend factor.

(4) We extend the local two-factor models further to a global two-factor model by aggregating the factors over the four core regions. We interpret the excellent fit of the global model as evidence for substantial comovement in international risk premia.

(5) Moreover, we employ the global two-factor model to predict excess returns of a variety

of test assets including all MSCI developed market country stock indices (excluding the four core markets that we use to construct the risk factors), regional stock indices, EM bonds, corporate high yield bonds in the U.S., the Eurozone and emerging markets as well as a volatility selling strategy. Most test assets have significant positive exposure to the global dividend risk factor, while the global bond factor is positively related to fixed income assets and negatively related to equity-like assets. The findings of two global factors capturing return dynamics of a vast set of assets do still hold after using rigorous block bootstrap methods for statistical inference and including well-known control variables.

# A Appendix – Statistical Inference

## A.1 Model evaluation

In assessing the predictive accuracy of our model, we follow Sarno, Schneider, and Wagner (2012) and compute the tests proposed by Clark and West (2007) and Giacomini and White (2006), which we denote $CW$ and $GW$ tests. Our focus is to analyze time variation in dividend risk premia, not on out-of-sample prediction of returns. Therefore we follow Sarno, Schneider, and Wagner (2012) in their analysis of foreign exchange risk premiums, and use in-sample predictions for model evaluation. The $CW$ test statistic given in equation 24 is based on comparison of the mean squared prediction errors $MSE^M$ and $MSE^B$ of a model and its nested benchmark, respectively, adjusted for the upward bias in $MSE^M$ due to introduction of noise from estimating a larger model $M$ under the null of $B$. The null hypothesis of the $CW$ test is that the nested models have equal mean-squared errors; a large $CW$ test statistic means that model $M$ has a lower mean squared prediction error. $CW$ is defined as

$$CW = MSE^B - MSE^M + N^{-1} \sum_{t=1}^{T} \left( \hat{r}_{t,T}^{B} - \hat{r}_{t,T}^{M} \right)^2 , \tag{24}$$

where $N$ is the number of observations in the sample. For standalone model evaluation, we use the constant model (no predictability) as a benchmark $B$, while for model comparison, the nested model serves as benchmark $B$, and the model with additional variables as the model $M$ to be evaluated. We apply the block-bootstrap procedure described in section A.2 to obtain $p$-values.

To assess conditional predictive ability, either for a model against no-predictability or for model comparison, we calculate the $GW$ test statistic given in formula 25:

$$GW = N \left( N^{-1} \sum_{t=1}^{T} h_t \Delta L_T \right) \hat{\Omega}_N^{-1} \left( N^{-1} \sum_{t=1}^{T} h_t \Delta L_T \right) , \tag{25}$$

where $\Delta L_T = SE_T^B - SE_T^M$, $h_t = (1, \Delta L_t)$, and $\hat{\Omega}_N^{-1}$ is a heteroscedasticity and autocorrelation-consistent estimate of the variance of $h_t \Delta L_T$ obtained using the weight function proposed by Newey and West (1987). The implementation of the $GW$ test statistic tests if predictions based on the null hypothesis that the model and the benchmark have equal conditional predictive ability, using the squared prediction error as loss functions of the two competing predictions at $t$ for $T$. Again, we obtain $p$-values from bootstrapping, where we simulate the proportion of times we would obtain an observed value as large as the test statistic $GW$ computed from the sample, even if the conditional predictability of models $M$ and $B$ are equal. The block-bootstrap procedure is described in detail in section A.2.

For model comparison, we further calculate $\Delta HR$ as the difference in the proportion of times the sign of the excess return is correctly predicted by the model $M$ (hit ratio of $M$) minus the hit ratio of the benchmark $B$. Again following Sarno, Schneider, and Wagner (2012), relative predictive ability is further assessed by the $R2$ statistics given in equation 26:

$$R2 = 1 - \frac{MSE^M}{MSE^B} \tag{26}$$

## A.2 Block-bootstrap procedure

Our analysis uses overlapping returns such that using unadjusted standard errors would likely lead to overstating statistical significance. While we mitigate potential problems arising from heteroscedasticity and autocorrelation by the sue of Newey and West (1987) standard errors, we employ in addition a block-bootstrap procedure for both the calculation of standard errors and to obtain $p$-values of the $CW$ and $GW$ test statistics. In our bootstrap methodology for assessing the predictive ability of a model, we impose a data generating process of no predictability. For model comparison, we impose the benchmark model as the data generating process. An overlapping block resampling scheme can handle serial correlaation and heteroscedasticity, as described by Sarno, Schneider, and Wagner (2012) and the references cited therein in appendix F, e.g., Künsch (1989) and Politis and White (2004). Specifically, we proceed as follows.

1. Run both the model regression of form $y_t = \alpha^M + \boldsymbol{\beta}^M \boldsymbol{x}_t^M + \epsilon^M$ and the benchmark regression $y_t = \alpha^B + \boldsymbol{\beta}^B \boldsymbol{x}_t^B + \epsilon^B$. Note that $\boldsymbol{x}^B$ is a subset of $\boldsymbol{x}^M$ and if the benchmark model is no-predictability, there are no $\boldsymbol{x}^B$, i.e. the benchmark regression reduces to computation of the mean. Save $\boldsymbol{\beta}^M$, $\epsilon^M$, $\hat{\boldsymbol{y}^B}$, and compute the $CW$ and $GW$ test-statistics. Set $\tilde{y}_t = \hat{y}_t^B + \epsilon_t^M$.

2. Form an artificial sample $S_t^* = (y_t^*, \boldsymbol{x}_t^M)$, by randomly sampling, with replacement, $b$ overlapping blocks of length $l$ from the sample $(\tilde{y}, \boldsymbol{x}^M)$.

3. Run the regressions $y_t^* = \alpha^{*M} + \boldsymbol{\beta}^{*M} \boldsymbol{x}_t^{*M} + \epsilon^{*M}$ and $y_t^* = \alpha^{*B} + \boldsymbol{\beta}^{*B} \boldsymbol{x}_t^{*B} + \epsilon^{*B}$. Save $\boldsymbol{\beta}^{*M}$ and compute the $CW^*$ and $GW^*$ test-statistics.

4. Repeat steps 2 and 3 5,000 times.

5. Obtain the covariance matrix $\Sigma_{\boldsymbol{\beta}^M}$ from the 5,000 vectors of $\boldsymbol{\beta}^{*M}$. Determine the one-sided $p$-values of the test-statistics by computing the proportional number of times that $CW^* > CW$ and $GW^* > GW$.

## References


Binsbergen, Jules H. van, Michael Brandt, and Ralph Koijen, 2012, On the timing and pricing of dividends, *American Economic Review* 102, 1596–1618.

Binsbergen, Jules H. van, Wouter Hueskes, Ralph Koijen, and Evert B. Vrugt, 2013, Equity yields, *Journal of Financial Economics* 110, 503 – 519.

Binsbergen, Jules H. van, and Ralph Koijen, 2016, The term structure of returns: Facts and theory, *Journal of Financial Economics* forthcoming Working paper.

Brennan, Michael, 1998, Stripping the S&P 500 Index, *Financial Analysts Journal* 54, 12–22.

Campbell, John, Carolin Pflueger, and Luis Viceira, 2015, Monetary policy drivers of bond and equity risks, Working Paper.

Cejnek, Georg, and Otto Randl, 2016, Risk and return of short-duration equity investments, *Journal of Empirical Finance* 36, 181–198.

Clark, Todd E., and Kenneth D. West, 2007, Approximately normal tests for equal predictive accuracy in nested models, *Journal of Econometrics* 138, 291–311.

Cochrane, John H., and Monika Piazzesi, 2005, Bond risk premia, *American Economic Review* 95, 138–160.

Dahlquist, Magnus, and Henrik Hasseltoft, 2013, International bond risk premia, *Journal of International Economics* 90, 17 – 32.

David, Alexander, and Pietro Veronesi, 2013, What ties return volatilities to price valuations and fundamentals?, *Journal of Political Economy* 121, 682–746.

De Moor, Lieven, and Piet Sercu, 2013, The smallest firm effect: An international study, *Journal of International Money and Finance* 32, 129–155.

Dimson, Elroy, 1979, Risk measurement when shares are subject to infrequent trading, *Journal of Financial Economics* 7, 197 – 226.

Dockner, Engelbert, Manuel Mayer, and Josef Zechner, 2013, Sovereign bond risk premiums, Working Paper.

Fama, Eugene, and Robert R Bliss, 1987, The information in long-maturity forward rates, *American Economic Review* 77, 680–92.

Giacomini, Raffaella, and Halbert White, 2006, Tests of conditional predictive ability, *Econometrica,* 74, 545–1578.

Ilmanen, Antti, 2003, Stock-bond-correlations, *Journal of Fixed Income* 13, 55 – 66.

Kessler, Stephan, and Bernd Scherer, 2009, Varying risk premia in international bond markets, *Journal of Banking & Finance* 33, 1361–1375.

Koijen, Ralph, Hanno Lustig, and Stijn van Nieuwerburgh, 2015, The cross-section and time series of stock and bond returns, Working Paper.

Kragt, Jac, Frank de Jong, and Joost Driessen, 2015, The dividend term structure, Working Paper.

Künsch, Hans R., 1989, The jackknife and the bootstrap for general stationary observations, *The Annals of Statistics* 17, 1217–1241.

Manley, Richard, and Christian Mueller-Glissmann, 2008, The Market for Dividends and Related Investment Strategies, *Financial Anaylsts Journal* 64, 17–29.

Mixon, Scott, and Esen Onur, 2014, Dividend swaps and dividend futures: State of play, Working Paper.

Mylnikov, George, 2014, Forecasting U.S. bond returns: A practitioner's perspective, *Journal of Portfolio Management* 40, 124–136.

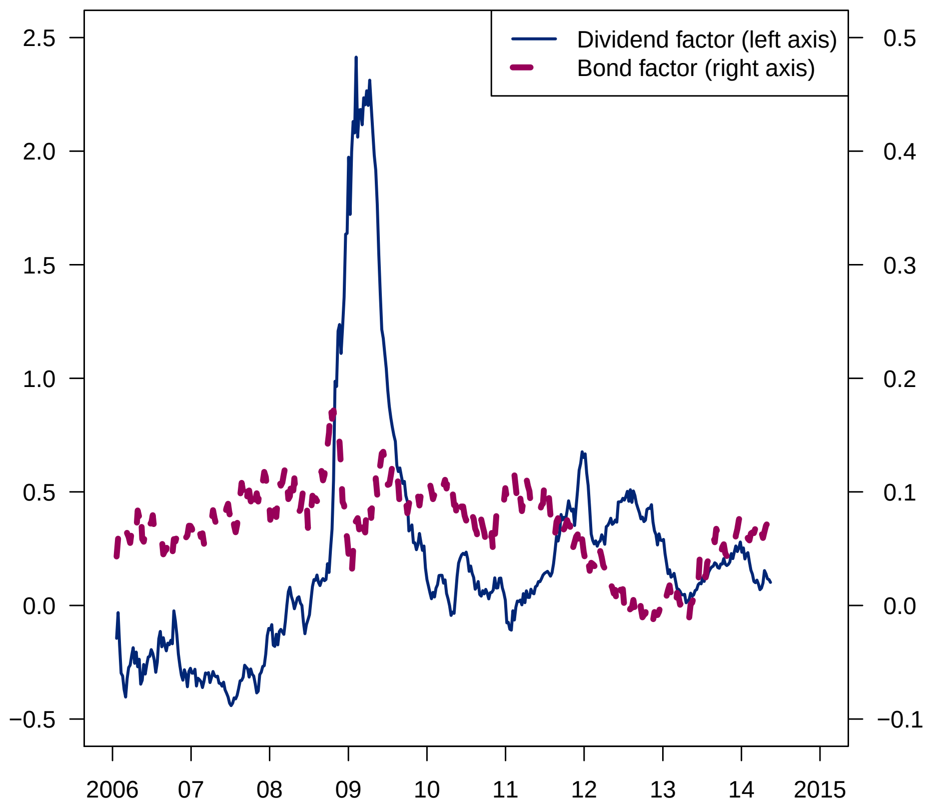
Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix., *Econometrica* 55, 703 – 708.

Politis, Dimitris N., and Halbert White, 2004, Automatic block-length selection for the dependent bootstrap., *Econometric Reviews* 23, 53 – 70.

Sarno, Lucio, Paul Schneider, and Christian Wagner, 2012, Properties of foreign exchange risk premiums, *Journal of Financial Economics* 105, 279–310.

# Figures and Tables

**Figure 1:** Global Factors.




The figure displays the global dividend factor $\mathbf{F_t^{dividends,global}}$, constructed as the sum of the local dividend factors, and the global bond factor $\mathbf{F_t^{bonds,global}}$, constructed as the sum of the local bond factors.

**Figure 2:** Actual vs Predicted Index Excess Returns.

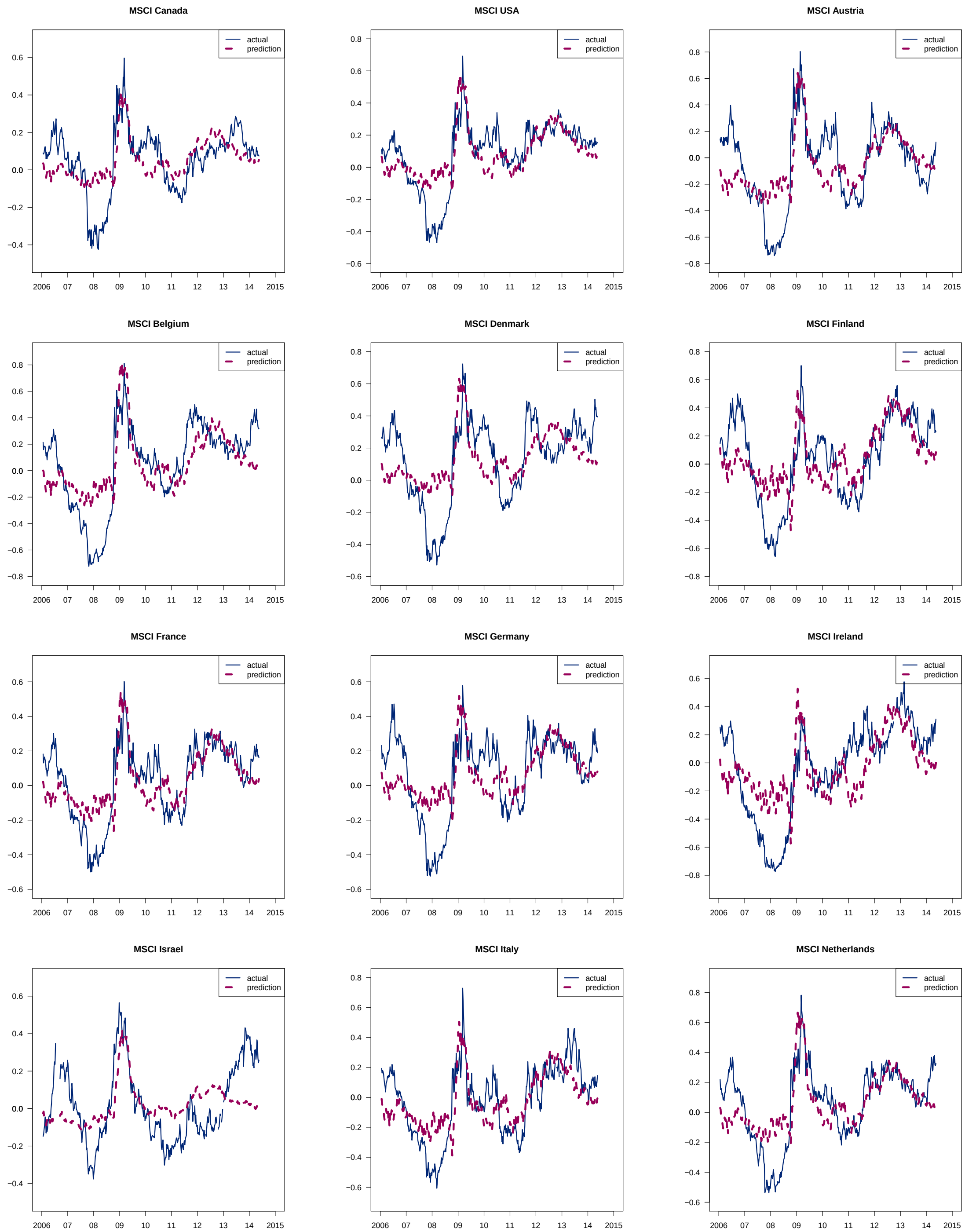
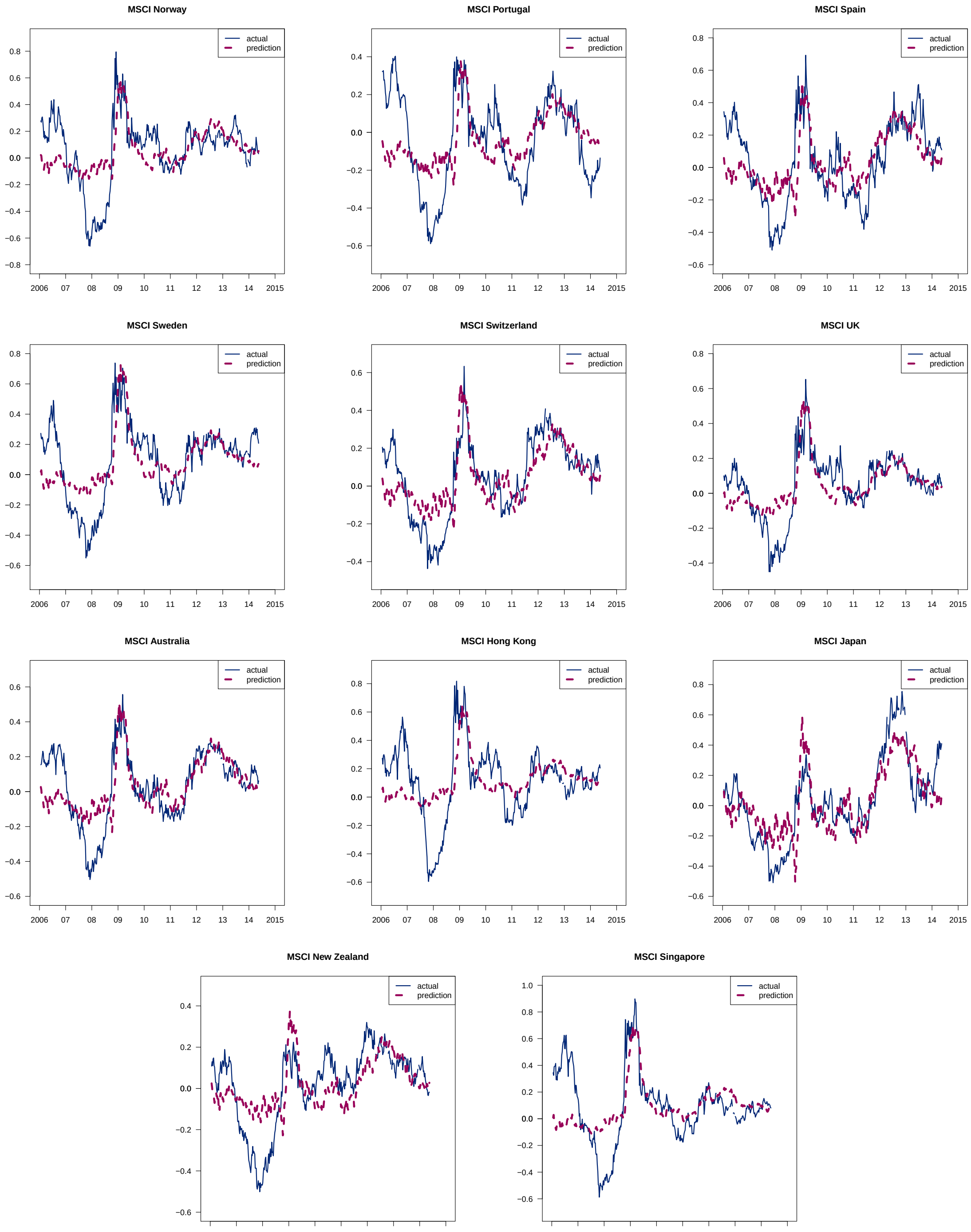



Figure continues on next page.

**Figure 2:** Actual vs Predicted Index Excess Returns (cont.)




The figure displays actual versus predicted rolling 52-weeks excess returns of MSCI country indices. Predicted values are obtained from the global two factor model of equation 21, $RX_{t+52}^{stocks,i} = a + b^{bonds,global} BF_t^{global} + b^{dividends,global} DF_t^{global} + \epsilon_{t+52}^{stocks,i}$.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro 1 | -15.19 | 4.38 | 4.46 | 26.24 | 6.93 |
| Euro 2 | -44.04 | 6.68 | 6.98 | 104.34 | 24.47 |
| Euro 3 | -63.33 | 3.78 | 7.04 | 107.14 | 29.75 |
| Euro 4 | -64.61 | 2.09 | 4.77 | 106.29 | 30.07 |
| US 1 | -14.84 | 1.39 | 2.24 | 18.65 | 5.71 |
| US 2 | -33.28 | 2.41 | 4.42 | 53.73 | 14.17 |
| US 3 | -46.19 | 2.29 | 4.97 | 57.95 | 17.43 |
| US 4 | -45.88 | 2.37 | 3.88 | 60.78 | 18.32 |
| U.K. 1 | -8.10 | 2.29 | 0.99 | 27.64 | 6.62 |
| U.K. 2 | -39.64 | 6.58 | 3.65 | 101.72 | 22.18 |
| U.K. 3 | -56.17 | 5.54 | 4.39 | 108.03 | 27.55 |
| U.K. 4 | -56.84 | 5.05 | 5.76 | 105.28 | 28.41 |
| Japan 1 | -22.73 | 8.11 | 7.72 | 46.68 | 11.95 |
| Japan 2 | -50.43 | 10.77 | 12.46 | 120.73 | 28.07 |
| Japan 3 | -67.72 | 10.23 | 11.43 | 138.58 | 33.48 |
| Japan 4 | -69.51 | 10.65 | 10.84 | 128.02 | 35.33 |

**Table 1: Summary Statistics - Excess Returns of Dividend Swaps**
This table provides summary statistics on the annual excess returns of dividend swap investments. The numbers are excess returns of a dividend swap corresponding to equation 7 with $n$ years to maturity, held for one year, and sold as an $n-1$ year dividend swap. The underlyings of the dividend swaps are aggregate index dividends on the Euro Stoxx 50, the S&P 500, the FTSE 100 and the Nikkei 225. All numbers are stated as %. The number of observations is equal to 435.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro 2 | -1.23 | 0.27 | 0.07 | 3.98 | 0.97 |
| Euro 3 | -1.75 | 1.25 | 1.04 | 7.07 | 1.82 |
| Euro 4 | -2.51 | 2.04 | 2.11 | 8.98 | 2.53 |
| Euro 5 | -3.24 | 2.76 | 3.09 | 10.20 | 3.19 |
| US 2 | -0.76 | 0.93 | 0.73 | 3.02 | 0.82 |
| US 3 | -1.23 | 1.90 | 1.56 | 5.94 | 1.54 |
| US 4 | -1.53 | 2.88 | 2.55 | 8.41 | 2.31 |
| US 5 | -2.34 | 3.64 | 3.59 | 10.66 | 3.09 |
| U.K. 2 | -1.34 | 0.90 | 0.62 | 5.02 | 1.27 |
| U.K. 3 | -2.69 | 1.95 | 1.69 | 8.31 | 2.34 |
| U.K. 4 | -3.61 | 2.77 | 2.89 | 9.19 | 2.95 |
| U.K. 5 | -4.73 | 3.32 | 3.59 | 10.97 | 3.79 |
| Japan 2 | -0.16 | 0.23 | 0.13 | 1.12 | 0.22 |
| Japan 3 | -0.35 | 0.44 | 0.29 | 2.08 | 0.42 |
| Japan 4 | -0.29 | 0.87 | 0.69 | 3.29 | 0.66 |
| Japan 5 | -0.18 | 1.33 | 1.16 | 4.36 | 0.85 |

**Table 2: Summary Statistics - Excess Returns of Zero Coupon Bonds**
This table provides summary statistics on the annual excess returns of zero coupon bonds. The numbers are excess returns of a zero coupon bond corresponding to equation 4 with $n$ years to maturity, held for one year, and sold as an $n-1$ year bond. We subtract the one-year bond yield of the corresponding country to obtain excess returns. In the Eurozone we use EUR swap yields. All numbers are stated as %. The number of observations is equal to 435.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro | -51.80 | 2.49 | 8.34 | 63.82 | 21.82 |
| US | -47.29 | 8.05 | 13.43 | 69.53 | 20.17 |
| U.K. | -44.52 | 5.03 | 7.24 | 64.96 | 17.51 |
| Japan | -53.51 | 5.39 | 3.44 | 79.27 | 26.88 |

**Table 3: Summary Statistics - Excess Returns of Core Stock Indices**
This table provides summary statistics on the annual excess returns of stock indices. The numbers are excess returns corresponding to equation 10. We subtract the one-year bond yield of the corresponding country to obtain excess returns. In the Eurozone we subtract the one-year EUR swap yield. The indices we use for the four regions are the Euro Stoxx 50, the S&P 500, the FTSE 100 and the Nikkei 225. All numbers are stated as %. The number of observations is equal to 435.

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0030 | -0.0284 | 0.0416 ** | 0.0750 |
| | *0.0505* | *0.1234* | *0.0210* | *0.0501* |
| RP1 | 0.4425 | 0.4882 | 0.4783 | -0.1388 |
| | *0.3179* | *0.5397* | *0.3306* | *0.2944* |
| RP2 | 0.8466 ** | 0.2985 | 0.9177 *** | 2.2317 *** |
| | *0.3491* | *1.0723* | *0.2255* | *0.5619* |
| RP3 | -2.5766* | 0.0416 | -2.1568 | -4.9990** |
| | *1.5216* | *0.4687* | *1.8032* | *2.3203* |
| RP4 | 2.9629 | -2.0794 | 6.2355 ** | 5.6709 ** |
| | *2.0543* | *2.0934* | *3.1504* | *2.7693* |
| Adj. $R^2$ | 0.5051 | 0.1517 | 0.6542 | 0.4947 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0413 | 0.0000 | 0.0000 |

**Table 4: Cochrane Piazzesi Across-Maturity Average Regressions for Dividend Derivatives**.
This table provides results for the following regression: $\frac{1}{4}\sum_{n=1}^{4} RX_{t+52}^{dividends,(n)} = \alpha + \gamma_1 F_t^{dividends,(1)} + \gamma_2 F_t^{dividends,(2)} + \gamma_3 F_t^{dividends,(3)} + \gamma_4 F_t^{dividends,(4)} + \bar{\epsilon}_{t+52}$, i.e. we regress across-maturity average excess returns on dividend derivatives on equity forward rates of all maturities $n$. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

Panel A: Explaining Returns of 1-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0324 ** | 0.0067 | 0.0085 | 0.0458 |
| s.e. (BS) | *0.0142* | *0.0179* | *0.0095* | *0.0299* |
| s.e. (NW) | *0.0140* | *0.0165* | *0.0083* | *0.0303* |
| Dividend factor | 0.2676 *** | 0.3427 | 0.2963 *** | 0.3546 *** |
| s.e. (BS) | *0.0601* | *0.3102* | *0.0371* | *0.0954* |
| s.e. (NW) | *0.0413* | *0.1450* | *0.0219* | *0.0784* |
| Adj. $R^2$ | 0.3888 | 0.1199 | 0.5692 | 0.3153 |
| p-val CW | 0.0000 | 0.0744 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0350 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 2-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0169 | -0.0007 | 0.0115 | -0.0015 |
| s.e. (BS) | *0.0468* | *0.0447* | *0.0343* | *0.0631* |
| s.e. (NW) | *0.0474* | *0.0417* | *0.0334* | *0.0627* |
| Dividend factor | 1.1804 *** | 1.1720 | 1.1168 *** | 1.0989 *** |
| s.e. (BS) | *0.2507* | *0.7722* | *0.1950* | *0.2133* |
| s.e. (NW) | *0.1753* | *0.3766* | *0.1566* | *0.1796* |
| Adj. $R^2$ | 0.6074 | 0.2302 | 0.7203 | 0.5505 |
| p-val CW | 0.0000 | 0.0106 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0026 | 0.0000 | 0.0000 |

Panel C: Explaining Returns of 3-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0170 | -0.0033 | -0.0071 | -0.0240 |
| s.e. (BS) | *0.0659* | *0.0567* | *0.0524* | *0.0762* |
| s.e. (NW) | *0.0651* | *0.0528* | *0.0509* | *0.0762* |
| Dividend factor | 1.2946 *** | 1.2407 | 1.2839 *** | 1.2711 *** |
| s.e. (BS) | *0.3075* | *1.0151* | *0.1805* | *0.2622* |
| s.e. (NW) | *0.2090* | *0.4666* | *0.1588* | *0.2014* |
| Adj. $R^2$ | 0.4939 | 0.1698 | 0.6170 | 0.5176 |
| p-val CW | 0.0000 | 0.0448 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0142 | 0.0000 | 0.0000 |

Panel D: Explaining Returns of 4-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0323 | -0.0027 | -0.0129 | -0.0203 |
| s.e. (BS) | *0.0664* | *0.0592* | *0.0549* | *0.0853* |
| s.e. (NW) | *0.0682* | *0.0553* | *0.0543* | *0.0825* |
| Dividend factor | 1.2575 *** | 1.2446 | 1.3029 *** | 1.2753 *** |
| s.e. (BS) | *0.3381* | *1.2151* | *0.1922* | *0.3356* |
| s.e. (NW) | *0.2185* | *0.5375* | *0.1642* | *0.2242* |
| Adj. $R^2$ | 0.4560 | 0.1544 | 0.5973 | 0.4677 |
| p-val CW | 0.0000 | 0.0868 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0304 | 0.0000 | 0.0000 |

**Table 5: Cochrane Piazzesi Constrained Regressions for Dividend Derivatives.**
This table provides results for constrained Cochrane Piazzesi regressions for dividend derivatives. The regression reads as $RX_{t+52}^{dividends,(n)} = b_n(\gamma^T \mathbf{F_t^{dividends}}) + \epsilon_{t+52}^{(n)}$ where $\gamma^T$ is derived from the results in table 4. Newey-West (52 lags) standard errors are reported below the coefficients. The number of observations is equal to 435.

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0005 | -0.0250*** | -0.0409*** | 0.0002 |
| | *0.0241* | *0.0038* | *0.0123* | *0.0013* |
| Y1 | 0.9648 * | 0.1667 | 1.8234 | 1.2373 ** |
| | *0.5349* | *1.3234* | *1.1346* | *0.5244* |
| F2 | -5.6796*** | -0.3245 | -5.1166** | -2.2754*** |
| | *1.6332* | *2.6278* | *2.1541* | *0.5841* |
| F3 | 5.7226 | -0.8973 | 2.3754 ** | 1.8727 * |
| | *4.9226* | *1.3722* | *1.0351* | *1.0719* |
| F4 | 3.0355 | 1.0736 | 1.2881 | 0.7671 * |
| | *6.5583* | *0.7705* | *0.8636* | *0.4067* |
| F5 | -3.8192 | 1.1862 ** | 0.9372 | -0.2599 |
| | *4.7590* | *0.5127* | *0.7355* | *0.2604* |
| Adj. $R^2$ | 0.3007 | 0.4629 | 0.4050 | 0.6856 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 6: Cochrane Piazzesi Across-Maturity Average Regressions for Zero Coupon Bonds**. This table provides results for the following regression: $\frac{1}{4}\sum_{n=2}^{5} RX_{t+52}^{bonds,(n)} = \alpha + \gamma_1 Y_t^{bonds,(1)} + \gamma_2 F_t^{bonds,(2)} + \gamma_3 F_t^{bonds,(3)} + \gamma_4 F_t^{bonds,(4)} + \gamma_5 F_t^{bonds,(5)} + \bar{\epsilon}_{t+52}$, i.e. we regress across-maturity average excess returns on zero coupon bonds on forward bond yields of all maturities $n$. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. For the Eurozone we use EUR swap rates. The number of observations is equal to 435.

Panel A: Explaining Returns of 2-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0038* | 0.0015 | 0.0006 | -0.0008*** |
| s.e. (BS) | *0.0020* | *0.0012* | *0.0034* | *0.0003* |
| s.e. (NW) | *0.0016* | *0.0009* | *0.0026* | *0.0003* |
| Bond factor | 0.4123 *** | 0.3303 *** | 0.3774 *** | 0.4352 *** |
| s.e. (BS) | *0.0804* | *0.0736* | *0.0983* | *0.0469* |
| s.e. (NW) | *0.0727* | *0.0795* | *0.0799* | *0.0385* |
| Adj. $R^2$ | 0.2601 | 0.2792 | 0.2405 | 0.7441 |
| p-val CW | 0.0000 | 0.0000 | 0.0014 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0022 | 0.0000 |

Panel B: Explaining Returns of 3-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0012 | 0.0018 | -0.0003 | -0.0013** |
| s.e. (BS) | *0.0045* | *0.0020* | *0.0060* | *0.0006* |
| s.e. (NW) | *0.0043* | *0.0015* | *0.0050* | *0.0006* |
| Bond factor | 0.8669 *** | 0.7367 *** | 0.8846 *** | 0.7969 *** |
| s.e. (BS) | *0.1365* | *0.1075* | *0.1446* | *0.1006* |
| s.e. (NW) | *0.1249* | *0.1228* | *0.1102* | *0.1084* |
| Adj. $R^2$ | 0.3262 | 0.3920 | 0.3888 | 0.7139 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0002 | 0.0000 |

Panel C: Explaining Returns of 4-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0011 | 0.0003 | 0.0011 | -0.0003 |
| s.e. (BS) | *0.0070* | *0.0032* | *0.0077* | *0.0009* |
| s.e. (NW) | *0.0068* | *0.0026* | *0.0069* | *0.0008* |
| Bond factor | 1.2219 *** | 1.2193 *** | 1.1915 *** | 1.2617 *** |
| s.e. (BS) | *0.2227* | *0.1419* | *0.1930* | *0.1541* |
| s.e. (NW) | *0.2110* | *0.1680* | *0.1495* | *0.1540* |
| Adj. $R^2$ | 0.3367 | 0.4789 | 0.4452 | 0.7045 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0002 | 0.0000 | 0.0000 | 0.0000 |

Panel D: Explaining Returns of 5-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0039 | -0.0036 | -0.0014 | 0.0024 |
| s.e. (BS) | *0.0096* | *0.0063* | *0.0101* | *0.0017* |
| s.e. (NW) | *0.0097* | *0.0057* | *0.0090* | *0.0014* |
| Bond factor | 1.4989 *** | 1.7137 *** | 1.5465 *** | 1.5063 *** |
| s.e. (BS) | *0.3380* | *0.2053* | *0.2780* | *0.2381* |
| s.e. (NW) | *0.3262* | *0.2283* | *0.2170* | *0.1859* |
| Adj. $R^2$ | 0.3193 | 0.5290 | 0.4532 | 0.6032 |
| p-val CW | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0012 | 0.0000 | 0.0000 | 0.0000 |

**Table 7: Cochrane Piazzesi Constrained Regressions for Zero Coupon Bonds**.
This table provides results for constrained Cochrane Piazzesi regressions for zero coupon bonds. The regression reads as $RX^{bonds,(n)}_{t+52} = b_n(\gamma^T \mathbf{F}^{\mathbf{bonds}}_{\mathbf{t}}) + \epsilon^{(n)}_{t+52}$ where $\gamma^T$ is derived from the results in table 6. Newey-West (52 lags) standard errors are reported below the coefficients. The number of observations is equal to 435.

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0926 | 0.2474 *** | 0.0539 | 0.2422 * |
| s.e. (BS) | *0.0689* | *0.0486* | *0.0425* | *0.1262* |
| s.e. (NW) | *0.0590* | *0.0228* | *0.0288* | *0.1045* |
| Bond factor | -6.5050** | -8.2827*** | -1.6856 | -32.3517** |
| s.e. (BS) | *2.5663* | *2.9362* | *1.4972* | *13.2961* |
| s.e. (NW) | *2.2806* | *2.6443* | *1.2211* | *10.1371* |
| Dividend Factor | 0.8292 ** | 1.2609 * | 0.7003 *** | 0.4458 ** |
| s.e. (BS) | *0.4106* | *0.6769* | *0.1322* | *0.1898* |
| s.e. (NW) | *0.2030* | *0.3143* | *0.0991* | *0.1169* |
| Adj. $R^2$ | 0.3339 | 0.3630 | 0.4819 | 0.4692 |
| p-val CW | 0.0052 | 0.0002 | 0.0000 | 0.0000 |
| p-val GW | 0.0010 | 0.0000 | 0.0000 | 0.0000 |

**Table 8: Two Factor Model for Stock Indices**
This table presents results for the regression $RX_{t+52}^{stocks} = b_n^{bonds}(\gamma^{T,bonds}\mathbf{F_t^{bonds}}) + b_n^{dividends}(\gamma^{T,dividends}\mathbf{F_t^{dividends}}) + \epsilon_{t+52}$, i.e. we predict excess returns on stock indices using both the CP bond risk factor ($\gamma^{T,bonds}\mathbf{F_t^{bonds}}$) and the dividend risk factor ($\gamma^{T,dividends}\mathbf{F_t^{dividends}}$). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

Explaining Returns of Stock Market Indices

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.1822 *** | 0.1840 *** | 0.0853 ** | 0.3325 *** |
| s.e. (BS) | *0.0646* | *0.0445* | *0.0414* | *0.1069* |
| s.e. (NW) | *0.0425* | *0.0264* | *0.0257* | *0.0761* |
| World Bond F | -2.9137*** | -2.1755*** | -1.1906* | -4.7559*** |
| s.e. (BS) | *0.7870* | *0.7273* | *0.6198* | *1.2215* |
| s.e. (NW) | *0.6670* | *0.7128* | *0.5737* | *0.9964* |
| World Div F | 0.2030 *** | 0.2175 *** | 0.2213 *** | 0.2279 ** |
| s.e. (BS) | *0.0759* | *0.0816* | *0.0639* | *0.1133* |
| s.e. (NW) | *0.0468* | *0.0451* | *0.0367* | *0.0558* |
| Adj. $R^2$ | 0.4741 | 0.4792 | 0.5157 | 0.6072 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 9: A Global Model for the Core Markets - Stock Indices**
This table presents results for the regression $RX_{t+52}^{stocks,i} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}) + \epsilon_{t+52}$, i.e. we predict excess returns on stock indices using both a global CP bond risk factor ($\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}$) and a global dividend risk factor ($\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}$). The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

Out-of-sample tests – various indices.

| | Intercept | | W Bond F | | W Div F | | $R^2$ | No.obs. |
|---|---|---|---|---|---|---|---|---|
| MSCI Canada | 0.1231 | * | -1.5024 | * | 0.1597 | ** | 0.3330 | 429 |
| s.e. (BS) | *0.0661* | | *0.8247* | | *0.0728* | | 0.0008 | |
| s.e. (NW) | *0.0482* | | *0.6946* | | *0.0399* | | 0.0002 | |
| MSCI USA | 0.1971 | *** | -2.3013 | *** | 0.2202 | *** | 0.4874 | 429 |
| s.e. (BS) | *0.0449* | | *0.7421* | | *0.0816* | | 0.0000 | |
| s.e. (NW) | *0.0261* | | *0.7205* | | *0.0458* | | 0.0000 | |
| MSCI Austria | 0.0802 | | -2.9339 | *** | 0.3197 | *** | 0.4315 | 429 |
| s.e. (BS) | *0.0812* | | *1.0879* | | *0.1059* | | 0.0000 | |
| s.e. (NW) | *0.0609* | | *0.9848* | | *0.0649* | | 0.0000 | |
| MSCI Belgium | 0.1847 | ** | -3.0558 | *** | 0.3573 | ** | 0.4660 | 429 |
| s.e. (BS) | *0.0839* | | *1.0906* | | *0.1585* | | 0.0000 | |
| s.e. (NW) | *0.0588* | | *1.0476* | | *0.0822* | | 0.0000 | |
| MSCI Denmark | 0.2297 | *** | -2.1973 | * | 0.2299 | ** | 0.3080 | 429 |
| s.e. (BS) | *0.0874* | | *1.1733* | | *0.1126* | | 0.0010 | |
| s.e. (NW) | *0.0690* | | *1.1492* | | *0.0606* | | 0.0002 | |
| MSCI Finland | 0.3466 | *** | -4.8634 | *** | 0.1637 | | 0.4347 | 429 |
| s.e. (BS) | *0.1109* | | *1.2553* | | *0.1055* | | 0.0000 | |
| s.e. (NW) | *0.0705* | | *0.9872* | | *0.0622* | | 0.0000 | |
| MSCI France | 0.1753 | *** | -2.7880 | *** | 0.2232 | *** | 0.5049 | 429 |
| s.e. (BS) | *0.0637* | | *0.7807* | | *0.0797* | | 0.0000 | |
| s.e. (NW) | *0.0375* | | *0.6589* | | *0.0471* | | 0.0000 | |
| MSCI Germany | 0.2197 | *** | -2.7410 | *** | 0.1853 | * | 0.3476 | 429 |
| s.e. (BS) | *0.0732* | | *0.9824* | | *0.1022* | | 0.0000 | |
| s.e. (NW) | *0.0488* | | *0.8849* | | *0.0574* | | 0.0000 | |
| MSCI Ireland | 0.2701 | *** | -5.0396 | *** | 0.1946 | | 0.3931 | 429 |
| s.e. (BS) | *0.0993* | | *1.3454* | | *0.1604* | | 0.0002 | |
| s.e. (NW) | *0.0613* | | *1.2150* | | *0.0874* | | 0.0000 | |
| MSCI Israel | 0.0308 | | -0.6984 | | 0.1807 | | 0.2468 | 422 |
| s.e. (BS) | *0.1090* | | *1.0825* | | *0.1131* | | 0.0150 | |
| s.e. (NW) | *0.0944* | | *0.9307* | | *0.0472* | | 0.0000 | |
| MSCI Italy | 0.1687 | * | -3.4428 | *** | 0.2126 | *** | 0.4772 | 429 |
| s.e. (BS) | *0.0930* | | *1.0431* | | *0.0720* | | 0.0000 | |
| s.e. (NW) | *0.0630* | | *0.8234* | | *0.0456* | | 0.0000 | |
| MSCI Netherlands | 0.1820 | ** | -2.6184 | *** | 0.2760 | *** | 0.4909 | 429 |
| s.e. (BS) | *0.0735* | | *0.9127* | | *0.0869* | | 0.0000 | |
| s.e. (NW) | *0.0470* | | *0.7950* | | *0.0538* | | 0.0000 | |
| MSCI Norway | 0.1444 | * | -2.0348 | * | 0.2384 | ** | 0.3273 | 429 |
| s.e. (BS) | *0.0813* | | *1.0730* | | *0.1028* | | 0.0016 | |
| s.e. (NW) | *0.0621* | | *0.9819* | | *0.0665* | | 0.0002 | |
| MSCI Portugal | 0.0802 | | -2.3238 | ** | 0.1808 | * | 0.2822 | 429 |
| s.e. (BS) | *0.0932* | | *1.1160* | | *0.0997* | | 0.0026 | |
| s.e. (NW) | *0.0721* | | *0.8753* | | *0.0664* | | 0.0008 | |
| MSCI Spain | 0.2319 | ** | -3.3625 | *** | 0.1935 | ** | 0.4219 | 429 |
| s.e. (BS) | *0.1056* | | *1.1838* | | *0.0841* | | 0.0010 | |
| s.e. (NW) | *0.0709* | | *0.8556* | | *0.0528* | | 0.0010 | |
| MSCI Sweden | 0.1256 | | -1.4791 | | 0.2939 | *** | 0.4454 | 429 |
| s.e. (BS) | *0.0827* | | *1.0029* | | *0.1055* | | 0.0000 | |
| s.e. (NW) | *0.0536* | | *0.8232* | | *0.0669* | | 0.0000 | |
| MSCI Switzerland | 0.1874 | *** | -2.6981 | *** | 0.2173 | ** | 0.5515 | 429 |
| s.e. (BS) | *0.0606* | | *0.6561* | | *0.0901* | | 0.0000 | |
| s.e. (NW) | *0.0423* | | *0.5643* | | *0.0460* | | 0.0000 | |
| MSCI UK | 0.0865 | ** | -1.2482 | ** | 0.2247 | *** | 0.5215 | 429 |
| s.e. (BS) | *0.0435* | | *0.6320* | | *0.0656* | | 0.0000 | |
| s.e. (NW) | *0.0279* | | *0.5888* | | *0.0381* | | 0.0000 | |
| MSCI Australia | 0.1663 | ** | -2.5399 | *** | 0.2075 | *** | 0.4944 | 429 |
| s.e. (BS) | *0.0768* | | *0.8247* | | *0.0738* | | 0.0000 | |
| s.e. (NW) | *0.0516* | | *0.6451* | | *0.0486* | | 0.0000 | |
| MSCI Hong Kong | 0.1377 | | -1.0760 | | 0.2410 | * | 0.2726 | 429 |
| s.e. (BS) | *0.1129* | | *1.2936* | | *0.1274* | | 0.0094 | |
| s.e. (NW) | *0.0781* | | *1.0197* | | *0.0737* | | 0.0030 | |
| MSCI Japan | 0.3379 | *** | -5.0228 | *** | 0.1929 | | 0.5886 | 429 |
| s.e. (BS) | *0.1091* | | *1.2092* | | *0.1295* | | 0.0000 | |
| s.e. (NW) | *0.0800* | | *1.0076* | | *0.0599* | | 0.0000 | |
| MSCI New Zealand | 0.1450 | ** | -2.3068 | *** | 0.1453 | | 0.3733 | 429 |
| s.e. (BS) | *0.0584* | | *0.7312* | | *0.1379* | | 0.0162 | |
| s.e. (NW) | *0.0334* | | *0.6683* | | *0.0648* | | 0.0014 | |
| MSCI Singapore | 0.0843 | | -0.7922 | | 0.2839 | ** | 0.3313 | 429 |
| s.e. (BS) | *0.1143* | | *1.1717* | | *0.1190* | | 0.0010 | |
| s.e. (NW) | *0.0948* | | *0.9999* | | *0.0853* | | 0.0002 | |

**Table 10: A Global Model for Out of Sample Test Assets - MSCI Equity**
This reports results of the global two-factor model, explaining excess returns of MSCI country indices over the one-year local government bond yield). All other definitions correspond to those in table 11.

Out-of-sample tests – various indices.

| | Intercept | W Bond F | W Div F | $R^2$ | No.obs. |
|---|---|---|---|---|---|
| MSCI World Local | 0.1881 *** | -2.5005 *** | 0.2175 *** | 0.5256 | 429 |
| s.e. (BS) | *0.0519* | *0.7075* | *0.0776* | 0.0000 | |
| s.e. (NW) | *0.0294* | *0.6513* | *0.0452* | 0.0000 | |
| MSCI Emerging Markets Local | 0.0768 | -0.5679 | 0.2321 * | 0.2785 | 429 |
| s.e. (BS) | *0.1171* | *1.2855* | *0.1286* | 0.0106 | |
| s.e. (NW) | *0.0814* | *0.9496* | *0.0761* | 0.0020 | |
| MSCI Frontier Markets Local | 0.2824 *** | -3.7169 *** | 0.1529 | 0.3643 | 429 |
| s.e. (BS) | *0.0903* | *1.1505* | *0.1133* | 0.0008 | |
| s.e. (NW) | *0.0597* | *0.9581* | *0.0602* | 0.0002 | |
| US Value | 0.2037 *** | -2.6561 *** | 0.2421 *** | 0.5142 | 429 |
| s.e. (BS) | *0.0488* | *0.7794* | *0.0897* | 0.0000 | |
| s.e. (NW) | *0.0282* | *0.7616* | *0.0493* | 0.0000 | |
| US Growth | 0.1898 *** | -1.9768 *** | 0.2000 ** | 0.4512 | 429 |
| s.e. (BS) | *0.0487* | *0.7353* | *0.0788* | 0.0002 | |
| s.e. (NW) | *0.0281* | *0.6919* | *0.0432* | 0.0002 | |
| US Small Value | 0.2066 *** | -2.5767 *** | 0.2831 *** | 0.5827 | 429 |
| s.e. (BS) | *0.0557* | *0.8369* | *0.0860* | 0.0000 | |
| s.e. (NW) | *0.0333* | *0.7534* | *0.0435* | 0.0000 | |
| US Small Growth | 0.2070 *** | -2.2827 ** | 0.2568 *** | 0.4924 | 429 |
| s.e. (BS) | *0.0482* | *0.8933* | *0.0788* | 0.0000 | |
| s.e. (NW) | *0.0301* | *0.8605* | *0.0416* | 0.0000 | |
| AQR Momentum | 0.2050 *** | -2.4858 *** | 0.1723 ** | 0.3891 | 429 |
| s.e. (BS) | *0.0485* | *0.8921* | *0.0758* | 0.0000 | |
| s.e. (NW) | *0.0293* | *0.8500* | *0.0395* | 0.0000 | |
| VIX Inverse Futures | 0.5765 ** | -5.1277 | 1.0747 ** | 0.4044 | 429 |
| s.e. (BS) | *0.2374* | *3.6102* | *0.5043* | 0.0000 | |
| s.e. (NW) | *0.1604* | *3.0555* | *0.1755* | 0.0002 | |
| US HY | 0.0195 | 0.0106 | 0.2132 *** | 0.6123 | 429 |
| s.e. (BS) | *0.0281* | *0.4638* | *0.0503* | 0.0000 | |
| s.e. (NW) | *0.0179* | *0.4429* | *0.0294* | 0.0000 | |
| Euro HY | 0.0376 | -0.6118 | 0.2699 *** | 0.6892 | 429 |
| s.e. (BS) | *0.0323* | *0.4964* | *0.0496* | 0.0000 | |
| s.e. (NW) | *0.0209* | *0.4674* | *0.0296* | 0.0000 | |
| EM Bonds | -0.0173 | 0.8336 * | 0.1382 *** | 0.4976 | 429 |
| s.e. (BS) | *0.0338* | *0.4652* | *0.0496* | 0.0000 | |
| s.e. (NW) | *0.0244* | *0.4139* | *0.0265* | 0.0000 | |
| EM HY | -0.0434 | 1.0590 ** | 0.3041 *** | 0.3726 | 223 |
| s.e. (BS) | *0.0296* | *0.4212* | *0.0923* | 0.0010 | |
| s.e. (NW) | *0.0273* | *0.3656* | *0.0870* | 0.0006 | |
| DB FX Carry | -0.0338 *** | 0.3073 ** | 0.0199 | 0.2742 | 429 |
| s.e. (BS) | *0.0084* | *0.1548* | *0.0230* | 0.0662 | |
| s.e. (NW) | *0.0053* | *0.1465* | *0.0110* | 0.0646 | |
| DB FX Momentum | -0.0044 | 0.2729 | -0.0548 * | 0.1581 | 429 |
| s.e. (BS) | *0.0250* | *0.3796* | *0.0330* | 0.0480 | |
| s.e. (NW) | *0.0163* | *0.3266* | *0.0211* | 0.0114 | |
| DB FX Value | -0.0081 | 0.3793 | 0.0232 | 0.0345 | 429 |
| s.e. (BS) | *0.0341* | *0.5839* | *0.0308* | 0.4702 | |
| s.e. (NW) | *0.0237* | *0.5503* | *0.0165* | 0.4706 | |
| DB FX Global | 0.0055 | -0.1688 | 0.0570 | 0.1017 | 429 |
| s.e. (BS) | *0.0527* | *0.5236* | *0.0589* | 0.2228 | |
| s.e. (NW) | *0.0402* | *0.4042* | *0.0349* | 0.0626 | |

**Table 11: A Global Model for Out of Sample Test Assets - Various Equity Indices**
This table presents results for the regression $RX^{asset,i}_{t+52} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}) + \epsilon^{(n)}_{t+52}$, i.e. we predict excess returns on various test assets (that we did not use to construct the risk factors) using both a global CP bond risk factor ($\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}$) and a global dividend risk factor ($\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}$). The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The test assets in this table are MSCI World, Emerging Markets, and Frontier markets indices, U.S. style indices, an inverse volatility tracking index, High Yield (HY) and Emerging markets (EM) bond indices, and Deutsche Bank currency strategy indices. We obtain excess returns on the test assets by subtracting the local one-year U.S. bond yield for all indices but Euro High Yield, where we subtract the one-year EUR swap rate.

Robustness (4) out-of-sample tests – various indices - global model.

| | Δ HR | Δ R2 | $p$ CW | $p$ GW |
|---|---|---|---|---|
| MSCI Canada | 0.1841 | 0.3903 | 0.0044 | 0.0078 |
| MSCI USA | 0.0909 | 0.4429 | 0.0010 | 0.0032 |
| MSCI Austria | -0.0396 | 0.4102 | 0.0014 | 0.0040 |
| MSCI Belgium | 0.0047 | 0.3367 | 0.0112 | 0.0218 |
| MSCI Denmark | 0.1562 | 0.3201 | 0.0062 | 0.0092 |
| MSCI Finland | 0.2284 | 0.4804 | 0.0000 | 0.0002 |
| MSCI France | 0.0513 | 0.4119 | 0.0010 | 0.0050 |
| MSCI Germany | 0.1772 | 0.3579 | 0.0032 | 0.0110 |
| MSCI Ireland | -0.0606 | 0.4692 | 0.0000 | 0.0000 |
| MSCI Israel | 0.1659 | 0.2687 | 0.0046 | 0.0020 |
| MSCI Italy | -0.0093 | 0.4130 | 0.0030 | 0.0066 |
| MSCI Netherlands | 0.1049 | 0.4190 | 0.0024 | 0.0076 |
| MSCI Norway | 0.0653 | 0.3547 | 0.0104 | 0.0210 |
| MSCI Portugal | 0.0536 | 0.3009 | 0.0260 | 0.0778 |
| MSCI Spain | 0.1935 | 0.3764 | 0.0082 | 0.0274 |
| MSCI Sweden | 0.0466 | 0.3136 | 0.0182 | 0.0664 |
| MSCI Switzerland | 0.0653 | 0.4135 | 0.0000 | 0.0024 |
| MSCI UK | 0.0186 | 0.3975 | 0.0072 | 0.0130 |
| MSCI Australia | 0.1911 | 0.4387 | 0.0020 | 0.0102 |
| MSCI Hong Kong | 0.1002 | 0.2915 | 0.0396 | 0.0654 |
| MSCI Japan | 0.0676 | 0.4573 | 0.0000 | 0.0000 |
| MSCI New Zealand | -0.0163 | 0.2818 | 0.0334 | 0.0808 |
| MSCI Singapore | 0.1352 | 0.4241 | 0.0012 | 0.0014 |

**Table 12: Robustness versus global CAPE and Term Spread Specification.**
All other definitions correspond to those in table 11.

Robustness (4) out-of-sample tests – various indices - local model.

| | $\Delta$ HR | $\Delta$ R2 | $p$ CW | $p$ GW |
|---|---|---|---|---|
| MSCI Canada | 0.0326 | 0.1290 | 0.1310 | 0.2052 |
| MSCI USA | -0.0093 | 0.0154 | 0.5642 | 0.4596 |
| MSCI Austria | 0.1142 | 0.3809 | 0.0000 | 0.0002 |
| MSCI Belgium | 0.0256 | 0.3199 | 0.0002 | 0.0000 |
| MSCI Denmark | 0.0490 | 0.2134 | 0.0220 | 0.0200 |
| MSCI France | 0.0699 | 0.4230 | 0.0002 | 0.0002 |
| MSCI Germany | 0.0047 | 0.2543 | 0.0020 | 0.0056 |
| MSCI Ireland | -0.0117 | 0.1697 | 0.0026 | 0.0010 |
| MSCI Italy | 0.0932 | 0.3437 | 0.0000 | 0.0000 |
| MSCI Netherlands | 0.0117 | 0.3942 | 0.0004 | 0.0004 |
| MSCI Norway | -0.0373 | 0.0828 | 0.1254 | 0.0888 |
| MSCI Portugal | 0.0443 | 0.1391 | 0.1020 | 0.1306 |
| MSCI Spain | 0.1585 | 0.3119 | 0.0030 | 0.0084 |
| MSCI Sweden | 0.0317 | 0.2586 | 0.0442 | 0.0622 |
| MSCI Switzerland | 0.1456 | 0.4899 | 0.0000 | 0.0000 |
| MSCI UK | 0.0140 | 0.3410 | 0.0004 | 0.0010 |
| MSCI Australia | 0.1049 | 0.4142 | 0.0006 | 0.0080 |
| MSCI Hong Kong | 0.0070 | 0.3382 | 0.0014 | 0.0010 |
| MSCI Japan | 0.1026 | 0.5447 | 0.0000 | 0.0000 |
| MSCI New Zealand | 0.0396 | 0.3471 | 0.0004 | 0.0006 |
| MSCI Singapore | 0.0485 | 0.4791 | 0.0002 | 0.0000 |

**Table 13: Robustness versus local CAPE and Term Spread Specification.**
All other definitions correspond to those in table 11.

| | Dividend Factor | Bond Factor |
|---|---|---|
| Intercept | 1.3234*** | -0.2608*** |
| | *0.5106* | *0.0434* |
| Implied Volatility | 0.4326*** | 0.0302*** |
| | *0.1097* | *0.0071* |
| Change in Volatility | -0.5472*** | -0.0168*** |
| | *0.175* | *0.0038* |
| TED Spread | 5.1715 | 1.503*** |
| | *4.6847* | *0.3812* |
| Change in TED Spread | -5.0043 | -0.1272 |
| | *8.1595* | *0.2547* |
| Inflation Expectation | -11.4665 | 0.7898 |
| | *6.8095* | *0.7809* |
| Change in Inflation Expectation | 11.4163*** | -0.4073 |
| | *3.9824* | *0.4469* |
| CAPE | -0.036*** | 0.0073*** |
| | *0.0093* | *0.001* |
| TERM Spread | 2.3896 | 1.2218*** |
| | *3.1216* | *0.2343* |
| Adj. R2 | 0.5987 | 0.7786 |
| No. Obs. | 434 | 434 |

**Table 14:** Drivers of Dividend and Bondfactors. This table provides results of a regression of the dividend and bond factors on a set of explanatory variables. All variables are global variables, which are contructed by summing over the four core regions of this paper (Eurozone, USA, UK and Japan

# IA Internet Appendix

The appendix provides details on additional results and robustness checks that we discuss only briefly in the main paper to preserve space.

## IA.1 Summary Statistics

The following tables provide summary statistics on zero coupon bond yields (table 15), forward bond yields (table 16) and forward equity forward rates (table 17) for all four regions under consideration. Consistent with the existing literature, the volatility of forward yields tends to decline with maturity, both for bond yields and for equity forward rates. All numbers are stated in %.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro 1 | 0.47 | 2.33 | 1.77 | 5.49 | 1.56 |
| Euro 2 | 0.33 | 2.27 | 1.78 | 5.47 | 1.51 |
| Euro 3 | 0.42 | 2.42 | 2.17 | 5.37 | 1.44 |
| Euro 4 | 0.57 | 2.58 | 2.51 | 5.25 | 1.36 |
| Euro 5 | 0.73 | 2.73 | 2.76 | 5.15 | 1.28 |
| US 1 | 0.05 | 1.50 | 0.35 | 5.32 | 1.88 |
| US 2 | 0.23 | 1.68 | 0.84 | 5.28 | 1.73 |
| US 3 | 0.30 | 1.90 | 1.31 | 5.22 | 1.61 |
| US 4 | 0.44 | 2.17 | 1.71 | 5.19 | 1.49 |
| US 5 | 0.64 | 2.42 | 2.08 | 5.17 | 1.38 |
| U.K. 1 | 0.10 | 2.03 | 0.70 | 5.84 | 2.10 |
| U.K. 2 | 0.14 | 2.21 | 1.27 | 5.91 | 1.96 |
| U.K. 3 | 0.16 | 2.46 | 1.95 | 5.92 | 1.83 |
| U.K. 4 | 0.40 | 2.69 | 2.33 | 5.89 | 1.68 |
| U.K. 5 | 0.63 | 2.88 | 2.61 | 5.82 | 1.54 |
| Japan 1 | 0.04 | 0.27 | 0.14 | 0.83 | 0.23 |
| Japan 2 | 0.02 | 0.37 | 0.20 | 1.07 | 0.30 |
| Japan 3 | 0.04 | 0.43 | 0.25 | 1.21 | 0.34 |
| Japan 4 | 0.07 | 0.54 | 0.37 | 1.40 | 0.38 |
| Japan 5 | 0.11 | 0.66 | 0.52 | 1.54 | 0.42 |

**Table 15: Summary Statistics - Zero Coupon Bond Yields**
This table provides summary statistics on zero coupon bond yields. Zero coupon yields are obtained by bootstrapping the corresponding government bond yield curve. For the Eurozone we use EUR swaps. All numbers are stated as %. The number of observations is equal to 435.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro 2 | 0.10 | 2.21 | 2.07 | 5.50 | 1.53 |
| Euro 3 | 0.62 | 2.72 | 2.94 | 5.18 | 1.33 |
| Euro 4 | 0.95 | 3.06 | 3.39 | 4.95 | 1.16 |
| Euro 5 | 1.34 | 3.35 | 3.71 | 4.96 | 1.01 |
| US 2 | 0.27 | 1.85 | 1.28 | 5.25 | 1.60 |
| US 3 | 0.44 | 2.36 | 2.20 | 5.11 | 1.43 |
| US 4 | 0.73 | 2.98 | 3.02 | 5.12 | 1.25 |
| US 5 | 1.25 | 3.44 | 3.61 | 5.22 | 1.10 |
| U.K. 2 | 0.11 | 2.39 | 1.85 | 6.02 | 1.86 |
| U.K. 3 | 0.20 | 2.97 | 3.23 | 5.95 | 1.71 |
| U.K. 4 | 1.04 | 3.40 | 3.45 | 5.79 | 1.27 |
| U.K. 5 | 1.49 | 3.62 | 3.70 | 5.63 | 1.11 |
| Japan 2 | -0.02 | 0.46 | 0.25 | 1.37 | 0.39 |
| Japan 3 | 0.00 | 0.56 | 0.37 | 1.51 | 0.42 |
| Japan 4 | 0.15 | 0.86 | 0.77 | 1.99 | 0.51 |
| Japan 5 | 0.24 | 1.14 | 1.08 | 2.82 | 0.60 |

**Table 16: Summary Statistics - Forward Bond Yields**
This table provides summary statistics on forward bond yields. For the Eurozone we use EUR swaps. All numbers are stated as %. The number of observations is equal to 435.

| | Min | Mean | Median | Max | St.Dev. |
|---|---|---|---|---|---|
| Euro 1 | -14.81 | 5.34 | 2.70 | 65.04 | 17.30 |
| Euro 2 | -11.03 | 6.84 | 3.36 | 77.06 | 14.97 |
| Euro 3 | -5.76 | 1.70 | 1.60 | 14.76 | 4.02 |
| Euro 4 | -6.37 | 0.26 | -0.18 | 7.85 | 2.69 |
| US 1 | -13.73 | -4.05 | -8.54 | 45.23 | 10.91 |
| US 2 | -12.47 | -3.88 | -5.33 | 22.91 | 5.72 |
| US 3 | -19.25 | -4.33 | -4.21 | 4.04 | 2.56 |
| US 4 | -12.41 | -3.99 | -3.77 | 2.25 | 1.80 |
| U.K. 1 | -13.20 | 0.04 | -3.07 | 48.74 | 12.72 |
| U.K. 2 | -8.90 | 3.30 | -0.52 | 67.70 | 12.95 |
| U.K. 3 | -6.60 | 0.32 | -0.23 | 8.97 | 3.00 |
| U.K. 4 | -4.16 | -0.27 | -0.31 | 5.14 | 1.84 |
| Japan 1 | -19.88 | 1.79 | -1.71 | 66.36 | 17.46 |
| Japan 2 | -13.66 | 1.05 | -0.51 | 56.57 | 12.62 |
| Japan 3 | -13.25 | -1.87 | -0.79 | 8.03 | 5.42 |
| Japan 4 | -11.86 | -1.58 | -1.75 | 6.98 | 4.12 |

**Table 17: Summary Statistics - Forward Equity Forward Rates**
This table provides summary statistics on forward equity forward rates. Forward equity forward rates are computed according to equation 5. All numbers are stated as %. The number of observations is equal to 435.

## IA.2 Unconstrained Cochrane-Piazzesi Regressions

The following tables report detailed results for unconstrained regressions of dividend swaps of all maturities on all forward equity forward rates (tables 18 and 19) and for unconstrained regressions of excess bond returns on forward bond yields (tables 20 and 21). The results correspond to regression equations 16 and 15.

Panel A: Explaining Returns of 1-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0355 *** | -0.0281 | 0.0197 ** | 0.0691 *** |
| | *0.0121* | *0.0503* | *0.0097* | *0.0247* |
| RP1 | 0.2958 *** | 0.2054 | 0.2390 *** | 0.3809 * |
| | *0.0691* | *0.2015* | *0.0789* | *0.2080* |
| RP2 | 0.0172 | 0.0633 | 0.1034 * | 0.2008 |
| | *0.0813* | *0.3729* | *0.0548* | *0.3697* |
| RP3 | -0.6102 | -0.1506 | 0.3904 | -1.4882 |
| | *0.8856* | *0.1879* | *0.4715* | *1.1633* |
| RP4 | 0.6428 | -1.1659 | 0.5600 | 1.5727 |
| | *1.1225* | *0.9224* | *0.6670* | *1.2694* |
| Adj. $R^2$ | 0.4156 | 0.1292 | 0.6374 | 0.3794 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.3134 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 2-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0096 | -0.0566 | 0.0469 ** | 0.0676 |
| | *0.0479* | *0.1213* | *0.0203* | *0.0494* |
| RP1 | 0.4503 | 0.5051 | 0.3752 | 0.0242 |
| | *0.2866* | *0.5375* | *0.3055* | *0.3209* |
| RP2 | 1.0354 *** | 0.5374 | 1.2755 *** | 2.2862 *** |
| | *0.3438* | *1.0495* | *0.2066* | *0.6040* |
| RP3 | -2.5296 | -0.5315 | -2.5640 | -4.9315** |
| | *1.7477* | *0.4610* | *1.7116* | *2.3520* |
| RP4 | 2.1270 | -2.4877 | 5.7387 * | 4.8273 * |
| | *2.3414* | *2.0194* | *3.0755* | *2.7770* |
| Adj. $R^2$ | 0.6014 | 0.2149 | 0.7297 | 0.5534 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0172 | 0.0000 | 0.0000 |

**Table 18: Cochrane Piazzesi Unconstrained Regressions for Dividend Derivatives - Part 1**
This table provides results for the following regressions $RX_{t+52}^{dividends,(n)} = \alpha + \beta_1 F_t^{dividends,(1)} + \beta_2 F_t^{dividends,(2)} + \beta_3 F_t^{dividends,(3)} + \beta_4 F_t^{dividends,(4)} + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on $n$-year dividend swaps on forward equity forward rates of all maturities. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

Panel A: Explaining Returns of 3-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0234 | -0.0335 | 0.0505 * | 0.0727 |
| | *0.0696* | *0.1574* | *0.0293* | *0.0627* |
| RP1 | 0.5461 | 0.6282 | 0.6481 | -0.3722 |
| | *0.4495* | *0.6958* | *0.4839* | *0.3402* |
| RP2 | 1.1092 ** | 0.2906 | 1.1472 *** | 3.0952 *** |
| | *0.4946* | *1.3900* | *0.3317* | *0.6563* |
| RP3 | -3.1501 | 0.4671 | -3.0984 | -6.2560** |
| | *1.9152* | *0.6093* | *2.5616* | *2.8695* |
| RP4 | 3.7744 | -2.8493 | 8.8019 * | 7.1249 ** |
| | *2.5782* | *2.6409* | *4.6126* | *3.4803* |
| Adj. $R^2$ | 0.4763 | 0.1434 | 0.6045 | 0.5032 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0144 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 4-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0339 | 0.0047 | 0.0494 | 0.0905 |
| | *0.0738* | *0.1669* | *0.0325* | *0.0723* |
| RP1 | 0.4779 | 0.6138 | 0.6508 | -0.5881 |
| | *0.4916* | *0.7383* | *0.4978* | *0.3648* |
| RP2 | 1.2246 ** | 0.3026 | 1.1445 *** | 3.3446 *** |
| | *0.5109* | *1.4960* | *0.3385* | *0.6797* |
| RP3 | -4.0167** | 0.3815 | -3.3552 | -7.3205** |
| | *1.8527* | *0.6463* | *2.6876* | *2.9824* |
| RP4 | 5.3073 ** | -1.8148 | 9.8416 ** | 9.1587 ** |
| | *2.4898* | *2.8310* | *4.6863* | *3.6517* |
| Adj. $R^2$ | 0.4406 | 0.1331 | 0.5880 | 0.4713 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0216 | 0.0000 | 0.0000 |

**Table 19: Cochrane Piazzesi Unconstrained Regressions for Dividend Derivatives - Part 2**
This table provides results for the following regressions $RX_{t+52}^{dividends,(n)} = \alpha + \beta_1 F_t^{dividends,(1)} + \beta_2 F_t^{dividends,(2)} + \beta_3 F_t^{dividends,(3)} + \beta_4 F_t^{dividends,(4)} + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on $n$-year dividend swaps on forward equity forward rates of all maturities. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

Panel A: Explaining Returns of 2-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0001 | -0.0022 | -0.0124** | 0.0001 |
| | *0.0072* | *0.0015* | *0.0058* | *0.0004* |
| Y1 | 0.3401 | -0.1636 | 1.0359 | 0.3819 *** |
| | *0.2594* | *0.6992* | *0.6470* | *0.1247* |
| F2 | -2.7645*** | 0.1974 | -2.2048* | -0.1060 |
| | *0.6081* | *1.4059* | *1.2032* | *0.2244* |
| F3 | 5.5974 ** | -0.0848 | 1.2240 ** | 0.4564 |
| | *2.2881* | *0.7868* | *0.5199* | *0.3743* |
| F4 | -2.6529 | 0.5176 | 0.0303 | 0.1459 |
| | *2.9416* | *0.4132* | *0.3332* | *0.1131* |
| F5 | -0.4449 | -0.0973 | 0.4283 | -0.1916** |
| | *1.5956* | *0.2436* | *0.3445* | *0.0772* |
| Adj. $R^2$ | 0.3021 | 0.3278 | 0.2925 | 0.8371 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 3-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0027 | -0.0104*** | -0.0271** | 0.0003 |
| | *0.0192* | *0.0024* | *0.0105* | *0.0009* |
| Y1 | 0.8373 * | -0.0490 | 1.6533 | 1.1349 *** |
| | *0.4891* | *1.2135* | *1.0658* | *0.3633* |
| F2 | -5.0729*** | -0.3452 | -4.4697** | -1.6895*** |
| | *1.3063* | *2.4435* | *2.0088* | *0.4376* |
| F3 | 7.2250 * | 0.3447 | 2.8033 *** | 1.9008 ** |
| | *3.9138* | *1.3239* | *0.9204* | *0.8180* |
| F4 | -1.0094 | 0.5435 | 0.3431 | 0.3019 |
| | *5.2502* | *0.7119* | *0.7023* | *0.2941* |
| F5 | -1.6952 | 0.3455 | 0.6830 | -0.3782** |
| | *3.7604* | *0.4287* | *0.6312* | *0.1800* |
| Adj. $R^2$ | 0.3100 | 0.4023 | 0.4016 | 0.7315 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 20: Cochrane Piazzesi Unconstrained Regressions for Zero Coupon Bonds - Part 1**
This table provides results for the following regressions $RX_{t+52}^{bonds,(n)} = \alpha + \beta_1 Y_t^{bonds,(1)} + \beta_2 F_t^{bonds,(2)} + \beta_3 F_t^{bonds,(3)} + \beta_4 F_t^{bonds,(4)} + \beta_5 F_t^{bonds,(5)} + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on $n$-year zero coupon bonds on forward bond yields of all maturities. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

Panel A: Explaining Returns of 4-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0002 | -0.0290*** | -0.0472*** | 0.0004 |
| | *0.0300* | *0.0047* | *0.0148* | *0.0015* |
| Y1 | 1.1792 * | 0.2734 | 1.9792 | 1.6314 ** |
| | *0.6409* | *1.6284* | *1.2894* | *0.6367* |
| F2 | -6.8482 *** | -0.6343 | -6.0146** | -3.1513*** |
| | *1.9984* | *3.2403* | *2.4452* | *0.7322* |
| F3 | 6.3090 | -0.8755 | 2.7582 ** | 2.4162 * |
| | *5.7250* | *1.6871* | *1.2264* | *1.3520* |
| F4 | 4.6098 | 1.4119 | 1.8789 * | 1.3408 *** |
| | *7.7489* | *0.9299* | *1.0772* | *0.4947* |
| F5 | -4.9741 | 1.2701 ** | 0.8960 | -0.5744* |
| | *5.8789* | *0.6340* | *0.8465* | *0.3129* |
| Adj. $R^2$ | 0.3067 | 0.4570 | 0.4266 | 0.7030 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 5-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0009 | -0.0585*** | -0.0768*** | 0.0002 |
| | *0.0411* | *0.0085* | *0.0199* | *0.0024* |
| Y1 | 1.5027 * | 0.6060 | 2.6250 | 1.8012 * |
| | *0.7666* | *1.7674* | *1.6204* | *0.9905* |
| F2 | -8.0330 *** | -0.5161 | -7.7771** | -4.1547*** |
| | *2.7060* | *3.4682* | *3.1002* | *0.9844* |
| F3 | 3.7591 | -2.9735 | 2.7162 * | 2.7173 |
| | *7.8952* | *1.8216* | *1.5536* | *1.7606* |
| F4 | 11.1944 | 1.8216 * | 2.9001 ** | 1.2800 * |
| | *10.7949* | *1.0610* | *1.3885* | *0.7299* |
| F5 | -8.1626 | 3.2262 *** | 1.7417 | 0.1047 |
| | *8.1563* | *0.8135* | *1.1557* | *0.4842* |
| Adj. $R^2$ | 0.3066 | 0.5409 | 0.4549 | 0.6074 |
| p-val $\left(\gamma^T = \mathbf{0}\right)$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 21: Cochrane Piazzesi Unconstrained Regressions for Zero Coupon Bonds - Part 2**
This table provides results for the following regressions $RX_{t+52}^{bonds,(n)} = \alpha + \beta_1 Y_t^{bonds,(1)} + \beta_2 F_t^{bonds,(2)} + \beta_3 F_t^{bonds,(3)} + \beta_4 F_t^{bonds,(4)} + \beta_5 F_t^{bonds,(5)} + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on $n$-year zero coupon bonds on forward bond yields of all maturities. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

## IA.3 A Single Factor Model for Stock Returns

Corresponding to the two-factor model in section 5.1 we test the exposure of stock index excess returns to the bond factor and the dividend factor in univariate settings. Table 22 shows that the dividend factor is positively and significantly related to subsequent excess stock returns, while the bond factor is significantly negative. This is consistent with the two-factor model. As discussed in the main paper, we attribute the negative sign of the bond factor to the output-focused monetary policy and the elevated macroeconomic uncertainty over our sample period, as well as low inflation expectations and the financial crisis. This line of thought is based on Campbell, Pflueger, and Viceira (2015) and Ilmanen (2003).

Exposure of Excess Stock Index Returns to the Bond Factor

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0601 | 0.2553 *** | 0.0908 * | 0.3243 *** |
| s.e. (BS) | *0.0839* | *0.0366* | *0.0479* | *0.1199* |
| s.e. (NW) | *0.0697* | *0.0291* | *0.0328* | *0.1032* |
| Bond factor | -2.2256 | -7.4765*** | -1.8127 | -37.5995*** |
| s.e. (BS) | *3.2668* | *2.6609* | *2.1797* | *13.2879* |
| s.e. (NW) | *2.7276* | *2.6188* | *1.9382* | *11.1615* |
| Adj. $R^2$ | 0.0128 | 0.2345 | 0.0271 | 0.3786 |
| p-val CW | 0.4770 | 0.0020 | 0.3644 | 0.0002 |
| p-val GW | 0.5786 | 0.0010 | 0.3202 | 0.0000 |

Exposure of Excess Stock Index Returns to the Dividend Factor

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0023 | 0.0595 | 0.0161 | -0.0108 |
| s.e. (BS) | *0.0586* | *0.0701* | *0.0399* | *0.0714* |
| s.e. (NW) | *0.0592* | *0.0656* | *0.0383* | *0.0704* |
| Dividend factor | 0.6430 | 0.9921 | 0.7032 *** | 0.6514 |
| s.e. (BS) | *0.4136* | *1.2410* | *0.1430* | *0.4383* |
| s.e. (NW) | *0.1811* | *0.5583* | *0.1124* | *0.2760* |
| Adj. $R^2$ | 0.2253 | 0.0798 | 0.4577 | 0.2095 |
| p-val CW | 0.0264 | 0.1744 | 0.0000 | 0.0632 |
| p-val GW | 0.0066 | 0.1266 | 0.0000 | 0.0700 |

**Table 22: A Single Factor Model for Stock Indices**
This table puts the analyses on a two-factor model in section 5.1 into a univariate setting. The upper panel reports results for the regression $RX_{t+52}^{stocks} = b_n^{bonds}(\gamma^{T,bonds}\mathbf{F_t^{bonds}}) + \epsilon_{t+52}$, while the lower panel presents results for the regression $RX_{t+52}^{stocks} = b_n^{dividends}(\gamma^{T,dividends}\mathbf{F_t^{dividends}}) + \epsilon_{t+52}$ . Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

## IA.4 A Local and International Factor Model for Stock Indices

To combine our local two-factor model and the global two-factor model we also estimate a local and international factor model for the four core equity markets. In addition to the local dividend and bond factor we aggregate over the remaining three dividend and bond factors respectively to construct international factors that capture all information about risk premia except the local information. Formally we estimate:

$$\begin{aligned} RX_{t+52}^{stocks,i} &= b_n^{bonds,i}(\gamma^{T,bonds,i}\mathbf{F_t^{bonds,i}}) + b_n^{bonds,int.}(\gamma^{T,bonds,int.}\mathbf{F_t^{bonds,int.}}) \\ &+ b_n^{dividends,i}(\gamma^{T,dividends,i}\mathbf{F_t^{dividends,i}}) + b_n^{dividends,int.}(\gamma^{T,dividends,int.}\mathbf{F_t^{dividends,int.}}) + \epsilon_{t+52} \end{aligned} \tag{27}$$

Two facts should be pointed out from the results in table 23: First, the international factors seem to be more important, as the local factors are mostly insignificant after controlling for the international factors. Second, comparing the levels of $R^2$ to those in table 9 of the global model (where we aggregate over all four local factors and use the resulting global factor only) reveals that the goodness of fit improves only marginally if one includes both local and international factors. This provides justification to use the global model in the main paper.

## IA.5 A Global Model

In addition to the global two-factor model for excess equity returns in the main paper, we provide evidence for a global model for excess returns on dividend swaps of various maturities and excess bond returns. It can be seen, that the global dividend factor is significantly and positively related to subsequent one-year excess returns on dividend derivatives, while the global bond factor is negatively related to excess dividend returns. This is consistent with the findings for the global model for stock index returns in the main paper.

Excess bond returns are positively and significantly related to the global bond factor, whereas the dividend factor is unimportant for bond returns, as could be expected.
For dividend returns, we estimate regression 28, where *global* indicates that we use the sum

| Explaining Returns of Stock Market Indices | | | | |
|---|---|---|---|---|
| | Euro | U.S. | U.K. | Japan |
| Intercept | 0.1854 *** | 0.1492 *** | 0.0982 ** | 0.4167 *** |
| s.e. (BS) | *0.0673* | *0.0536* | *0.0399* | *0.1035* |
| s.e. (NW) | *0.0402* | *0.0333* | *0.0222* | *0.0715* |
| Local Bond F | -3.3689 | 1.6050 | -0.0208 | -25.5996*** |
| s.e. (BS) | *2.4555* | *3.1559* | *2.1041* | *7.1683* |
| s.e. (NW) | *2.1565* | *2.3940* | *1.8072* | *5.6745* |
| Int Bond F | -2.8089** | -3.4914*** | -1.9215 | -3.3496 *** |
| s.e. (BS) | *1.1046* | *1.2863* | *1.3917* | *1.1853* |
| s.e. (NW) | *0.7930* | *1.2423* | *1.2782* | *1.0019* |
| Local Div F | 0.2989 | -0.2782 | 0.4493 * | -0.1569 |
| s.e. (BS) | *0.5133* | *0.9502* | *0.2399* | *0.2892* |
| s.e. (NW) | *0.4704* | *0.5507* | *0.1602* | *0.2118* |
| Int Div F | 0.1700 | 0.3047 *** | 0.1216 | 0.3827 *** |
| s.e. (BS) | *0.2334* | *0.1118* | *0.1545* | *0.1270* |
| s.e. (NW) | *0.2352* | *0.0736* | *0.0828* | *0.0927* |
| Adj. $R^2$ | 0.4725 | 0.4909 | 0.5248 | 0.6738 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 23: A Local and International Factor Model for Stock Indices**
This table presents results for the regression $RX_{t+52}^{stocks,i} = b_n^{bonds,i}(\gamma^{T,bonds,i}\mathbf{F_t^{bonds,i}}) + b_n^{bonds,int.}(\gamma^{T,bonds,int.}\mathbf{F_t^{bonds,int.}}) + b_n^{dividends,i}(\gamma^{T,dividends,i}\mathbf{F_t^{dividends,i}}) + b_n^{dividends,int.}(\gamma^{T,dividends,int.}\mathbf{F_t^{dividends,int.}}) + \epsilon_{t+52}$, i.e. we predict excess returns on stock indices using a local CP bond risk factor ($\gamma^{T,bonds,i}\mathbf{F_t^{bonds,i}}$), a local dividend risk factor ($\gamma^{T,dividends,i}\mathbf{F_t^{dividends,i}}$) as well as an international CP bond risk factor ($\gamma^{T,bonds,int.}\mathbf{F_t^{bonds,int.}}$) and an international dividend risk factor ($\gamma^{T,dividends,int.}\mathbf{F_t^{dividends,int.}}$). The international risk factors are constructed by summing over all local risk factors except the one corresponding to the country on the right-hand side of the regression. Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

over all countries. Results are shown in table 25.

$$RX_{t+52}^{dividends,(n),i} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}) + \epsilon_{t+52}^{(n)} \tag{28}$$

Panel A: Explaining Returns of 1-Year Dividend Swaps

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0417 ** | 0.0332 * | 0.0066 | 0.0826 ** |
| s.e. (BS) | *0.0185* | *0.0185* | *0.0174* | *0.0362* |
| s.e. (NW) | *0.0147* | *0.0125* | *0.0139* | *0.0326* |
| World Bond F | -0.2269 | -0.4598* | -0.0488 | -0.3707 |
| s.e. (BS) | *0.2266* | *0.2694* | *0.1993* | *0.6423* |
| s.e. (NW) | *0.2084* | *0.2312* | *0.1591* | *0.6391* |
| World Div F | 0.0832 *** | 0.0584 *** | 0.0932 *** | 0.1133 *** |
| s.e. (BS) | *0.0195* | *0.0154* | *0.0189* | *0.0427* |
| s.e. (NW) | *0.0121* | *0.0081* | *0.0075* | *0.0272* |
| Adj. $R^2$ | 0.4271 | 0.3795 | 0.5726 | 0.2680 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0008 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Panel B: Explaining Returns of 2-Year Dividend Swaps

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0662 | 0.0553 | 0.0248 | 0.1510 * |
| s.e. (BS) | *0.0654* | *0.0401* | *0.0424* | *0.0772* |
| s.e. (NW) | *0.0515* | *0.0266* | *0.0336* | *0.0646* |
| World Bond F | -1.1007 | -1.0093 | -0.5247 | -1.7773 |
| s.e. (BS) | *0.7624* | *0.6253* | *0.4695* | *1.2149* |
| s.e. (NW) | *0.6666* | *0.5638* | *0.3970* | *1.1867* |
| World Div F | 0.3606 *** | 0.1804 *** | 0.3644 *** | 0.3727 *** |
| s.e. (BS) | *0.0864* | *0.0434* | *0.0468* | *0.0839* |
| s.e. (NW) | *0.0554* | *0.0249* | *0.0351* | *0.0564* |
| Adj. $R^2$ | 0.6501 | 0.5285 | 0.7861 | 0.5559 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 24: A Global Model for the Core Markets - Dividend Derivatives Part 1**
This table presents results for the regression $RX_{t+52}^{dividends,(n),i} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{Y_t^{dividends,global}}) + \epsilon_{t+52}^{(n)}$, i.e. we predict excess returns on dividend derivatives using both a global CP bond risk factor ($\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}$) and a global dividend risk factor ($\gamma^{T,dividends,global}\mathbf{Y_t^{dividends,global}}$). The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

For bond returns, we estimate regression 29, with results shown in table 27.

| Panel C: Explaining Returns of 3-Year Dividend Swaps | | | | |
|---|---|---|---|---|
| | Euro | U.S. | U.K. | Japan |
| Intercept | 0.1105 | 0.0664 * | 0.0775 | 0.2467 *** |
| s.e. (BS) | *0.0748* | *0.0384* | *0.0507* | *0.0719* |
| s.e. (NW) | *0.0610* | *0.0232* | *0.0403* | *0.0612* |
| World Bond F | -2.2963** | -1.2960* | -1.6071** | -3.4242*** |
| s.e. (BS) | *0.9324* | *0.7083* | *0.6801* | *1.1943* |
| s.e. (NW) | *0.8369* | *0.6667* | *0.6417* | *1.1846* |
| World Div F | 0.4024 *** | 0.2157 *** | 0.4171 *** | 0.4298 *** |
| s.e. (BS) | *0.0990* | *0.0613* | *0.0659* | *0.0840* |
| s.e. (NW) | *0.0655* | *0.0304* | *0.0450* | *0.0551* |
| Adj. $R^2$ | 0.5997 | 0.5079 | 0.7018 | 0.6040 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| Panel D: Explaining Returns of 4-Year Dividend Swaps | | | | |
|---|---|---|---|---|
| | Euro | U.S. | U.K. | Japan |
| Intercept | 0.1316 * | 0.0639 * | 0.1049 * | 0.3434 *** |
| s.e. (BS) | *0.0796* | *0.0344* | *0.0581* | *0.0742* |
| s.e. (NW) | *0.0633* | *0.0196* | *0.0438* | *0.0604* |
| World Bond F | -2.8137*** | -1.3060* | -2.0804*** | -4.7561*** |
| s.e. (BS) | *0.9101* | *0.7032* | *0.7381* | *1.1220* |
| s.e. (NW) | *0.7916* | *0.6623* | *0.6559* | *1.0995* |
| World Div F | 0.3907 *** | 0.2341 *** | 0.4188 *** | 0.4249 *** |
| s.e. (BS) | *0.0991* | *0.0671* | *0.0704* | *0.0904* |
| s.e. (NW) | *0.0672* | *0.0318* | *0.0470* | *0.0518* |
| Adj. $R^2$ | 0.5941 | 0.5316 | 0.6915 | 0.6443 |
| p-val CW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| p-val GW | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table 25: A Global Model for the Core Markets - Dividend Derivatives – Part 2**
This table presents results for the regression $RX_{t+52}^{dividends,(n),i} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}) + \epsilon_{t+52}^{(n)}$, i.e. we predict excess returns on dividend derivatives using both a global CP bond risk factor $(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}})$ and a global dividend risk factor $(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}})$. The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

$$RX^{bonds,(n),i}_{t+52} = b^{bonds,global}_n(\gamma^{T,bonds,global}\mathbf{F^{bonds,global}_t}) \tag{29}$$
$$+b^{dividends,global}_n(\gamma^{T,dividends,global}\mathbf{F^{dividends,global}_t}) + \epsilon^{(n)}_{t+52}$$

Panel A: Explaining Returns of 2-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0059** | 0.0018 | -0.0061** | 0.0003 |
| s.e. (BS) | *0.0029* | *0.0026* | *0.0030* | *0.0008* |
| s.e. (NW) | *0.0020* | *0.0018* | *0.0030* | *0.0004* |
| World Bond F | 0.1118 *** | 0.1173 *** | 0.2132 *** | 0.0302 *** |
| s.e. (BS) | *0.0406* | *0.0244* | *0.0473* | *0.0108* |
| s.e. (NW) | *0.0390* | *0.0169* | *0.0507* | *0.0084* |
| World Div F | 0.0044 | -0.0030 | 0.0021 | -0.0003 |
| s.e. (BS) | *0.0041* | *0.0059* | *0.0032* | *0.0017* |
| s.e. (NW) | *0.0023* | *0.0028* | *0.0026* | *0.0008* |
| Adj. $R^2$ | 0.2341 | 0.3021 | 0.3789 | 0.2438 |
| p-val CW | 0.0076 | 0.0312 | 0.0002 | 0.0722 |
| p-val GW | 0.0226 | 0.0390 | 0.0002 | 0.0298 |

Panel B: Explaining Returns of 3-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0049 | 0.0030 | -0.0135*** | -0.0000 |
| s.e. (BS) | *0.0059* | *0.0050* | *0.0049* | *0.0012* |
| s.e. (NW) | *0.0045* | *0.0033* | *0.0050* | *0.0007* |
| World Bond F | 0.2288 *** | 0.2538 *** | 0.4570 *** | 0.0637 *** |
| s.e. (BS) | *0.0736* | *0.0444* | *0.0542* | *0.0183* |
| s.e. (NW) | *0.0660* | *0.0260* | *0.0600* | *0.0146* |
| World Div F | 0.0082 | -0.0070 | 0.0073 | 0.0005 |
| s.e. (BS) | *0.0094* | *0.0097* | *0.0056* | *0.0027* |
| s.e. (NW) | *0.0055* | *0.0047* | *0.0048* | *0.0011* |
| Adj. $R^2$ | 0.2660 | 0.4076 | 0.5311 | 0.3115 |
| p-val CW | 0.0066 | 0.0026 | 0.0000 | 0.0102 |
| p-val GW | 0.0268 | 0.0038 | 0.0000 | 0.0026 |

**Table 26: A Global Model for the Core Markets - Zero Coupon Bonds Part 1**
This table presents results for the regression $RX^{bonds,(n),i}_{t+52} = b^{bonds,global}_n(\gamma^{T,bonds,global}\mathbf{F^{bonds,global}_t}) + b^{dividends,global}_n(\gamma^{T,dividends,global}\mathbf{Y^{dividends,global}_t}) + \epsilon^{(n)}_{t+52}$, i.e. we predict excess returns on zero coupon bonds using both a global CP bond risk factor ($\gamma^{T,bonds,global}\mathbf{F^{bonds,global}_t}$) and a global dividend risk factor ($\gamma^{T,dividends,global}\mathbf{Y^{dividends,global}_t}$). The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

Panel C: Explaining Returns of 4-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0033 | 0.0017 | -0.0129 | 0.0009 |
| s.e. (BS) | *0.0088* | *0.0066* | *0.0081* | *0.0017* |
| s.e. (NW) | *0.0065* | *0.0048* | *0.0071* | *0.0010* |
| World Bond F | 0.3069 *** | 0.4326 *** | 0.5739 *** | 0.1091*** |
| s.e. (BS) | *0.1003* | *0.0632* | *0.0756* | *0.0240* |
| s.e. (NW) | *0.0809* | *0.0438* | *0.0618* | *0.0178* |
| World Div F | 0.0121 | -0.0126 | 0.0055 | 0.0014 |
| s.e. (BS) | *0.0153* | *0.0089* | *0.0110* | *0.0038* |
| s.e. (NW) | *0.0085* | *0.0053* | *0.0077* | *0.0015* |
| Adj. $R^2$ | 0.2605 | 0.5392 | 0.5085 | 0.3697 |
| p-val CW | 0.0176 | 0.0000 | 0.0000 | 0.0022 |
| p-val GW | 0.0512 | 0.0000 | 0.0000 | 0.0008 |

Panel D: Explaining Returns of 5-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0008 | -0.0027 | -0.0175 | 0.0031 |
| s.e. (BS) | *0.0120* | *0.0086* | *0.0118* | *0.0027* |
| s.e. (NW) | *0.0087* | *0.0065* | *0.0096* | *0.0016* |
| World Bond F | 0.3657 *** | 0.6227 *** | 0.7323 *** | 0.1419*** |
| s.e. (BS) | *0.1295* | *0.0990* | *0.1186* | *0.0300* |
| s.e. (NW) | *0.0920* | *0.0760* | *0.0819* | *0.0184* |
| World Div F | 0.0153 | -0.0175*** | 0.0018 | 0.0018 |
| s.e. (BS) | *0.0216* | *0.0067* | *0.0172* | *0.0048* |
| s.e. (NW) | *0.0116* | *0.0051* | *0.0108* | *0.0020* |
| Adj. $R^2$ | 0.2401 | 0.6177 | 0.4888 | 0.3756 |
| p-val CW | 0.0388 | 0.0000 | 0.0000 | 0.0012 |
| p-val GW | 0.0972 | 0.0000 | 0.0000 | 0.0000 |

**Table 27: A Global Model for the Core Markets - Zero Coupon Bonds Part 2**
This table presents results for the regression $RX_{t+52}^{bonds,(n),i} = b_n^{bonds,global}(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}}) + b_n^{dividends,global}(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}}) + \epsilon_{t+52}^{(n)}$, i.e. we predict excess returns on zero coupon bonds using both a global CP bond risk factor $(\gamma^{T,bonds,global}\mathbf{F_t^{bonds,global}})$ and a global dividend risk factor $(\gamma^{T,dividends,global}\mathbf{F_t^{dividends,global}})$. The global risk factors are constructed by summing over the local risk factors of all four markets in our core sample (Eurozone, U.S., U.K., Japan). Newey-West (52 lags) standard errors are provided below the coefficients. The number of observations is equal to 435.

## IA.6 Mylnikov Regressions

Mylnikov (2014) develops an empirical forecasting model for U.S. bond returns that can essentially be viewed as a compromise between the Fama and Bliss (1987) and the Cochrane and Piazzesi (2005) approaches. Instead of five forward bond yields, two forward spreads are used as independent variables. This could mitigate potential issues arising from collinearity. We take the evidence to the international level by implementing the approach for our four core markets and estimate a similar model for excess dividend returns. Our main findings of predictability in the market for traded claims on dividends and linear combination of equity forward rates driving time variation in dividend risk premia is strongly supported by this alternative model as well. We implement the model for dividend derivatives presented in table 28 as follows:

(30)

$$RX_{t+52}^{dividends,(n)} = \alpha + \beta_1(F_t^{dividends,(2)} - F_t^{dividends,(1)}) + \beta_2(F_t^{dividends,(4)} - F_t^{dividends,(2)}) + \epsilon_{t+52}^{(n)}$$

For zero coupon bonds, we follow Mylnikov (2014) and estimate regression 31, presented in table 29.

$$RX_{t+52}^{bonds,(n)} = \alpha + \beta_1(F_t^{bonds,(3)} - Y_t^{bonds,(1)}) + \beta_2(F_t^{bonds,(5)} - F_t^{bonds,(3)}) + \epsilon_{t+52}^{(n)} \quad (31)$$

Panel A: Explaining Returns of 1-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0321 ** | 0.0140 | 0.0184 * | 0.0688 ** |
| | *0.0129* | *0.0144* | *0.0110* | *0.0273* |
| RP2-RP1 | -0.2999*** | -0.1221 | -0.2607** | -0.4861*** |
| | *0.0775* | *0.1499* | *0.1078* | *0.1655* |
| RP4-RP2 | -0.2467*** | -0.2146 | -0.3623*** | -0.3207*** |
| | *0.0395* | *0.2672* | *0.0338* | *0.0553* |
| Adj. $R^2$ | 0.4113 | 0.0666 | 0.4765 | 0.3326 |

Panel B: Explaining Returns of 2-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0061 | 0.0240 | 0.0226 | 0.0666 |
| | *0.0458* | *0.0365* | *0.0315* | *0.0633* |
| RP2-RP1 | -0.4696 | -0.3748 | -0.2226 | -0.3716 |
| | *0.3251* | *0.4066* | *0.3076* | *0.3278* |
| RP4-RP2 | -1.2190*** | -0.9003 | -1.4120*** | -1.4450*** |
| | *0.1445* | *0.6968* | *0.1043* | *0.1761* |
| Adj. $R^2$ | 0.5923 | 0.1831 | 0.6356 | 0.4451 |

Panel C: Explaining Returns of 3-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0389 | 0.0228 | 0.0166 | 0.0589 |
| | *0.0653* | *0.0466* | *0.0482* | *0.0844* |
| RP2-RP1 | -0.5806 | -0.3893 | -0.4476 | -0.0494 |
| | *0.5039* | *0.5315* | *0.4998* | *0.4581* |
| RP4-RP2 | -1.3011*** | -0.9891 | -1.4937*** | -1.6221*** |
| | *0.1842* | *0.8709* | *0.1566* | *0.2212* |
| Adj. $R^2$ | 0.4591 | 0.1295 | 0.4445 | 0.3325 |

Panel D: Explaining Returns of 4-Year Dividend Swap

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | -0.0528 | 0.0238 | 0.0125 | 0.0683 |
| | *0.0699* | *0.0485* | *0.0517* | *0.0969* |
| RP2-RP1 | -0.5386 | -0.4901 | -0.4380 | 0.1077 |
| | *0.5558* | *0.5813* | *0.5343* | *0.5560* |
| RP4-RP2 | -1.2453*** | -0.9880 | -1.4668*** | -1.4693*** |
| | *0.1962* | *0.9348* | *0.1715* | *0.2427* |
| Adj. $R^2$ | 0.4086 | 0.1407 | 0.4025 | 0.2277 |

**Table 28: Mylnikov Regressions for Dividend Derivatives**
This table provides results for the following regression $RX_{t+52}^{dividends,(n)} = \alpha + \beta_1(F_t^{dividends,(2)} - F_t^{dividends,(1)}) + \beta_2(F_t^{dividends,(4)} - F_t^{dividends,(2)}) + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on dividend derivatives on the spread between the two-year and the one-year forward equity forward rates as well as on the spread between the four-year and the two-year forward equity forward rate. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.

Panel A: Explaining Returns of 2-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0060 | 0.0128 ** | 0.0104 | 0.0019 ** |
| | *0.0072* | *0.0052* | *0.0070* | *0.0008* |
| F3 - Y1 | -0.1612 | 0.3223 * | 0.1100 | 0.8670 *** |
| | *0.3343* | *0.1913* | *0.2305* | *0.2577* |
| F5 - F3 | -0.4221 | -0.5838* | -0.3905 | -0.3498** |
| | *0.7408* | *0.3112* | *0.3030* | *0.1668* |
| Adj. $R^2$ | 0.0555 | 0.1056 | 0.1017 | 0.5393 |

Panel B: Explaining Returns of 3-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0150 | 0.0239 ** | 0.0181 | 0.0046 ** |
| | *0.0132* | *0.0093* | *0.0118* | *0.0020* |
| F3 - Y1 | -0.3078 | 0.7470 * | 0.6423 | 1.4799 ** |
| | *0.6529* | *0.4107* | *0.4085* | *0.5904* |
| F5 - F3 | -0.1918 | -1.0542* | -0.7552 | -0.7489* |
| | *1.4212* | *0.5734* | *0.5300* | *0.4006* |
| Adj. $R^2$ | 0.0092 | 0.0978 | 0.1986 | 0.4091 |

Panel C: Explaining Returns of 4-Year Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0190 | 0.0307 ** | 0.0206 | 0.0082 ** |
| | *0.0173* | *0.0132* | *0.0137* | *0.0032* |
| F3 - Y1 | -0.3439 | 1.0308 | 0.9701 * | 2.2410 *** |
| | *0.8786* | *0.6726* | *0.5204* | *0.8467* |
| F5 - F3 | 0.4247 | -0.9978 | -0.3497 | -1.0101* |
| | *1.9027* | *0.8521* | *0.6796* | *0.6125* |
| Adj. $R^2$ | -0.0043 | 0.0516 | 0.1630 | 0.3893 |

Panel D: Explaining Returns of 5 Bonds

| | Euro | U.S. | U.K. | Japan |
|---|---|---|---|---|
| Intercept | 0.0210 | 0.0299 * | 0.0225 | 0.0088 ** |
| | *0.0203* | *0.0158* | *0.0169* | *0.0037* |
| F3 - Y1 | -0.3758 | 1.1482 | 1.1312 * | 2.4096 ** |
| | *1.0588* | *0.9750* | *0.6830* | *1.0407* |
| F5 - F3 | 1.2856 | -0.3169 | -0.0267 | -0.4161 |
| | *2.2946* | *1.1537* | *0.9129* | *0.7465* |
| Adj. $R^2$ | 0.0076 | 0.0597 | 0.1229 | 0.3832 |

**Table 29: Mylnikov Regressions for Zero Coupon Bonds**
This table provides results for the following regression $RX_{t+52}^{bonds,(n)} = \alpha + \beta_1(F_t^{bonds,(3)} - Y_t^{bonds,(1)}) + \beta_2(F_t^{bonds,(5)} - F_t^{bonds,(3)}) + \epsilon_{t+52}^{(n)}$, i.e. we regress subsequent excess returns on zero coupon bonds on the spread between the three-year forward bond yield and the one-year zero coupon bond yield as well as on the spread between the five-year and the three-year forward bond yield. As Cochrane and Piazzesi (2005) argue that risk premia are slow-moving processes, the reported coefficients are the sum of three lags of equity forward rates. Standard errors are reported below the coefficients and are derived from a Wald-test for the joint significance of all lags. This approach corresponds to a method developed by Dimson (1979). Standard errors are computed using a Newey-West (52 lags) covariance matrix to account for overlapping annual returns. The number of observations is equal to 435.