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Risk and return of short-duration equity investments[☆]

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ABSTRACT

We analyze short-duration equity investments using traded claims on index dividends. We show that investment strategies with constant short maturity outperform a systematic long position in the underlying equity index on a risk-adjusted basis and in absolute terms. Furthermore, we find higher international diversification benefits for this strategy, compared to traditional equity indices. We relate the observed outperformance to market downside exposure, in particular an options-based downside risk factor. We use three alternative models to extract ex-ante risk premia implied in the prices of dividend derivatives and find evidence for substantial time variation in expected returns.

1. Introduction

Recent evidence indicates that the term structure of equity risk premia is not flat, i.e. expected risk premia depend on the maturity of equity cash flows. Binsbergen et al. (2012) calibrate leading asset pricing models and derive the predictions those models provide for the shape of the term structure of risk premia. It turns out that traditional models such as consumption-based asset pricing models with habit formation, as in Campbell and Cochrane (1999), or long-run risk models, as in Bansal and Yaron (2004), imply risk premia that increase in maturity, while more recent models such as Lettau and Wachter (2007) predict a downward-sloping term structure of risk premia. Variable rare disaster models like Gabaix (2012) imply a flat term structure but predict Sharpe ratios that decrease in maturity.

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One strategy to test these predictions is to compare the realized performance of short and long-duration equity investments. Binsbergen et al. (2012) use S&P 500 index options and implement an investment strategy that isolates the risk exposure to implied dividends. To formulate the appropriate strategy that exposes investors to short-term dividend claims, they extract dividends from the put-call parity equation. The authors find short-maturity dividend claims to outperform the underlying equity index on a risk-adjusted basis, thus providing support for equity risk premia that decrease in maturity. Using dividend swaps, Binsbergen et al. (2013) construct equity yields similar to bond yields, where equity yields consist of discount rates, dividend expectations for a certain maturity and the corresponding risk premium. They provide further evidence for a downward-sloping term structure of equity risk premia.

Reconciling these empirical findings with traditional asset pricing theory, Belo et al. (2015) combine unlevered EBIT dynamics with a dynamic capital structure to conclude that dividends are riskier than EBIT in the short run. Ai et al. (2013) show that a production-based model with heterogeneous exposure to productivity shocks across capital vintages is able to produce a downward-sloping term structure of equity risk premia. Marfe (2013) arrives at a similar conclusion in the absence of productivity shocks by modeling labor relations. Ang and Ulrich (2012) calibrate a macro-finance model where the risk premium associated with expected inflation decreases with horizon, and find short-horizon equity to be more risky. Furthermore, Croce et al. (forthcoming) show that short-term dividend strips are more risky if agents cannot distinguish between short-term and long-term shocks in long-run risk models. Schulz (forthcoming) attributes the high returns of short-maturity dividend claims purely to tax effects.

Brennan (1998) first introduced the idea of creating distinct traded instruments that expose investors to dividend cash flows of a single year. He shows that this can increase efficiency in asset markets as different maturities of equity cash flows serve different investor clienteles. Shortly after the publication of this paper, the market for dividend derivatives emerged. Manley and Mueller-Glissmann (2008) present the evolution of this market and elaborate in great detail on the mechanics of dividend derivatives. The first traded instruments were dividend swap contracts in the OTC markets, later followed by options and exchange-traded dividend futures — which are currently available on the Eurostoxx 50, FTSE 100, and Nikkei 225 indices, but not yet on a major US index as the S&P 500. Mixon and Onur (2014) shed light on trading activity in listed dividend futures as well as OTC dividend swaps, and illustrate the typical institutional positioning. The market for dividends provides investment characteristics that are related to traditional equity investment vehicles but has additional features that make it an asset class in its own right. Most importantly, the final payoff of dividend derivatives depends only on the difference between the price at initiation and the amount of dividends accrued throughout the maturity year. This is in contrast to standard equity investments, where for any finite investment horizon there is not only uncertainty about cash flows but investors are also exposed to valuation risk at the time of divestment.

In this paper we analyze a simple investment strategy based on dividend swaps. We construct portfolios that expose investors to a dividend cash flow of constant duration by combining dividend swaps of two consecutive maturities. The strategy is implemented for four different markets, namely the Euro Stoxx 50, FTSE 100, S&P 500 and the Nikkei 225, from 2006 to 2015. The dividend strategy significantly outperforms the underlying equity indices on a single-factor risk-adjusted basis and on an absolute basis. The risk-adjusted outperformance largely disappears if options-based risk factors are taken into account. Boguth et al. (2013) attribute previously found empirical results on the term structure of equity risk premia to potential measurement error and leverage effects that arise when isolating the implied dividend stream from traded index derivatives. We avoid this potential measurement error by using dividend derivatives and obtain findings consistent with Binsbergen et al. (2012, 2013). In addition, the findings of this paper are similar to those derived by Duffee (2010) for the treasury bond market and by Derwall et al. (2009) for the corporate bond market. Our risk-based explanation relates to downside risk, an approach that has recently been applied comprehensively across asset classes by Lettau et al. (2014) and is also consistent with the use of option-based risk factors in the context of hedge fund returns by Agarwal and Naik (2004). Evidence by Baker et al. (forthcoming) for individual firms and Garrett and Priestley (2000) for the aggregate market strongly points to the existence of downside risk in dividend markets. Since small declines in permanent earnings tend not to be reflected in dividend reductions, a potential for waves of substantial dividend cuts builds up during periods of poor economic conditions.

Our first contribution is to provide further evidence for asset pricing models that assign higher risk premia to short-maturity cash flows. We find nonlinear, options-based risk factors to be especially important in capturing risk exposures of our strategies. A second contribution of our paper is on the benefits of international diversification. A distinct feature of the dividend strategy is cross-country correlations that are significantly lower than for the traditional underlying equity indices. In this context, we extend the analysis on conditional correlations presented in Erb et al. (1994), and find the improved diversification to be present over different phases of the business cycle. Diversification benefits result in an equally weighted global constant maturity dividend strategy that features high realized Sharpe ratios. Third, we contribute by relating ex-ante risk premia to ex-post realized returns. We use three variants in order to model implied ex-ante risk premia: (i) We build on the insights from Lintner (1956) on dividend smoothing by corporations, based on past dividends and current earnings. These findings are well established in the literature, including recent papers such as Skinner (2008), Lambrecht and Myers (2012), and Baker et al. (forthcoming). We estimate market-specific coefficients of a Lintner-type model to derive structural estimates for dividend growth expectations based on consensus analysts' forecasts for dividends and earnings. (ii) We make direct use of analyst forecasts of dividends. (iii) We use carry to approximate ex-ante risk-premia, expanding the evidence by Koijen et al. (2015) who find carry measures to predict subsequent returns over several asset classes. In combination with market prices for dividend swaps we compute for each of these variants the implied risk premia appropriate for the short-duration equity strategy and relate the estimated ex-ante risk premia to subsequent realized returns. We present robust findings that these risk premia are high on average, exhibit substantial time variation, and are useful predictors for subsequently realized returns.

2. Data

We use a proprietary dataset on OTC dividend swaps from Goldman Sachs. Dividend swaps are available for several maturities. The underlying of index dividend swaps is dividends announced and paid by all member companies of a specific equity index accumulated within one year. The dividend accumulation period for the year n swap runs from the day after the third Friday in December of year $n-1$ to the third Friday in December of year n. Typically, no dividends are paid between the third Friday in December and year-end, so it is common to denote this swap as calendar year n dividend swap. An investor who at time t enters a long position in the year n dividend swap agrees to pay a fixed amount $F_{t,n}$, which is the current implied dividend level (the certainty equivalent of dividends of a given future year), and receives at maturity the realized dividend level, yielding a profit or loss equal to the difference between the implied dividend level at initiation of the contract and the realized level at maturity. Thus, at maturity a dividend investor has no exposure to market valuations of future dividend streams and consequently can trade purely upon his expectations with respect to dividends of the maturity year in question. Dividend swaps mature once every calender year in December, and traded contracts are available for maturities up to six years ahead. The sample covers dividend swaps on four major equity indices, S&P 500, FTSE 100, Nikkei as well as the Euro Stoxx 50, and ranges from January 2006 to May 2015. We use a weekly data frequency. Our data sample is similar to that employed in Binsbergen et al. (2013). For robustness we cross-check our data with exchange-listed dividend futures retrieved from Bloomberg for those markets and time periods where listed contracts are available, and find the swap data to be highly reliable.[2]

We use Bloomberg as the data source for several time series. As benchmarks for the underlying equity indices, we use total return indices. We download weekly total equity index returns, index levels and dividend yields. Furthermore, we gather monthly data on the ISM indices for the economies corresponding to the equity markets. We also collect data to calculate options-based risk factors. To this end, we obtain time series of volatilities implied by one-month put options for all four indices and levels of moneyness 80%, 90%, 95%, 97.5%, 100%, 102.5%, 105%, and 110%. We use one-month libor rates for EUR, GBP, USD and JPY. Estimating the parameters of a Lintner model for dividend policy requires us to use consensus analysts' forecasts of aggregate dividends and earnings one and two years ahead. Those consensus estimates are also gathered at a weekly frequency from Bloomberg. We furthermore retrieve data on realized annual dividends and earnings in the US from Professor Robert Shiller's website.[3] For the Eurozone, UK, and Japan we use total return indices and price indices as well as time series of price-earnings ratios and dividend yields from Global Financial Data. Based on these ratios and index levels we are able to back out historical index dividends and index earnings for all regions on an annual basis. For the US and the UK the resulting sample starts in 1946, for Japan in 1957 and for the Eurozone in 1972.[4]

3. Short-duration equity investment strategy

Investors can easily obtain positive exposure to short-duration equity risk by taking a long position in the dividend swap that matures next and rolling into the subsequent swap contract shortly before the maturity date. Similarly, investors can systematically roll the second contract to maintain exposure to dividends of the following calendar year. We create synthetic indices that replicate these strategies. To keep dollar exposure unchanged at the roll date, the number of contracts has to be adjusted by the factor $\frac{F_{t,FY(t)}}{F_{t,FY(t+1yr)}}$ to account for gains or losses due to the roll yield, where $F_{t,\,FY(t)}$ denotes the swap strike at time t for a dividend swap maturing in December of fiscal year $FY(t)$. Note that this strategy, in which contracts are rolled once a year, exposes investors to a variable maturity as the remaining time span to December of each year gets shorter. Since we are interested in relating our results to recent studies on the term structure of realized risk premia, our goal is to analyze investable constant maturity dividend profiles. Therefore we construct a portfolio of dividend swaps with different maturities, where the weights are adjusted weekly. Counting the number of weeks w from the last contract settlement date, the portfolio consists of $\frac{52-w}{52}$ contracts of the next maturity date and $\frac{w}{52}$ contracts of the subsequent maturity date. An investor could implement this strategy starting on the third Friday of December of year t by establishing a long position of 52 contracts in the dividend swap maturing in exactly one year, $FY(t)$. Each subsequent week she sells one contract of maturity $FY(t)$ and buys one contract of maturity $FY(t+1yr)$. If $F_{t,\,FY(t)} \neq F_{t,\,FY(t+1yr)}$, the number of contracts has to be adjusted proportionally to keep total exposure unchanged from dynamic trading. The price of the replicating portfolio of the strategy reads as $w_t F_{t,\,FY(t)} + (1-w_t)F_{t,\,FY(t+1yr)}$, where w_t is the weight of the first contract involved. At the roll date this weight is equal to $w_{t_{roll}} = \frac{52}{52} = 1$, decreasing to zero until just before the next roll date.[5]

As a benchmark we compute weekly total excess returns for the underlying equity indices. For each market, we compare the investment performance of a long strategy in the constant one-year maturity dividend swap with a long position in the equity

[2] See the Internet Appendix for more details.
[3] http://aida.wss.yale.edu/shiller/data.htm.
[4] We use France and Germany as proxies for the Eurozone.
[5] Binsbergen and Koijen (2015) employ a similar approach.

index itself. Given the composition of the one-year constant maturity strategy's replicating portfolio, we compute weekly excess returns

$$R^{Div,1}_{t+1} = w_t \frac{F_{t+1,FY(t)} - F_{t,FY(t)}}{F_{t,FY(t)}} + (1 - w_t) \frac{F_{t+1,FY(t+1\mathrm{yr})} - F_{t,FY(t+1\mathrm{yr})}}{F_{t,FY(t+1\mathrm{yr})}},$$

where $F_{t,\,FY(t)}$ is the time t dividend swap strike for the contract ending in fiscal year $FY(t)$. Benchmark returns are calculated as $R^{bm}_{t+1} = \frac{I_{t+1}-I_t}{I_t} - r_f$ using total return index levels I_t. In order to interpret $R^{Div,1}_{t+1}$ directly as excess returns, we assume that investors enter fully collateralized positions, i.e., the margin placed with the broker equals the notional of the derivatives contract.[6] In addition to analyzing single-market strategies, we also define global strategies for constant maturity dividends and the benchmark as equally weighted portfolios of the four markets with weekly rebalancing.

3.1. Investment performance

Fig. 1 illustrates the resulting investment performances for all four regions, based on cumulative excess returns. The blue lines depict the results for the constant one-year dividend strategy and the purple line is the benchmark, which is a systematic long investment in the underlying equity index. It is surprising that the one-year maturity strategy outperforms in three out of the four markets over the sample horizon of close to ten years. The exception is the S&P 500, where the dividend strategy slightly underperforms the index in absolute terms, yet given the lower variability of the dividend strategy it is important to calculate risk-adjusted performance.

The result is even more puzzling in light of the fact that a substantial amount of dividends that are to be paid in one year's time are announced the year before. So there is good visibility in terms of the expected level of realized dividends. Since most dividends for the next year have already been announced, the gradual increase in dividend swap strikes is similar to the pull to par effect of a bond, despite the fact that equity investors only have residual claims on company profits. From Fig. 1 it seems that the moderate dividend risk of the one-year maturity strategy offers investors a disproportional realized risk premium. This is in line with asset pricing models that imply a downward-sloping term structure of risk premia. Furthermore, the results support earlier empirical findings on short-maturity dividend strategies using index options, such as Binsbergen et al. (2013). Table 1 provides annualized mean returns, standard deviations and Sharpe ratios for the one-year constant maturity dividend strategies (CMDS 1) as well as for the benchmark strategy. In three markets, Sharpe ratios are substantially higher than the corresponding benchmarks' values. The exception is the S&P 500 where the Sharpe ratio of CMDS 1 is slightly lower. The global CMDS 1 strategy achieves a Sharpe ratio of 0.91, contrasting a value of 0.34 for the benchmark.

3.1.1. Transaction costs

So far, our analyses are based on mid-market prices, for both dividend derivatives and equity index futures. To properly account for transaction costs, we adjust returns in the following way: To implement the constant maturity dividend strategy in practice, one needs to roll $\frac{1}{52}$ of the overall exposure into the subsequent contract each week. Thus, we adjust returns according to

$$R^{Div,n,TC}_t = R^{Div,n}_t - \frac{TC_D}{52},$$

where $R^{Div,n,TC}_t$ are returns after transaction costs TC_D. For the benchmark strategy, we do not need to roll on a regular basis, since we use a buy-and-hold equity index strategy (which could be implemented using ETFs for instance).

To obtain a time-varying estimate for TC_D, we estimate the time t spread for the dividend swap with maturity T from daily swap data following Roll (1984) as $RS^T_t = 2 \cdot \sqrt{-\mathrm{cov}(\Delta P_t, \Delta P_{t-1})}$. We use 10 trading days of swap prices to estimate spreads. According to Hasbrouck (2009), positive covariances tend to occur when trading costs are low, so a common remedy is to set the covariance to zero whenever its estimate is positive. We set the trading cost of the CMDS-T strategy $TC_{D,t} = \frac{RS^T_t + RS^{T+1}_t}{2}$. We estimate median transaction costs of 0.49% (Euro Stoxx 50), 1.81% (S&P 500), 0.27% (FTSE 100), and 0.28% (Nikkei 225). Wilkens and Wimschulte (2010) report for their sample period from July through November 2008 average bid-ask spreads of 1.7% and 3.6% for the two shortest maturity futures contracts on Euro Stoxx 50 dividends. This magnitude seems to be driven by the specific time period, since Euro Stoxx 50 dividend futures were introduced in July 2008. We cross-check bid-ask spreads for dividend futures, extending the observation period through May 2015: The bid-ask spread for the Euro Stoxx 50 dividend futures contract with the shortest maturity averages 0.36%, which is comparable to the above estimate that we obtain from the Roll measure. For the benchmark indices we set the spread TC_{bm} equal to 5 basis points per annum in all periods. The latter number is consistent with the literature, e.g., Herold et al. (2005). Table 2 provides performance statistics after accounting for

[6] A similar interpretation is given in Koijen et al. (2015). To see the intuition, denote the amount of funds placed as margin at initiation as M_t. Then the market value of the investment strategy one week later is given by $M_t(1 + r_f) + F_{t+1} - F_t$ and the one week total return per unit of capital is given by $\frac{M_t(1+r_f)+F_{t+1}-F_t-M_t}{M_t}$, which can be simplified to $\frac{F_{t+1}-F_t}{M_t} + r_f$. Subtracting the risk-free rate r_f yields the excess return per unit of capital $\frac{F_{t+1}-F_t}{M_t}$. Assuming a fully collateralized position equates M_t and F_t, which shows that our return R_{t+1} is the appropriate measure for excess returns.

Fig. 1. Short-maturity equity strategy and benchmark. This figure illustrates the performance of the investment strategies described above. The blue lines represent the performance of a systematic dividend strategy with constant maturity of one year and the purple line is the benchmark strategy, which is a systematic investment in the underlying equity index via index futures. The four panels show results for the four regions in our sample. The performance indices are set to 100 in January 2006. Note that the indices represent total excess returns.

transaction costs. Despite imposing higher percentage costs for short-duration dividend strategies, the general pattern of high Sharpe ratios for dividend swaps survives.

3.2. International diversification benefits

From the last rows of Tables 1 and 2, it seems that short-maturity equity strategies provide stronger international diversification benefits than the benchmark strategies. Table 3 contains correlations across the four regions in the sample for CMDS 1 and the benchmark strategy. The correlations across markets are substantially lower for the dividend strategy compared to the benchmark. To test for statistical significance, we conduct Jennrich tests and obtain a p-value of below 0.001 for the difference in the correlation matrices.[7]We interpret this finding to mean that the potential for international diversification in dividend

[7] As shown by Jennrich (1970) the test statistic is $\tau = \frac{n_1 n_2}{n_1+n_2}\boldsymbol{d}'\hat{\boldsymbol{\Gamma}}^{-1}\boldsymbol{d} \overset{a}{\sim} \chi^2\left(\frac{p(p-1)}{2}\right)$, where n_1 and n_2 are the sample sizes of two p-variate normal populations, $\boldsymbol{d}$ is a vector of element-by-element differences of the two sample correlation matrices in lexicographic order and $\hat{\boldsymbol{\Gamma}}^{-1}$ is a consistent estimator of the covariance matrix.

Table 1
Performance statistics.

	CMDS 1			Benchmark		
	Mean	St. dev.	Sharpe	Mean	St. dev.	Sharpe
Euro Stoxx 50	7.45	12.33	0.60	5.32	22.99	0.23
S&P 500	2.62	9.07	0.29	7.98	18.70	0.43
FTSE 100	5.90	9.97	0.59	6.08	19.04	0.32
Nikkei 225	11.65	12.71	0.92	6.28	22.95	0.27
Global	6.90	7.62	0.91	6.41	18.93	0.34

This table provides annualized mean returns, standard deviations and Sharpe ratios for the one-year constant maturity dividend strategies based on mid-market prices as well as for the benchmark strategy.

Table 2
Performance statistics with transaction costs.

	CMDS 1			Benchmark		
	Mean	St.dev.	Sharpe	Mean	St. dev.	Sharpe
Euro Stoxx 50	6.94	12.33	0.56	5.27	22.99	0.23
S&P 500	0.72	9.09	0.08	7.93	18.70	0.42
FTSE 100	5.63	9.97	0.56	6.03	19.04	0.32
Nikkei 225	11.35	12.71	0.89	6.23	22.95	0.27
Global	6.16	7.62	0.81	6.36	18.93	0.34

This table provides annualized mean returns, standard deviations and Sharpe ratios for the one-year constant maturity dividend strategies as well as for the benchmark strategy after transaction costs.

strategies goes beyond the diversification benefits prevalent in traditional equity investments. While fully analyzing the economics of international diversification is beyond the scope of this paper, the observed patterns are consistent with discount rates being more highly correlated across countries than market-aggregate cash flows. Campa and Fernandes (2006) have found the gains from international diversification in stock portfolios to depend on the degree of financial integration of economies. Fig. 2 illustrates the performance of the global strategies and Table 4 provides annual performance statistics. Due to the high diversification benefits the global one-year constant maturity dividend strategy yields a very attractive Sharpe ratio. Comparing CMDS 1 to the benchmark, the dividend strategy has the higher Sharpe ratio in all years with positive benchmark returns. In the two years with negative benchmark returns a comparison of Sharpe ratios is not sensible; yet, CMDS also performs better with either less extreme losses (2008) or even positive excess returns (2011).

Following Erb et al. (1994), we analyze conditional correlations to detect whether diversification benefits disappear during times of market distress. To this end, we partition returns into three states. We analyze correlations for a subsample where both returns of two markets in question are positive, where both returns are negative, and for times where returns are out of phase. Table 5, panels A and B show that correlations tend to increase if returns are negative. In panel A we use CMDS returns as the conditioning variable, whereas in panel B we use benchmark index returns. However, international correlations remain lower for the short-maturity strategies as compared to the benchmark strategies even during phases of negative returns. As an alternative stress test we use macro data as a conditioning variable. We observe pairwise correlations if the ISM index in both regions is above 50 (indicating expansion), if it is below 50 in both regions and if it is out of phase. Results are shown in panel C of Table 5. Again, the potential for international diversification remains superior in the domain of the short-maturity dividend strategies as compared to the benchmark strategy. Results are qualitatively the same if we condition on consumer growth rates (panel D).

Further evidence on the international diversification benefits of dividend strategies is given in Fig. 3, relating mean returns and standard deviations for constant maturity dividend strategies with maturities of 1 to 4 years as well as benchmark strategies. It is striking that the shortest maturity strategies tend to be in the top left, indicating that those strategies exhibit less risk than longer maturity strategies and at the same time generate high excess returns.

Table 3
Correlations across regions.

	Euro Stoxx 50	S&P 500	FTSE 100	Nikkei 225
Euro Stoxx 50	1.00	0.32	0.63	0.14
S&P 500	0.85	1.00	0.27	0.30
FTSE 100	0.90	0.87	1.00	0.17
Nikkei 225	0.66	0.65	0.66	1.00

This table provides correlations across the four regions in our sample for the one-year constant maturity dividend strategy (CMDS 1, above diagonal) and the benchmark (below diagonal).

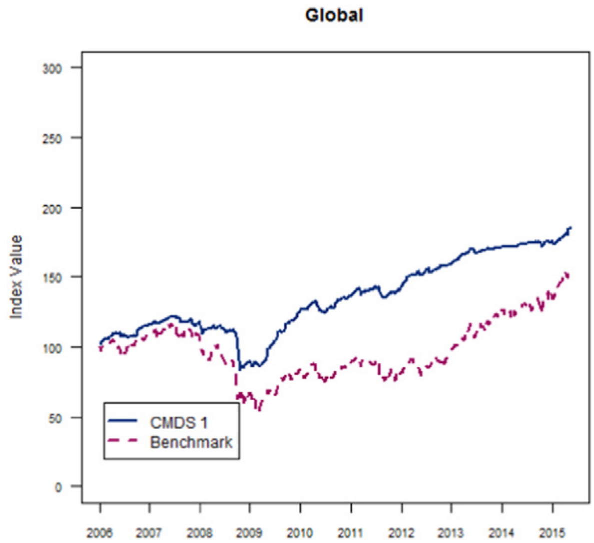

Fig. 2. Short-maturity equity strategy and benchmark — global. This figure illustrates the performance of the global investment strategies. The blue line represents the performance of a systematic dividend strategy with constant maturity of one year and the purple line is the benchmark strategy, which is a systematic investment in the underlying equity index via index futures. The performance indices are set to 100 in January 2006. Note that the indices represent total excess returns.

4. Time-varying risk and risk premia

In this section, we relate performance to downside risk. We measure downside risk both traditionally as extremely low returns, and alternatively as an options-based risk factor. To gain further insight into the economic significance of dividend downside risk, we analyze the empirical variability of cash dividends. Moreover, we calibrate a Lintner model of dividend payouts and estimate ex-ante risk premia implied by dividend swap prices.

4.1. Downside risk

Returns of the dividend swap strategy should be related to its risk exposure. Downside risk has been found relevant in a number of markets. Ang et al. (2006) show the importance of downside risk for stocks. Recently, Schneider et al. (2015) provide a downside-risk explanation for beta- and volatility-based low-risk anomalies. While Dobrynskaya (2014) focuses on currency markets, Lettau et al. (2014) provide empirical evidence for a number of asset classes. Further, the co-entropy measure introduced by Backus et al. (2015) to explain the term structure of asset prices can be interpreted as a downside risk measure. Downside risk is highly relevant across important asset classes including dividends. More specifically for dividend markets, Baker et al. (forthcoming) show that individual firms are punished more in terms of market reaction for dividend cuts than they are for symmetric increases. Managers seek to pay out dividend levels that do not fall short of a reference point, in order to avoid

Table 4
Performance statistics global.

	CMDS 1			Benchmark		
	Mean	St. dev.	Sharpe	Mean	St. dev.	Sharpe
2006	14.88	5.82	2.56	11.12	11.51	0.97
2007	1.78	4.57	0.39	0.60	13.80	0.04
2008	−26.30	16.34	−1.61	−46.18	34.51	−1.34
2009	34.35	9.76	3.52	28.83	23.98	1.20
2010	8.72	5.59	1.56	7.08	16.87	0.42
2011	4.07	6.17	0.66	−5.57	20.87	−0.27
2012	11.70	3.94	2.97	16.81	12.70	1.32
2013	7.64	2.25	3.40	29.32	12.03	2.44
2014	2.16	2.01	1.07	9.42	13.27	0.71
2015	14.89	3.63	4.10	22.70	11.71	1.94
Overall	6.90	7.62	0.91	6.41	18.93	0.34

This table provides annualized mean returns, standard deviations and Sharpe ratios for the one-year constant maturity dividend strategy as well as for the benchmark strategy for every year in the sample and overall.

Table 5
Conditional correlations.

	CMDS 1			Benchmark		
	Up	Down	Out-of-phase	Up	Down	Out-of-phase
Panel A: Correlations conditional on return						
Euro Stoxx 50/S&P 500	0.23	0.66	−0.41	0.76	0.79	−0.47
Euro Stoxx 50/FTSE 100	0.68	0.81	−0.37	0.80	0.88	−0.57
Euro Stoxx 50/Nikkei 225	0.02	0.42	−0.60	0.40	0.62	−0.55
S&P 500/FTSE 100	0.31	0.68	−0.55	0.79	0.83	−0.59
S&P 500/Nikkei 225	0.30	0.61	−0.40	0.40	0.64	−0.50
FTSE 100/Nikkei 225	0.23	0.40	−0.61	0.38	0.68	−0.53
Panel B: Correlations conditional on index return						
Euro Stoxx 50/S&P 500	0.15	0.46	0.30	0.76	0.79	−0.47
Euro Stoxx 50/FTSE 100	0.60	0.63	0.57	0.80	0.88	−0.57
Euro Stoxx 50/Nikkei 225	−0.08	0.27	0.10	0.40	0.62	−0.55
S&P 500/FTSE 100	0.15	0.44	0.08	0.79	0.83	−0.59
S&P 500/Nikkei 225	0.45	0.36	−0.03	0.40	0.64	−0.50
FTSE 100/Nikkei 225	0.06	0.32	0.05	0.38	0.68	−0.53
Panel C: Correlations conditional on PMI indices						
Euro Stoxx 50/S&P 500	0.21	0.41	0.07	0.78	0.90	0.80
Euro Stoxx 50/FTSE 100	0.45	0.70	0.46	0.85	0.95	0.89
Euro Stoxx 50/Nikkei 225	0.09	0.14	0.23	0.54	0.76	0.56
S&P 500/FTSE 100	0.23	0.29	−0.01	0.83	0.88	0.87
S&P 500/Nikkei 225	0.27	0.35	0.03	0.53	0.74	0.57
FTSE 100/Nikkei 225	0.16	0.21	0.13	0.55	0.75	0.55
Panel D: Correlations conditional on consumer growth						
Euro Stoxx 50/S&P 500	0.19	0.63	0.20	0.80	0.80	0.84
Euro Stoxx 50/FTSE 100	0.41	0.76	0.48	0.86	0.92	0.87
Euro Stoxx 50/Nikkei 225	0.15	0.35	0.13	0.54	0.75	0.55
S&P 500/FTSE 100	0.17	0.34	0.25	0.85	0.82	0.88
S&P 500/Nikkei 225	0.20	0.54	0.34	0.54	0.69	0.57
FTSE 100/Nikkei 225	0.06	0.42	0.29	0.58	0.76	0.51

This table provides conditional pairwise correlations for the one-year constant maturity strategy (left columns) and the benchmark (right columns). In panel A, the conditioning variable is the instrument's return; in panel B, the benchmark return; in panel C, purchasing manager indices (below or above 50); in panel D, consumer growth.

loss averse investors from selling off the company's stock excessively. While this theory was developed for individual companies, Garrett and Priestley (2000) argue that dividend decisions across firms are correlated. In their analysis on the level of the aggregate market, they find an asymmetric response of dividends to permanent earnings: Downward stickiness is significantly more pronounced than upward stickiness. Given that small declines in permanent earnings are not reflected in dividend reductions, this implies that a potential for huge cuts of aggregate dividends builds up during periods of poor economic conditions. Hence, the pricing of dividend derivatives should reflect the probability of near term waves of dividend cuts.

Therefore, we allow for the relevance of downside risk in explaining returns of dividend swap strategies and relate excess returns of a dividend strategy to the excess returns of its benchmark strategy. We implement the following set of Henriksson and Merton (1981) time series regressions:

$$R_t^{Div,n} = \alpha + \beta R_t^{bm} + \beta^{down} R_t D_t + \epsilon_t, \tag{1}$$

where $R_t^{Div,n}$ is the excess return of a dividend strategy with n years of maturity, R_t^{bm} is the excess return on the benchmark strategy and D_t is a dummy variable that has a value of 1 if the market excess return is smaller than $\mu - \sigma$ and 0 otherwise. Thus, the term $\beta^{down} R_t D_t$ is an interaction term that changes the slope of the regression line if the regressor is less than the mean minus one standard deviation. In economic terms it states how much the systematic market risk of the dividend strategy increases in phases of bad capital-market returns. Since we use a proprietary data set on dividend swaps we want to ensure that we properly account for the possibility of stale prices. Thus we regress the dividend returns on contemporaneous as well as on lagged benchmark returns and aggregate the beta coefficients. We follow the widely used procedure suggested by Dimson (1979). Additionally, including lagged values of market returns mitigates a potential downward bias in returns measured at high frequency, as shown by Boguth et al. (2015).

For the constant one-year maturity strategy, Table 6 shows that the systematic co-movement with the benchmark strategy is substantially below one, but significantly different from zero in most markets. While the intercepts are statistically significant and economically large, they cannot be interpreted as performance measures. The reason is that the second factor is the payoff of a put option, not a return (see Jagannathan and Korajczyk (1986) and Ferson and Schadt (1996)). Yet, the regressions clearly

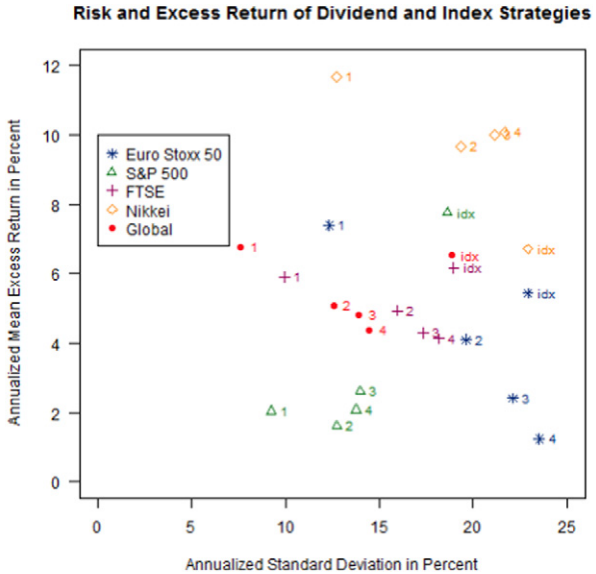

Fig. 3. Risk return characteristics of various strategies. This figure relates weekly mean returns and standard deviation for constant maturity dividend strategies with maturities of 1 to 4 years as well as benchmark strategies.

show that market betas increase significantly when the benchmark strategy performs poorly. This can be seen from the positive and statistically significant downside betas. Betas roughly double in bad times (or even quadruple in Japan), which indicates the attractive empirical performance of the dividend strategy could be related to downside risk.

We therefore create a tradeable downside risk factor based on the returns to out-of-the-money options and relate it to the returns of the constant maturity dividend strategies.[8] For all four equity indices relevant for this paper we collect volatilities implied by put options with one month to maturity (from Bloomberg). We gather the appropriate times series of implied volatility for various levels of moneyness: 80%, 90%, 95%, 97.5%, 100%, 102.5%, 105% and 110%. Then we interpolate to get a continuum of implied volatility levels for all four markets. Using one-month libor rates (in EUR, GBP, USD and JPY) as the relevant risk-free rate, the spot price of the equity indices and dividend yields for the equity indices, we are able to determine prices of European put options with any given moneyness using the Black–Scholes formula with continuous dividends.

Now we implement systematic put writing strategies: Each week we sell an amount equal to $\frac{W_t}{Strike^{95\%}}$ of 5% out-of-the money put options and collect the premiums, where W_t denotes wealth at each point in time t. We hold the short put position for one week, then we buy back the put and write a new put — again with one-month maturity and 5% out-of-the money. Weekly returns of this strategy are calculated as percentage changes in the resulting time series of wealth (W_t), which consists of the initial wealth level, put premia collected, negative market values of the short put positions in the portfolio and interest earned on cash. We deduct the risk-free rate to get excess returns. Finally we construct an equally weighted put writing portfolio using all four markets. Note that the put strategy described is sustainable in the long run in the sense that an investor following this strategy can never lose his entire wealth. However, in periods of low equity returns and increasing volatilities, losses will be severe.

Using the excess returns on the option strategy as a risk factor which is nonlinear in nature, we analyze the following regression setup as an alternative way of capturing downside risk in dividend strategies. We regress excess returns of the one-year constant maturity dividend strategies on excess returns of the underlying equity index and on excess returns of the put strategies. The regression reads asfollows:

$$R_t^{Div,n} = \alpha + \beta R_t^{bm} + \beta^{put} R_t^{put} + \epsilon_t, \tag{2}$$

where $R_t^{Div,n}$ is the excess return of a dividend strategy with n years of maturity, R_t^{bm} is the excess return on the benchmark strategy and R_t^{put} is the put-options-based risk factor for nonlinear returns. Consistent with the previous analysis we regress the dividend returns on contemporaneous and on lagged benchmark returns as well as on contemporaneous and on lagged

[8] Option-based risk factors are common in the hedge fund literature. Similar to many hedge fund strategies, dividend futures seem to generate stable returns as compared to the benchmark indices (i.e., lower volatility), while exhibiting increasing overall market exposure in down states. This nonlinearity is a typical feature of hedge fund returns as shown by Mitchell and Pulvino (2001) and Fung and Hsieh (2001). Agarwal and Naik (2004) find that hedge fund returns have significant exposure to systematic out-of-the money put writing strategies. Hedge funds have been among the most active investors in the market for traded dividend claims as reported by Manley and Mueller-Glissmann (2008).

Table 6
Beta regressions 1 year constant maturity.

CMDS 1 yr	Euro Stoxx	S&P 500	FTSE	Nikkei	Global
Intercept	0.0027***	0.0011*	0.0013*	0.0048***	0.0018***
	0.00081	*0.00064*	*0.00066*	*0.00093*	*0.00046*
Beta	0.2791***	0.1334***	0.2736***	0.0731	0.2554***
	0.0451	*0.0440*	*0.0443*	*0.0487*	*0.0310*
Down-beta	0.2141***	0.1931***	0.1036	0.3475***	0.1684***
	0.0622	*0.0595*	*0.0654*	*0.0697*	*0.0433*
No. obs	490	490	490	490	490
Adj. R^2	0.3173	0.1286	0.1651	0.1401	0.3470

This table provides summary statistics for the beta regressions for four regions as well as for a global strategy. Asterisks denote significance at the 1%, 5%, and 10% levels (*, **, and ***, respectively) derived from a p-value of a Wald test for joint significance of the coefficient on the contemporaneous and the lagged return. Standard errors are presented below the coefficients in italics. Number of observations and R^2 are provided at the bottom.

Table 7
Sensitivity to option strategies.

CMDS 1yr	Euro Stoxx	S&P 500	FTSE	Nikkei	Global
Alpha	−0.00006	− 0.00029	0.00048	0.0017**	0.00026
	0.00062	*0.00054*	*0.00069*	*0.00076*	*0.00044*
Beta	−0.0315	0.0707	0.2055***	0.1314**	0.1113**
	0.0591	*0.0609*	*0.0671*	*0.0593*	*0.0465*
Option-beta	1.3527***	0.5648***	0.4060**	0.3797***	0.7295***
	0.1630	*0.1774*	*0.1795*	*0.1566*	*0.1222*
No. obs	487	490	397	487	397
Adj. R^2	0.3875	0.1652	0.1900	0.1064	0.4115

This table provides regression results in which we relate the returns of the one-year constant maturity dividend strategies to the return of the benchmark indices and the returns to systematic out-of-the money put writing strategies on the corresponding equity indices. Each week, the option strategies sell 5% out-of-the money puts on the equity index with one-month maturity and hold them for one week. In the following week the put is bought back and a new 5% out-of-the money put is sold. Implied volatilities are taken from Bloomberg and put prices are calculated using the Black–Scholes formula with continuous dividends. Asterisks denote significance at the 1%, 5%, and 10% levels (*, **, and ***, respectively) derived from a p-value of a Wald test for joint significance of the coefficient on the contemporaneous and the lagged return. Standard errors are presented below the coefficients in italics. Number of observations and R^2 are provided at the bottom.

put option returns to account for the possibility of stale prices. We aggregate the coefficients and use Wald tests to test for the joint significance of the contemporaneous and the lagged coefficients. Again we follow the widely used procedure suggested by Dimson (1979).

Results are provided in Table 7 for all four markets and the global portfolio. It is striking that the coefficients on the put option risk factor are significant for all markets.[9] Market betas decrease as compared to the downside beta analysis and alphas disappear except for Japan. Here, alphas can be interpreted as measures of outperformance as all factors can be interpreted as tradeable returns. With the exception of Japan, the regressions do not show outperformance of short-maturity dividend strategies when accounting for downside risk. Even though dividends are sticky and to a certain extent predictable in the short run, they exhibit considerable exposure to an options-based downside risk factor.

4.1.1. Liquidity

Sincedividend derivatives have less trading volume than regular index derivatives, we control for possible liquidity effects. To this end, we obtain time series of three-month government bond yields for all four regions as well as three-month libor rates from Bloomberg.[10] The difference between the two yields is usually referred to as the TED spread, which acts as a proxy variable for liquidity. To include exposure to liquidity shocks into our regression analysis we follow the procedure applied by Asness et al. (2013) and construct liquidity shocks as residuals from an AR(2) process of the TED spreads. This funding liquidity proxy seems to be a relevant control variable, especially since Mixon and Onur (2014) report that leveraged accounts (hedge funds) are net long dividend derivatives. Moreover, we control for dividend-market-specific liquidity by including the Roll measure estimated before. The global liquidity shock is constructed from an equally weighted combination of all four country-specific TED spreads. Table 8 reports results for the options-based analysis after controlling for liquidity shocks. The coefficients are still close to those reported before in Table 7, which means that the sensitivity to the options-based risk factor is not a proxy for liquidity risk. The exposure to liquidity shocks is significantly negative for the Nikkei. Note that a higher TED spread (or equivalently, positive AR(2) residuals) corresponds to lower levels of liquidity. Thus, Nikkei dividend strategies suffer if liquidity dries up. Interestingly, the sign is positive for the S&P 500, the FTSE and the global strategy. The Euro Stoxx 50 does not exhibit a significant exposure to funding liquidity shocks. The dividend-market-specific Roll measure for liquidity (transactions cost) has negative signs, however, only the US market exhibits significant exposure to market liquidity. The adjusted R^2 increase slightly if

9 Note that we have fewer observations for the UK since implied volatilities for the FTSE 100 Index are only available on Bloomberg starting in 2007.
10 We take government bond yields of Germany as a proxy for the Eurozone.

Table 8
Sensitivity to option strategies and liquidity.

CMDS 1 yr	Euro Stoxx	S&P 500	FTSE	Nikkei	Global
Alpha	0.00085	0.0015	0.0011	0.0036**	− 0.00011
	0.0012	*0.00094*	*0.0014*	*0.0014*	*0.0010*
Beta	− 0.0076	0.0277	0.1918***	0.1328**	0.1149**
	0.0606	*0.0595*	*0.0673*	*0.0577*	*0.0468*
Option-beta	1.2795***	0.7772***	0.5731***	0.3928**	0.7632***
	0.1686	*0.1778*	*0.1943*	*0.1530*	*0.1290*
Liquidity	0.0034	0.0187***	0.0179**	− 0.1205**	0.0221***
	0.0091	*0.0060*	*0.0079*	*0.0468*	*0.0081*
Roll-Liq	− 0.0017	− 0.00097**	− 0.0031	− 0.0062	0.00042
	0.0019	*0.00041*	*0.0046*	*0.0040*	*0.0013*
No. obs	487	489	397	487	397
Adj. R^2	0.3876	0.1954	0.1952	0.1578	0.4225

This table provides regression results in which we relate the returns of the one-year constant maturity dividend strategies to the return of the benchmark indices and the returns to systematic out-of-the money put writing strategies on the corresponding equity indices. Furthermore, we control for liquidity effects. Each week, the option strategies sell 5% out-of-the money puts on the equity index with one-month maturity and hold them for one week. In the following week the put is bought back and a new 5% out-of-the money put is sold. Implied volatilities are taken from Bloomberg and put prices are calculated using the Black–Scholes formula with continuous dividends. The liquidity measure Liquidity is constructed as the residuals from an AR(2) process of the TED spread. The TED spread is defined as the difference between 3-month government bond yields and 3-month libor rates for the corresponding countries. The liquidity measure Roll-Liq is the implied half-spread from the covariances of daily swap prices expressed in percent. Asterisks denote significance at the 1%, 5%, and 10% levels (*, **, and ***, respectively) derived from a p-value of a Wald test for joint significance of the coefficient on the contemporaneous and the lagged return. Standard errors are presented below the coefficients in italics. Number of observations and R^2 are provided at the bottom.

liquidity shocks are included in the regression. Overall, neither funding liquidity nor market liquidity shocks have a substantial impact on the results presented so far.

We conduct several additional robustness checks. To conserve space, we delegate details of the robustness checks to the separate Internet Appendix. There we show that using listed dividend futures instead of OTC dividend swaps, altering the maturity of our dividend strategies and altering the level of moneyness of the put option factor leaves the results qualitatively unchanged.

4.2. Alternative explanations

Whilethis paper provides ample empirical evidence for downside risk being priced in dividend derivatives markets, alternative explanations cannot be fully ruled out. We check for short-run stickiness of cash dividends, using a long time series of annual dividends and equity prices from Global Financial Data and data from Professor Robert Shiller's website for the US. Fig. 4 depicts historical changes in nominal dividends over one year (left panel) and changes in nominal equity prices over one year (right panel) for all relevant regions (we use France and Germany to proxy for the Eurozone). Cash dividends on the index level appear to have much lower variability than prices.

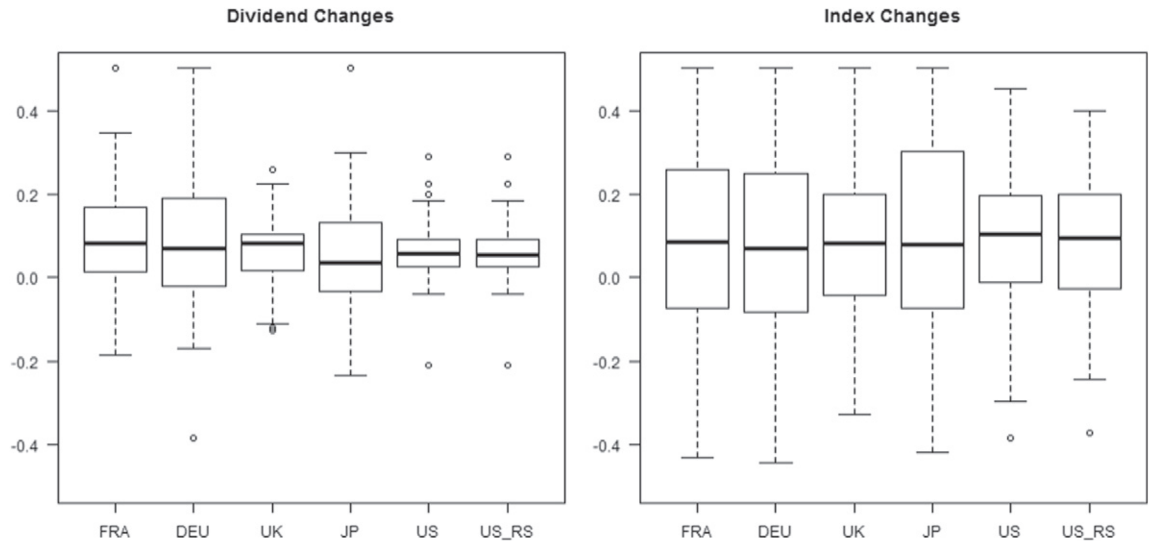

Fig. 4. Boxplot of one-year nominal dividend changes and index changes. This figure compares historical one-year nominal dividend changes (left panel) and one-year nominal equity index changes (right panel). We use France and Germany to proxy for the Eurozone. The data was retrieved from Global Financial Data. To cross check the data set we use US data from Prof. Shiller's website (http://aida.wss.yale.edu/shiller/data.htm) and compare the results of our US analysis using both data sets.

Anecdotal evidence has it, that a structural imbalance in dividend markets might distort dividend swap prices. Banks tend to be long dividend risk due to long dated index derivatives which they sell to clients and especially due to structured retail products such as principal protected notes and autocallables. To hedge dividend risk, banks short dividend derivatives. Mixon and Onur (2014) show that indeed dealers are net short dividend derivatives whereas asset managers and levered accounts (hedge funds) tend to be long. However, this might lead to higher average returns on long dividend derivatives positions but does not mechanically lead to downside risk. Even if banks act pro-cyclically and sell more dividend derivatives during market downturns (which might be the case since for instance plummeting equity index levels tend to increase the duration of autocallables and, thus, increase the amount and duration of banks' dividend risk) it seems unlikely that banks sell off the shortest maturity contract the most, as this does not hedge the increasing duration of many structured products during these downturns. We use one-year constant maturity dividend strategies in our paper, while Mixon and Onur (2014) report an average maturity of dividend swaps of 4.8 years (original tenor). Banks' selling pressure therefore seems unlikely to systematically introduce downside risk in the market for short-term dividend swaps we investigate.

Another issue might be liquidity. Significant downside risk (as proxied by sensitivity to put writing strategies in this paper) could potentially be a proxy for market illiquidity during crashes. To counter that criticism we control for illiquidity using a dividend-market-specific liquidity measure (spreads estimated by the Roll (1984) measure) and a funding liquidity proxy. Moreover, as reported by Mixon and Onur (2014), the overall USD notional outstanding of listed dividend futures and OTC swaps combined is 18.59 billion USD. The market for listed dividend futures (excluding OTC swaps) alone accounts for some 6.14% of the outstanding USD notional of ordinary index futures. Hence, while dividend derivatives are still a developing market, the size is not negligible, though.

While it is difficult to rule out alternative explanations like systematic market imbalances, liquidity anomalies, or pure mispricing entirely, we interpret our evidence for downside risk being priced in short-term dividend derivatives markets as convincing. This is consistent with dividend swap prices reflecting the risk-adjusted expected level of future dividends, i.e. $F_{t,FY(t)} = \mathbf{E}_t^{\mathbf{Q}}\left(D_{FY(t)}\right)$ and carrying a positive risk premium, i.e., $\mathbf{E}_t^{\mathbf{Q}}\left(D_{FY(t)}\right) < \mathbf{E}_t^{\mathbf{P}}\left(D_{FY(t)}\right)$.[11] To further analyze the risk premia implied in dividend swap prices, it is useful to estimate expected levels of dividends under the real-world measure, i.e., $\mathbf{E}_t^{\mathbf{P}}\left(D_{FY(t)}\right)$, which we implement in Section 4.3.

4.3. Ex-ante risk premia

A dividend swap or dividend futures price for year n can be interpreted as the risk-adjusted expected value of the dividends that will be paid during year n. A position in the analyzed dividend derivatives does not require a cash outlay (apart from typically interest-bearing margin requirements). Therefore, the risk-free interest rate does not enter the equation and the dividend futures curve depends only on dividend expectations and risk premia. If the expected nominal growth rate in future dividends exceeds the risk premium for this dividend stream, the curve is upward-sloping; if dividend growth is below risk premia, the dividend futures curve is downward-sloping. In their decomposition of equity yields, Binsbergen et al. (2013) use a VAR model to predict dividend growth, which then allows them to infer risk premiums. An alternative is to use a structural model for dividend growth. Lintner (1956) explains the apparent stickiness in dividends by modeling current dividend payouts as a function of profitability and previous dividends, a methodology that is still widely used to model dividends on an aggregate basis — see for instance Skinner (2008) and Lambrecht and Myers (2012).

We implement a structural model for dividends to back out ex-ante risk premia implied in traded claims on dividends. Thus, we gather data on historical dividends and earnings for all four regions (France and Germany are used as a proxy for the Eurozone) to estimate the following model for dividends:[12]

$$\Delta D_{Y(t)} = \lambda \cdot D_{Y(t-1)} + \beta \cdot E_{Y(t)} + \epsilon_t, \tag{3}$$

where $D_{Y(t)}$ are dividends of year t, $E_{Y(t)}$ are earnings of year t and $\Delta D_{Y(t)} = D_{Y(t)} - D_{Y(t-1)}$.

We use data from Professor Robert Shiller's website for the US and data from Global Financial Data to construct the corresponding dataset for the other three regions. The annual sample starts in 1946 for the US and UK, in 1957 for Japan and in 1972 for Europe and runs through to the end of 2005 for all regions.[13] Table 9 shows the regression results.

To capture the short-term dynamics in the dividend growth rate $\hat{g}^D_{t,Y(t-1),Y(t)}$, we transform Eq. (3) and use estimated coefficients $\hat{\lambda}$ and $\hat{\beta}$ from Table 9 to obtain predicted dividend growth from year $Y(t-1)$ to $Y(t)$:

$$\hat{g}^D_{t,Y(t-1),Y(t)} = \hat{\lambda} + \hat{\beta} \cdot \frac{\mathbb{E}\left(E_{Y(t)}\right)}{D_{Y(t-1)}}. \tag{4}$$

[11] We thank an anonymous referee for pointing out this interpretation.

[12] This corresponds to the approach in Skinner (2008). However, we estimate the regression without intercept to avoid level dependence in dividend growth rates.

[13] We estimate the Lintner regressions on a sample up to 2005, as our dividend swap data start in 2006. This way we ensure that we estimate ex-ante risk premia out of sample.

Table 9
Lintner model.

	France	Germany	UK	US	Japan
$\hat{\lambda}$	– 0.1563	– 0.1416*	– 0.1859***	– 0.0674***	– 0.0960**
$\hat{\beta}$	0.0991*	0.0699*	0.1285***	0.0485***	0.0466**
No. obs	34	34	60	60	49
Adj. R^2	0.1240	0.0529	0.5232	0.7045	0.1688

This table provides the OLS estimation output of a Lintner dividend model on annual data for the relevant regions through the end of 2005 as in Eq. (3). Asterisks denote significance at the 1%, 5%, and 10% levels (*, **, and ***, respectively). Number of observations and R^2 are provided at the bottom.

Note that earnings that accumulate over year t are not yet known at the beginning of the year; thus we have to use expectations instead of realized numbers. Here we use consensus analysts' estimates from Bloomberg as inputs. Similarly estimates for the following year's dividend growth $\hat{g}^D_{t,Y(t),Y(t+1)}$ can be calculated as

$$\hat{g}^D_{t,Y(t),Y(t+1)} = \hat{\lambda} + \hat{\beta} \cdot \frac{\mathbb{E}\left(E_{Y(t+1)}\right)}{\mathbb{E}\left(D_{Y(t)}\right)}, \tag{5}$$

where weuse Lintner-based dividend forecasts for the current fiscal year as well as consensus analysts' estimates for second-year earnings as the appropriate expectations. To estimate the risk premium $\hat{\mu}_{t,Y(t)}$ inherent in the price of the first available dividend swap $F_{t,Y(t)}$ note that

$$F_{t,Y(t)} = \frac{\mathbb{E}\left(D_{Y(t)}\right)}{1 + \hat{\mu}_{t,Y(t)}}, \tag{6}$$

which is equal to

$$F_{t,Y(t)} = \frac{D_{Y(t-1)} \cdot \left(1 + \hat{g}^D_{t,Y(t-1),Y(t)}\right)}{1 + \hat{\mu}_{t,FY(t)}}, \tag{7}$$

and by rearranging terms the risk premium implied by the first year dividend swap reads as

$$\hat{\mu}_{t,Y(t-1),Y(t)} = \frac{D_{Y(t-1)}}{F_{t,Y(t)}} \cdot \left(1 + \hat{g}^D_{t,FY(t-1),FY(t)}\right) - 1, \tag{8}$$

with $\hat{g}^D_{t,FY(t-1),FY(t)}$ from Eq. (4). Similarly, it is possible to obtain estimates for the risk premium for dividends of year $Y(t+1)$, observed at t:

$$\hat{\mu}_{t,Y(t),Y(t+1)} = \frac{F_{t,FY(t)}}{F_{t,FY(t+1)}} \cdot \left(1 + \hat{g}^D_{t,Y(t),Y(t+1)}\right) - 1. \tag{9}$$

We need to adapt the estimation to fit our constant maturity dividend strategy, using a method similar to the calculation of bond yields to back out the appropriate risk premia. Recall that the strategy is implemented by combining current year and next year dividend swaps. We solve for the risk premium that equates the swap price and the weighted average of current and next year dividend expectations discounted by the risk premium of the constant maturity portfolio $\mu_{t,t+1Y}$:

$$\frac{w_t \hat{D}_{Y(t)}}{(1 + \mu_{t,t+1Y})^{(Y(t)-t)}} + \frac{(1 - w_t)\hat{D}_{Y(t+1)}}{(1 + \mu_{t,t+1Y})^{(Y(t+1)-t)}} = w_t F_{t,FY(t)} + (1 - w_t) F_{t,FY(t+1)}. \tag{10}$$

As discussed before, dividend swaps are unfunded investments. Thus expected dividends must be discounted with risk premia, i.e., excess returns, as opposed to returns including both risk premia and the risk-free rate. Using our dataset of dividend swap prices and expected dividends from the Lintner model presented above, we can back out the risk premium of the constant maturity dividend portfolio every week by calculating roots in Eq. (10).

4.3.1. Fundamental carry

A related approach towards capturing the dynamics of expected returns on short-duration dividend strategies is to define a measure of fundamental carry as follows:

$$\text{Fundamental carry} = \frac{D_{Y(t-1)}}{w_t F_{t,FY(t)} + (1 - w_t) F_{t,FY(t+1)}} - 1\ . \tag{11}$$

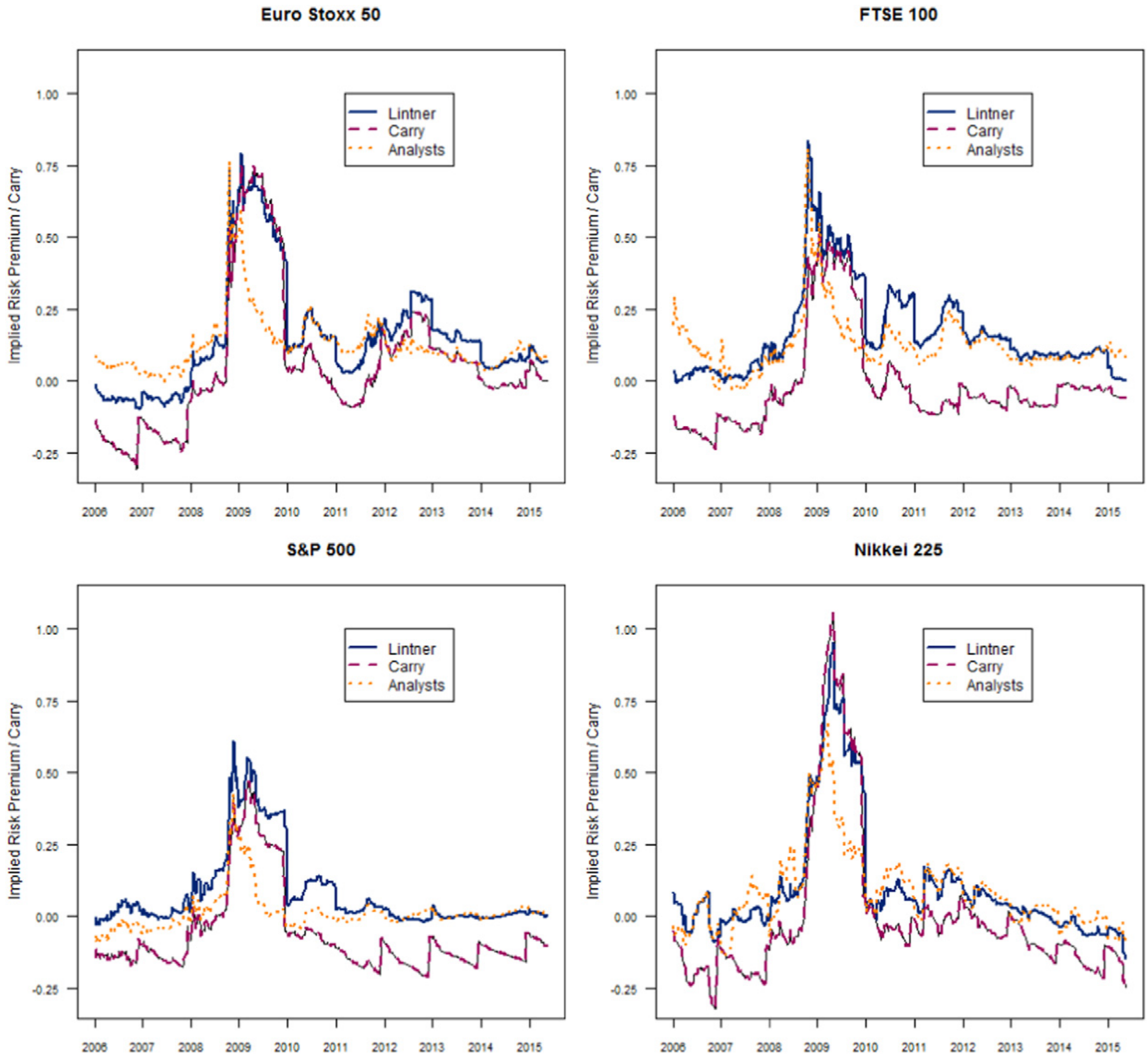

Fig. 5. Risk premia and carry. This figure illustrates ex-ante risk premia (solid blue lines) implied by our one-year constant maturity dividend strategy. Expected dividends are extracted from a Lintner model and risk premia are backed out by calculating roots of Eq. (10). The risk premia presented are p.a. To calculate risk premia of the Euro Stoxx strategy we use the coefficients from the Lintner model for France. Furthermore, the dashed red lines illustrate the dynamics of the fundamental carry over time. The carry is defined as $\left[(D_{Y(t-1)}) \,/\, (w_t F_{t,FY(t)} + (1-w_t)F_{t,FY(t+1)})\right] - 1$. The dotted yellow line is the risk premium backed out from analyst forecasts on index dividends derived from Bloomberg.

This measure basically compares the dividend level realized last December to the current market price of the constant one-year dividend portfolio. Put differently, it measures the return that investors would earn if aggregate index dividends stayed constant. This notion is related to the carry concept in Koijen et al. (2015), which measures achievable returns under a ceteris paribus assumption (e.g., for equities the carry is a forward-looking dividend yield under the risk-neutral probability measure). In our case the carry quantifies returns to dividend investors that are realized if aggregate payouts in one specific market (for instance the U.K.) stay the same, so we call it fundamental carry. Note that the fundamental carry is a special case of the ex-ante risk premium derived before: If expected dividends $\hat{D}_{Y(t)}$ and $\hat{D}_{Y(t+1)}$ in Eq. (10) coincide with last year's dividends $D_{Y(t-1)}$, then the fundamental carry equals the ex-ante risk premium.

A third alternative to estimate ex-ante risk premia is to use consensus analysts' forecasts for index dividends directly and to interpret the difference between traded dividend swap strikes and analysts' forecasts as risk premium.

Fig. 5 shows the dynamics of the short-duration equity risk premiums (solid blue lines) implied by dividend swap prices and Lintner-type dividend expectations. It is interesting to see that implied risk premia were low (and even negative in the Eurozone) up to 2007. Coinciding with the emerging financial crisis they spiked tremendously. While they have come down in the US, U.K. and Japan, risk premia are still elevated in the Eurozone compared to their pre-crisis levels. Fig. 5 also plots the

Table 10
Ex-ante risk premia.

	Euro Stoxx 50	S&P 500	FTSE 100	Nikkei 225
Panel A: Risk premium based on Lintner model				
Mean	15.17	8.05	16.91	10.31
Median	12.14	1.73	11.81	4.21
St. dev.	19.92	13.83	15.51	20.71
Min	−9.86	−3.00	−0.71	−14.86
Max	79.16	61.10	83.58	95.57
Panel B: Risk premium based on carry				
Mean	5.78	−6.46	−1.71	−0.24
Median	0.84	−11.93	−5.81	−7.10
St. dev.	24.03	14.96	16.56	26.56
Min	−30.65	−21.29	−23.62	−32.29
Max	75.56	47.27	52.85	105.85
Panel C: Risk premium based on analyst forecasts				
Mean	12.56	1.36	12.76	8.65
Median	10.39	0.51	10.73	5.52
St. dev.	10.16	6.98	10.81	14.34
Min	−0.22	−9.12	−3.30	−13.20
Max	76.51	42.86	80.91	67.01

This table provides summary statistics for ex-ante risk premia (stated in %) of the constant one-year dividend strategies for all four markets. Expected dividends are derived from a Lintner model in panel A as shown in Section 4.3, based on the carry model in panel B, and from analyst forecasts of dividend levels in panel C. Risk premia are calculated as roots in Eq. (10).

time series of fundamental carry (dashed purple lines) for all markets and compares it to the ex-ante risk premia. It can be seen that the fundamental carry is lower than the risk premium in most periods, reflecting the fact that expected dividend growth is positive on average. Consistent with the evolution of risk premia, the fundamental carry has come back to pre-crisis levels in the US, U.K. and Japan, whereas it is still somewhat higher in the Eurozone. Moreover, the dotted yellow line depicts risk premia based on analysts' dividend forecasts directly. Table 10 displays summary statistics of the risk premia for all markets. Median risk premia are fairly high and lie between 1.7% and 12.1%, based on the Lintner model, while average values range between 8.1% and 16.9%. Ex-ante risk premia are lowest for the S&P 500 and highest for the FTSE. Standard deviations between 13.8% and 20.7% indicate that risk premia (expected returns) vary substantially over time. Risk premia tend to be lower when measured using analyst forecasts and even lower under the carry model.

4.3.2. Risk premia vs. excess returns

After having presented our approach towards calculating ex-ante risk premia implied by dividend swap strategies, we investigate whether these implied risk premia are significantly related to realized excess returns of the constant maturity dividend strategies. Thus we perform the following regression:

$$R^{Div,1}_{t,t+1Y} = \alpha + \beta\mu_{t,t+1Y} + \epsilon_t, \tag{12}$$

where $R^{Div,1}_{t,t+1Y}$ is the holding period (excess) return of the one-year constant maturity dividend strategy from t to t plus one year, and $\mu_{t,t+1Y}$ is the implied one-year risk premium, measured ex ante at time t. Put differently, at every point in time we calculate implied risk premia for the one-year constant maturity strategy and relate it to the subsequently realized one-year excess return of the strategy over the following year. In order to perform the regression analysis at a weekly frequency we compute rolling annual returns. As this induces serial correlation in the residuals, we use p-values derived from Newey–West standard errors for statistical inference.

Panel A in Table 11 presents the regression results. Whereas most intercepts are indistinguishable from zero, betas are economically large and significantly different from zero. This indicates that expected returns on the short-duration dividend strategies vary significantly over time. The systematic relation between ex-ante risk premia and subsequent dividend holding period returns is smallest in magnitude for the US market, which is not surprising since the strategy performs worst compared to the benchmark in this market. For the other markets, betas range between 0.5 and 0.8. On the basis of the reported values of R^2, implied risk premia explain realized returns reasonably well in our sample.

Moreover, we investigate the effect of the dynamics of the fundamental carry on subsequent holding period returns. Thus, we conduct the following regression analysis:

$$R^{Div,1}_{t,t+1Y} = \alpha + \beta \text{carry}_{t,t+1Y} + \epsilon_t, \tag{13}$$

Table 11
Ex-ante risk premia vs. ex-post returns.

	Euro Stoxx	S&P 500	FTSE	Nikkei
Panel A: Risk premium based on Lintner model				
Intercept	−0.0165	−0.0016	−0.0829***	0.0337
	0.0282	0.0175	0.0227	0.0337
Beta	0.5602***	0.2615***	0.7970***	0.6479***
	0.1274	0.0954	0.1279	0.0962
No. obs	437	437	437	437
Adj. R^2	0.5234	0.1566	0.6730	0.4407
Panel B: Risk premium based on carry				
Intercept	0.0456**	0.0347*	0.0710***	0.1044***
	0.0217	0.0179	0.0205	0.0282
Beta	0.4344***	0.2217**	0.6365***	0.5138***
	0.1129	0.0965	0.1634	0.0761
No. obs	437	437	437	437
Adj. R^2	0.4623	0.1332	0.5184	0.4704
Panel C: Risk premium based on analyst forecasts				
Intercept	−0.0739***	0.0140	−0.0955***	0.0361
	0.0275	0.0151	0.0179	0.0357
Beta	1.1437***	0.5896***	1.1956***	0.7660***
	0.1359	0.1371	0.1304	0.2031
No. obs	437	437	437	437
Adj. R^2	0.5707	0.2094	0.7724	0.2911

This table reports results from regressing rolling annual realized (excess) returns of the one-year constant maturity dividend strategy on implied ex-ante risk premia, based on the Lintner model (panel A), carry (panel B), and analyst forecasts (panel C). Realized returns are lagged by one year so that for every (weekly) observation implied risk premia correspond to the realized annual return of the year subsequent to the observation. Since rolling returns induce serial correlation in the residuals, Newey–West standard errors are reported below the coefficients. Asterisks denote significance at the 1%, 5%, and 10% levels (*, **, and ***, respectively).

where carry is defined in Eq. (11). The results are presented in panel B of Table 11. Adjusted R^2 are slightly lower than for Eq. (12). Betas are again statistically significant and somewhat smaller in magnitude. We do not perform a multivariate regressionusing both ex-ante risk premia and fundamental carry due to the high degree of multicollinearity between those two potential regressors (recall that the fundamental carry is a special case of risk premia as defined above). Finally, panel C relates risk premia based on analysts' dividend forecasts to subsequently realized returns.

4.3.3. Conditional strategies

As we find risk premia on constant-maturity dividend strategies to vary substantially over time, it is interesting to implement and evaluate conditional investment strategies. The conditional dividend strategy invests in constant-maturity dividend claims if the respective measure of ex-ante risk premia is positive (Lintner-based, fundamental carry or analysts-based) at the beginning of the week, holds the position for one year, and invests in cash otherwise. This risk premium check is reiterated every week. If it is positive, a fraction equal to 1/52 of the overall exposure is invested for a holding period of one year. Hence, only if the risk premium check is positive for 52 consecutive weeks is the strategy fully invested. If estimated risk premia are negative in some weeks, the investment is in cash instead of the dividend strategy. Table 12 summarizes the resulting performance measures as well as the average fraction invested. The top three panels report statistics for dividend strategies using the three different measures of ex-ante risk premia, whereas the bottom panel reports results for the buy-and-hold (no conditioning) dividend strategies for the same time period (starting in 2007 since the conditional strategies could only be fully invested after 52 weeks and, thus, only then can we sensibly compare them to the buy-and-hold strategy). Interestingly, using fundamental carry as the conditioning variable leads to a substantial risk-adjusted outperformance of the conditional strategies over the buy-and-hold strategies. Moreover, these results extend the widely-cited findings of Koijen et al. (2015) along three dimensions: (i) Carry as applied in the present paper involves the difference between a macroeconomic variable (aggregated dividends) and a market price (of dividend derivatives); (ii) another asset class is added to the research focus on carry, namely traded dividend claims; (iii) and carry is applied to the time series of returns as opposed to the cross section.

5. Conclusion

Drawing on recent evidence in the literature that the term structure of equity risk premia might slope downwards, we use a proprietary dataset on dividend swaps in four regions to implement a simple investment strategy. We create systematic long positions in the dividend swap market and rebalance the portfolio in such a way that investors have a constant remaining maturity to a risky dividend payoff. We construct this strategy for each of the four regions for a one-year constant maturity

Table 12
Performance statistics for conditional strategies.

	CMDS 1			Benchmark			Fraction
	Mean	St. dev.	Sharpe	Mean	St. dev.	Sharpe	Invested
Conditional on risk premium from Lintner model							
Euro Stoxx 50	7.32	11.13	0.66	6.55	21.67	0.30	0.82
S&P 500	1.73	8.19	0.21	4.08	17.92	0.23	0.72
FTSE 100	5.39	10.33	0.52	5.67	19.74	0.29	1.00
Nikkei 225	8.02	10.63	0.75	5.09	19.75	0.26	0.75
Conditional on carry							
Euro Stoxx 50	7.55	5.67	1.33	7.90	13.23	0.60	0.56
S&P 500	1.40	3.91	0.36	2.67	8.23	0.32	0.17
FTSE 100	4.38	4.37	1.00	4.19	7.37	0.57	0.21
Nikkei 225	6.99	5.87	1.19	3.57	8.81	0.41	0.26
Conditional on risk premium from analyst forecasts							
Euro Stoxx 50	6.51	12.91	0.50	4.13	23.83	0.17	1.00
S&P 500	1.98	6.64	0.30	5.85	13.98	0.42	0.56
FTSE 100	5.73	9.82	0.58	6.16	19.15	0.32	0.94
Nikkei 225	7.98	10.61	0.75	4.36	19.75	0.22	0.79
Long only							
Euro Stoxx 50	6.49	12.92	0.50	4.08	23.86	0.17	1.00
SP 500	2.23	8.97	0.25	7.83	19.52	0.40	1.00
FTSE 100	5.38	10.35	0.52	5.67	19.77	0.29	1.00
Nikkei 225	9.70	12.02	0.81	6.06	23.56	0.26	1.00

This table provides mean excess returns (stated in %), volatility, Sharpe ratios and the average fraction of wealth invested in systematic dividend and index strategies. In the upper three panels, a positive estimated risk premium (based on the Lintner model, carry, or analyst forecasts, respectively) in week t increases the fraction of wealth invested over the next 52 weeks by $\frac{1}{52}$, while for a negative estimated risk premium this fraction is invested in the risk-free asset. In the lower panel, 100% is invested in the risky asset over the whole sample period. Presented results are based on data after availability of the first year of ex-ante risk premia estimates, i.e. for weeks ending Jan 12, 2007 to May 15, 2015.

and compare it to a benchmark strategy, which is a systematic long position in the underlying index. It turns out that the very short-maturity strategy outperforms the benchmark strategy in most regions on a risk-adjusted basis and in absolute terms. Moreover, we show that international correlations across regions are significantly lower for the short-maturity equity strategies than for the equity indices itself. Thus, we exploit the increased diversification benefits to construct an equally weighted global portfolio, which outperforms a traditional global equity portfolio in terms of the Sharpe ratio. To analyze whether international correlations increase in times of market distress we calculate conditional correlations, either conditioned on market returns or on a proxy for the macroeconomic environment. Correlations also increase for the short-maturity equity strategies; they remain substantially lower than for the benchmark strategies even in times of market stress, though.

Dividend payouts tend to evolve smoothly, if they fall short of a reference point; however, markets sell off disproportionately as shown by recent literature. Thus, to account for the possibility that observed excess returns of the dividend strategies are a pure risk premium for downside risk, we conduct regression analyses allowing for state-dependent market betas. We find that the systematic risk exposure to the underlying equity indices increases significantly if market returns are very negative. However, the short-maturity strategies generate significant intercepts for most regions and also for the global portfolio. As an alternative way to capture nonlinear risk exposures, we relate the returns of the short-maturity dividend strategies to risk factors derived from systematic put-writing strategies, an approach usually applied for hedge fund returns. Risk loadings on the options-based risk factors seem to capture a substantial amount of the risk-adjusted outperformance of our strategies, even after controlling for funding liquidity risk and market liquidity risk. Drawing on historical dividend data, we show that severe drawdowns in nominal dividends usually are associated with even more severe equity market drawdowns, mitigating the downside risk of short (constant) maturity equity strategies.

We present an approach to estimating implied risk premia corresponding to the short-maturity dividend strategies using a Lintner model for dividend policy and consensus analysts' forecasts for aggregate dividends and earnings. Alternatively, we use a carry-based measure for implied risk premia. These ex-ante risk premia spiked tremendously during the recent financial crisis. While they have come down in some markets, risk premia are still elevated in other markets. Over our sample implied risk premia are high, with median values between 1.7% and 12.1% and even higher magnitudes on average. Ex-ante risk premia also exhibit high volatility, indicating substantial time variation in expected returns of our strategies. Furthermore, we show that implied risk premia are significantly related to subsequently realized holding period returns of our strategies.

Our results support recent asset pricing models that imply a downward-sloping term structure of equity risk premia. Moreover, the results extend the empirical evidence gained from implementing investment strategies exposing investors to short-maturity dividend claims by trading in index options. A practical implication of our paper is that investors need to consider the optimal duration of equity portfolios, in addition to the selection of individual markets. This is similar to fixed income markets, where the optimal positioning on the yield curve is a central task of asset managers. As we show in this paper, expected returns on short-duration equity investments vary substantially over time, which suggests that the duration of equity portfolios should be adjusted periodically.

Appendix A. Additional robustness checks

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jempfin.2016.01.017.

References

Agarwal, V., Naik, N., 2004. Risk and portfolio decisions involving hedge funds. Re. Financ. Stud. 17 (1), 63–98.
Ai, H., Croce, M., Diercks, A., Li, K., 2013. Production-based term structure of equity returns. Working paper.
Ang, A., Chen, J., Xing, Y., 2006. Downside risk. Rev. Financ. Stud. 19 (4), 1191–1239.
Ang, A., Ulrich, M., 2012. Nominal bonds, real bonds, and equity. Working paper.
Asness, C., Moskowitz, T., Pedersen, L.H., 2013. Value and momentum everywhere. J. Financ. 68 (3), 929–985.
Backus, D., Boyarchenko, N., Chernov, M., 2015. Term structures of asset prices and returns. Working paper.
Baker, M., Mendel, B., Wurgler, J., 2015. Dividends as reference points: A behavioral signaling approach. Rev. Financ. Stud. (forthcoming).
Bansal, R., Yaron, A., 2004. Risks for the long run: A potential resolution of asset pricing puzzles. J. Financ. 59 (4), 1481–1509.
Belo, F., Goldstein, R., Collin-Dufresne, P., 2015. Dividend dynamics and the term structure of dividend strips. J. Financ. 70 (3), 1115–1160.
Binsbergen, J.H.v., Brandt, M., Koijen, R., 2012. On the timing and pricing of dividends. Am. Econ. Rev. 102 (4), 1596–1618.
Binsbergen, J.H.v., Hueskes, W., Koijen, R., Vrugt, E.B., 2013. Equity yields. J. Financ. Econ. 110 (3), 503–519.
Binsbergen, J.H.v., Koijen, R., 2015. The term structure of returns: Facts and theory. Working paper.
Boguth, O., Carlson, M., Fisher, A., Simutin, M., 2013. Leverage and the limits of arbitrage pricing: Implications for dividend strips and the term structure of equity risk premia. Working paper.
Boguth, O., Carlson, M., Fisher, A., Simutin, M., 2015. Horizon effects in average returns: The role of slow information diffusion. Rev. Financ. Stud. forthcoming.
Brennan, M., 1998. Stripping the S&P 500 index. Financ. Anal. J. 54 (1), 12–22.
Campa, J.M., Fernandes, N., 2006. Sources of gains from international portfolio diversification. J. Empir. Financ. 13 (45), 417–443. ISSN 0927-5398.
Campbell, J., Cochrane, J., 1999. By force of habit: A consumption-based explanation of aggregate stock market behavior. J. Polit. Econ. 107 (2), 205–251.
Croce, M., Lettau, M., Ludvigson, Sydney, 2015. Investor information, long-run risk, and the term structure of equity. Rev. Financ. Stud. 28 (3), 706–742.
Derwall, J., Huij, J., de Zwart, G., 2009. The short-term corporate bond anomaly. Working paper.
Dimson, E., 1979. Risk measurement when shares are subject to infrequent trading. J.Financ. Econ. 7 (2), 197–226.
Dobrynskaya, V., 2014. Downside market risk of carry trades. Rev. Financ. 18 (5), 1885–1913.
Duffee, G., 2010. Sharpe ratios in term structure models. Working paper.
Erb, C., Harvey, C., Viskanta, T., 1994. Forecasting international equity correlations. Financ. Anal. J. 50 (6), 32–45.
Ferson, W.E., Schadt, R.W., 1996. Measuring fund strategy and performance in changing economic conditions. J. Financ. 51 (2), 425–461.
Fung, W., Hsieh, D., 2001. The risk in hedge fund strategies: theory and evidence from trend followers. Rev. Financ. Stud. 14 (2), 313–341.
Gabaix, X., 2012. Variable rare disasters: an exactly solved framework for ten puzzles in macro-finance. Q. J. Econ. 127 (2), 645–700.
Garrett, I., Priestley, R., 2000. Dividend behavior and dividend signaling. J. Financ. Quant. Anal. 35 (2), 173–189.
Hasbrouck, J., 2009. Trading costs and returns for U.S. equities: estimating effective costs from daily data. J. Financ. 64 (3), 1445–1477. ISSN 00221082.
Henriksson, R.D., Merton, R.C., 1981. On market timing and investment performance. J. Bus. 54 (4), 513–533. ISSN 00219398.
Herold, U., Maurer, R., Purschaker, N., 2005. Total return fixed-income portfolio management. J. Portf. Manag. 31 (3), 32–43. ISSN 00954918.
Jagannathan, R., Korajczyk, R.A., 1986. Assessing the market timing performance of managed portfolios. J. Bus. 59 (2), 217–235. ISSN 00219398.
Jennrich, Robert, 1970. An asymptotic χ^2 test for the equality of two correlation matrices. J. Am. Stat. Assoc. 65 (330), 904–912.
Koijen, R., Moskowitz, T., Pedersen, L., Vrugt, E., 2015. Carry. Working paper.
Lambrecht, B.M., Myers, S.C., 2012. A Lintner model of payout and managerial rents. J. Financ. 67 (5), 1761–1810. ISSN 00221082.
Lettau, M., Maggiori, M., Weber, M., 2014. Conditional risk premia in currency markets and other asset classes. J. Financ. Econ. 114 (2), 197–225.
Lettau, M., Wachter, J., 2007. Why is long-horizon equity less risky? A duration-based explanation of the value premium. J. Financ. 62 (1), 55–92.
Lintner, J., 1956. Distribution of incomes of corporations among dividends, retained earnings, and taxes. Am. Econ. Rev. 46 (2), 97–113. ISSN 00028282.
Manley, R., Mueller-Glissmann, C., 2008. The market for dividends and related investment strategies. Financ. Anayl. J. 64 (3), 17–29.
Marfe, R., 2013. Labor relations, endogenous dividends and the equilibrium term structure of equity. Working paper.
Mitchell, M., Pulvino, T., 2001. Characteristics of risk and return in risk arbitrage. J. Financ. 56 (6), 2135–2175.
Mixon, S., Onur, E., 2014. Dividend swaps and dividend futures: state of play. Working paper.
Roll, R., 1984. A simple implicit measure of the effective bid-ask spread in an efficient market. J. Financ. 39 (4), 1127–1139. ISSN 00221082.
Schneider, P., Wagner, C., Zechner, J., 2015. Low risk anomalies? Working paper.
Schulz, F., 2015. On the Timing and pricing of dividends: comment. Am. Econ. Rev. forthcoming.
Skinner, D., 2008. The evolving relation between earnings, dividends, and stock repurchases. J. Financ. Econ. 87 (1), 582–609.
Wilkens, S., Wimschulte, J., 2010. The pricing of dividend futures in the European market: a first empirical analysis. J. Derivatives Hedge Funds 16 (16), 136–143.