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Abstract

In this paper I present a simple stock price decomposition model using the dividend discount model and dividend futures. The main contribution of this paper is the use of dividend futures which represent the risk-adjusted expectations of future dividends. This allows for the calculation of the implied equity risk premium and the decomposition of stock price movements into individual components. Due to the use of daily market data, this method can take into account the structural changes associated with falling interest rates and the Covid-19 pandemic. I empirically show the risk premium development of the S&P 500 Index and Euro Stoxx 50 Index in the last decade.

Abstrakt

V tomto článku představuji jednoduchý model dekompozice cen akcií s využitím dividendového diskontního modelu a dividendových futures. Hlavním přínosem článku je použití dividendových futures, které představují rizikově očištěná očekávání ohledně budoucích dividend. To umožňuje výpočet implikované akciové rizikové prémie a dekompozici vývoje cen akcií do jednotlivých složek. Díky využití tržních dat s denní frekvencí může tato metoda zohlednit strukturální změny spojené s klesajícími úrokovými sazbami a pandemií COVID-19. Empiricky ukazuji vývoj rizikových prémií akciových indexů S&P 500 a Euro Stoxx 50 v posledním desetiletí.

JEL Codes: G12, G41.
Keywords: Asset prices, dividend futures, risk premium.

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1. Introduction

It is generally accepted that equity prices represent the present value of all future dividends.[1] The assumption of discounted dividend valuation is applied in some form or other in all the best known textbook models used for the valuation of individual companies, whether it is the Gordon model or the Free Cash Flow model. The advantage of these types of models is their explicitly forward-looking nature. A disadvantage is the existence of a large number of free variables and an excessive use of expert judgment (Mauboussin et al., 2021).

The studies conducted by academic economists often focus on stock indices as a whole rather than on individual companies. These studies frequently center on the relationship between dividends (earnings) and price, often referred to as the Campbell-Shiller decomposition (Campbell and Shiller, 1988). This decomposition indicates the existence of co-integration relations between these variables. Alternatively, the co-integration assumptions are implicitly built into the model, and their predictive powers are investigated. The different regressions with market ratios such as P/D, P/E, P/S and CAPE are examples of this approach. Although I do not question the existence of co-integration relations, it is possible that the decline in the term structure of interest rates, especially in the last ten years, has led to a structural change in these ratios. Thus, these variables cannot take into account the forward-looking nature of prices, and it is necessary to use different approaches to explain price movements.

This paper contributes to the existing literature by augmenting a simple dividend discount model with dividend futures. This framework allows me to use forward-looking variables with predictive power regarding future developments. This approach also allows for the use of non-deflated and daily data and makes it possible to measure the time-varying equity risk premium of investors in the model. For this reason, this study does not focus on excess returns or overvaluation, but rather on a structural interpretation of price movements, with an emphasis on the changing perception of risk. Overall, this approach can provide useful information about future risks and allows for a narrative-based approach which explains movements in the stock market and even the calibration of possible stress test scenarios. It relates to Brennan (1998) which argues that a market for dividend derivatives would promote rational pricing in stock markets.

The rest of this paper is structured as follows: In section 2, I present the existing literature on the equity risk premium. I then present a combination of the dividend discount model and dividend futures from a theoretical perspective. Finally, in sections 4 and 5, I perform an empirical analysis and calculate the implied risk premiums for the Euro Stoxx 50 and S&P 500 indices.

2. Literature Review

The topic of this study is similar to the innovative work of Shiller (1981) who focused on excessive price volatility and the fundamental stock price and its derivation through realized dividends. This paper is based on several studies which focus explicitly on explaining the level of stock indices (Barsky and De Long (1993), Panigirtzoglou and Scammell (2005), Inkinen et al. (2010) and Andrle (2019)). The focus of these studies is to explain the level of the given indices using the Dividend Discount Model and market analysts' predictions of future earnings and dividends. The studies also (at least implicitly) highlight the extrapolative nature of market analysts' expectations that influence price at a given moment. Moreover, although a given price may seem overvalued in hindsight, it may correspond to a rational valuation at a given moment. These studies also provide

[1] At least in the long run when we do not allow for the existence of infinitely growing bubbles.

estimates of the equity risk premium implied by their models, which is a proxy for market sentiment and an "irrational" component of valuation. Overall, the literature on estimating risk premium is relatively sparse and centers mainly on practical valuation. A good summary on the estimation of risk premium is presented by Damodaran (2020), Duarte and Rosa (2015) and Fernandez (2007), whose studies also mention two other commonly used methods for determining risk premium. First, a historical method based on real excess price returns relative to bond returns and, second, regressions models which often use the Fama-French decomposition (Fama and French, 1995) to calculate the market risk premium.

Studies also have been conducted in other research fields using option prices and the Breeden and Litzenberger (1978) methodology to determine the risk premium and market expectations. As in this paper, these studies use the pricing kernel and risk-neutral densities to determine the risk premium. The main problem of this approach is the need for strong implicit assumptions regarding the behavior of the model. For example, constraints are placed on the utility function parameters or the development of state prices. Existing studies usually assume that the subjective density distribution is equal to the realized historical distribution (Ait-Sahalia and Lo (1998), Jackwerth (2000), Liu et al. (2007), Rosenberg and Engle (2000)). A different approach is presented in a study by Bliss and Panigirtzoglou (2004), where the authors use risk-neutral densities and a specific form of the pricing kernel to derive the risk aversion coefficient. Another approach is put forward by Ross (2011), where he does not place an explicit constraint on the utility function but on the state price process itself. The approach presented in this paper is considerably more straightforward and although it places a constraint on the pricing kernel and other variables, these constraints are explicit and much simpler to interpret.

Gormsen and Koijen (2020) puts forward a different approach which is loosely related to risk premium. He uses the development of dividend futures contracts to show investor expectations regarding the development of the stock market and the economy. This approach is based on the idea that dividend futures represent risk-adjusted expectations that are quoted on daily basis.

3. Model Formulation

In this section, I present a general framework for the decomposition of the stock price into individual components S_t^1, S_t^2, S_t^3. The first stage represents the expected dividends calculated from dividend futures. The other two stages represent the final value of the index, which consists of the steady-state values and the convergence to them. The general framework presented below allows for the decomposition of the price with respect to its individual stages. However, as emphasized above, the main advantage of this framework is that it makes it possible to calculate the implied equity risk premium.

I build on the three-stage dividend discount model by Fuller and Hsia (1984), a simple model which allows me to use as much data as possible. The novelty of this study, compared to others, is its use of dividend futures following the example of Gormsen and Koijen (2020). These futures are quoted daily and represent risk-adjusted expectations regarding future dividends. The model can be written as follows:

$$P_t = \sum_{n=1}^{\infty} E_t^p M_{t+n|t} \, DIV_{t+n|t} = S_t^1 + S_t^2 + S_t^3 \tag{1}$$

Equation 1 represents the general dividend discounted model, i.e. the price P_t at time t is expressed as the expected infinite discounted sum of future dividends $DIV_{t+n|t}$ modified by the pricing kernel $M_{t+n|t}$. I wish to emphasize that the pricing kernel does not correspond to the risk-free rate, as it involves the risk perceptions of investors, i.e., it consists of risk-free rates and an equity risk premium.[2] E_t^p denotes the expectations with respect to the probability measure p at time t, representing the subjective probability of future developments as perceived by the individual investors. I decompose Equation 1 into three stages, which I refer to as S_t^i with $i = (1,2,3)$.

The model assumes the existence of a balanced growth path to which all variables in the model converge. In other words, a representative investor assumes the existence of the steady-state values of nominal interest rates $i_{long|t}$ and the growth rate of the stock index $g_{long|t}$.

Stage 1 of the model represents the discounted sum of dividends up to time N-1, where N-1 represents the time of the last quoted dividend future.

$$S_t^1 = \sum_{n=1}^{N-1} \frac{FUTURE_{t+n|t}}{(1+i_{t+n|t})^n} = \sum_{n=1}^{N-1} E_t^p \frac{DIV_{t+n|t}}{(1+rp_t+i_{t+n|t})^n} \tag{2}$$

The calculation itself then proceeds as follows: Stage 1 is calculated directly from dividend futures $FUTURE_{t+n|t}$, where the subscript indicates the price of the dividend future with maturity at time $t+n$ and at time t. I use the no-arbitrage condition between the present value dividend (specifically dividend strip) and the future price (van Binsbergen et al., 2011). Also note that the present value of dividends can be expressed using a pricing kernel as in the equation 1. The no-arbitrage condition can be written as follows:

$$E_t^p M_{t+n|t}\, DIV_{t+n|t} = E_t^p \frac{DIV_{t+n|t}}{(1+rp_t+i_{t+n|t})^n} = \frac{FUTURE_{t+n|t}}{(1+i_{t+n|t})^n} \tag{3}$$

I assume a specific form of the pricing kernel that can be expressed using the spot risk-free yield curve and the equity risk premium. The equity risk premium is assumed to be constant at different maturities, i.e., the equity risk premium is fixed across periods within a single valuation, but it varies across valuations computed at a different t. This also implicitly postulates that the liquidity premium is only included in the yield curve. Although this is a significant simplification, it allows for a numerically tractable risk premium calculation. Alternatively, I argue that this computed equity risk premium represents a weighted average of the different equity risk premiums at different maturities.

Stage 2 represents the interpolation between the steady state value and the last quoted dividend future. A 6–10 year convergence period is most commonly used in the literature, but the length of this convergence period is often chosen arbitrarily (Damodaran, 2020). I decided on a total of 20 years (L-1), including the first stage. I selected this duration because I see the possibility of using a larger part of the yield curve as an advantage.[3] Stage 2 is calculated as follows:

$$S_t^2 = \sum_{n=N}^{L-1} E_t^p \frac{(1+g_{n|t})DIV_{t+N-1|t}}{(1+rp_t+i_{t+n|t})^n} \tag{4}$$

[2] Both components are considered to be time-varying.

[3] Alternatively, I can present my arguments using the average duration of the financial cycle (Drehmann et al., 2012).

The time-varying equity risk premium is still maintained in the pricing kernel. $DIV_{t+N-1|t}$ represents the last dividend from the previous stage. $g_{n|t}$ represents the growth rate of dividends, which is computed as a linear interpolation between steady-state growth $g_{long|t}$ and the last future-implied dividend growth rate. Interpolation can be written as follows, where $g_{N-1|t}$ is the ratio of the last two implied dividends, i.e., $\frac{DIV_{t+N-1|t}}{DIV_{t+N-2|t}}$.

$$g_{n|t}{=}g_{N-1|t} + (g_{long|t} - g_{N-1|t}) \left(\frac{n-N-1}{L-N} \right) \tag{5}$$

Stage 3 represents the steady-state stage. I use a perpetuity formula (i.e., the sum of infinite geometric sequences) with constant dividend growth and a constant risk-free interest rate. The intuition behind this formula is the same as that behind textbook Gordon model, where the terminal price is determined by the difference between the growth rate and the discount factor on condition that the growth rate does not exceed the discount factor.

$$S_t^3 = \sum_{n=L}^{\infty} DIV_{t+L-1|t} \frac{(1+g_{long|t})^{n-L+1}}{(1+i_{long|t}+rp_t)^{n+1}} = \frac{DIV_{t+L-1|t}(1+g_{long|t})}{(1+i_{long|t}+rp_t)^{L-1}(i_{long|t}+rp_t-g_{long|t})} \tag{6}$$

$g_{long|t}$ and $i_{long|t}$ denote the steady-state nominal growth rate of the economy and the steady-state interest rate respectively. Regarding the calibration of the long-term interest rate parameter, I use the long end of the yield curve as a proxy for $i_{long|t}$. Furthermore, I continue to maintain the time-varying equity risk premium rp_t.

The main idea behind calibration $g_{long|t}$ is that dividends will eventually grow as fast as the whole economy (Damodaran, 2020), but the expected growth of the economy is also unknown. I primarily do not use the historical growth rate because market interest rates are used. This would lead to a methodological dichotomy between a forward-looking and historical approach.[4] For this reason, long-term growth is approximated by the yield curve. To mitigate short term fluctuations, I use an annual moving average.[5] This approach is proposed, for example, in Damodaran (2020). An optimal growth model (Ramsey, 1928) can be used to show that interest rates should always be higher than the growth rate of the economy, assuming a dynamically efficient economy. In reality, interest rates are often lower than the growth rate and the average spread can be added to compensate for this (see Blanchard and Weil (1992)). Note that this will not significantly change the model-implied dynamics of the equity risk premium; it will mainly change its overall level.

Alternatively, Panigirtzoglou and Scammell (2005) state that the growth rate in a steady state is equal to Return on Equity (*ROE*) minus the payout ratio (*b*), i.e., in a steady state, there is no excess return above the required rate of return.

$$g_{long|t} = ROE\,(1-b) = (rp_t + i_{long|t})(1-b) \tag{7}$$

The payout ratio b is assumed to be constant and can be determined as the historical ratio of dividends to earnings, which is approximately 50% based on historical data. The problem with this approach is the counter-intuitive development of long-term growth as it reaches its highest values during market crash periods.

[4] From a purely practical point of view, we require a non-infinite terminal price, i.e., $g_{long|t} > i_{long|t} + rp_t$.

[5] These rates are remarkably similar to the Holston et al. (2017) estimate of the natural interest rate with an added inflation target based on the Taylor rule.

Finally, following the example of Barsky and De Long (1993), I also assume extrapolative expectations regarding long-term future dividend growth. This is achieved assuming that steady-state dividend growth can be approximately expressed as an Exponentially Weighted Moving Average (EWMA) of the difference in log-dividends:

$$g_{long|t} = (1-\lambda)(\sum_{n=0}^{N-1} \lambda^n \Delta \ln E_t^p DIV_{t+N-1-n|t}) + \lambda^{N-1} g_0 \quad (8)$$

Intuitively, long term growth is the geometric average of past and expected dividend growth when investors use the whole information set. λ denotes the smoothing parameter and g_0 denotes the initial growth trend which can represent, for example, actual historical dividend growth. The equation illustrates that dividends behave like an integrated moving average process of order (1, 1), i.e., the series can be decomposed into permanent shocks and transitory shocks. This also implies that the extrapolative expectations are the same as the rational ones.

This calculation of S_t^i and rp_t consists of a set of simultaneous equations. These are n equations for each $FUTURE_{t+n|t}$ and one equation for the price P_t. For example, in the case of 11 futures, there are 11 equations and 11 unknowns (the equity risk premium and implied dividend for the first 10 years). However, due to the nonlinearity of the equations, we are forced to resort to numerical optimization. Specifically, I implemented Broyden's method (Broyden, 1965). Alternatively, the model can be used to conduct a sensitivity analysis, for example, to find a long-term value of rp_t. The actual value can then be compared with the model-derived price which can serve as a proxy for a through-the-cycle valuation.

4. Data

I performed the calculation using daily data from the S&P 500 Index and the Euro Stoxx 50 Index from 2016 – February 2021 or, where applicable, from 2013 – February 2021.[6] The data used are the dividend futures of the given index, the US and EUR IRS yield curves, and the price of the given index. In the case of the broadest US index, the S&P 500, dividend futures are quoted for up to 11 years.[7] In the case of the Euro Stoxx 50 Index, they are quoted for up to 10 years. The main disadvantage of the approach presented in this paper is the relative novelty of dividend futures. As a result, the analysis is performed only for a period of slightly over four years, or six years in the case of the latter. Furthermore, due to the novelty of dividend futures, some mispricing may occur, especially at the beginning of trading (Wilkens and Wimschulte, 2009).

I use cubic spline interpolation on dividend futures. This is because futures are quoted on a specific date in December, and interpolation is needed to maintain the same maturity, although the future prices themselves are quoted daily. In other words, I am creating a dividend yield curve for easier data manipulation.[8] I also interpolate the yield curve using the standard NSS model (Svensson, 1994). In both cases, I use IRS data for a period of one month to 20 years.[9] All data were obtained from the Bloomberg terminal.

[6] Dividend futures are also listed for individual companies. In the case of large indices, dividend futures for the FTSE and Nikkei are also available.

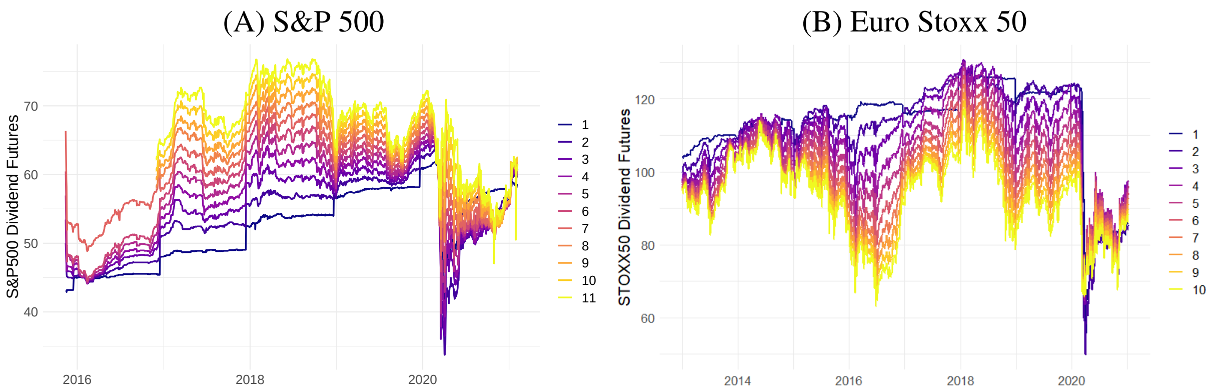
[7] This has been the case since December 2017.

[8] Other interpolation methods such as NSS or linear interpolation did not have a significant effect on results.

[9] I also use treasury data in my estimations, as there is no universally agreed benchmark for Europe. Nevertheless, this did not have a significant effect on the results.

As regards dividend futures, Figure 1 show their development in the period under review. Sharp transitions are due to the elimination of a matured dividend future and the inclusion of a new one. Note in particular the different dynamics between the European and US indices. The S&P 500 Index is characterized by rising dividend futures, while in the case of the Euro Stoxx 50 Index, dividend futures are mostly in backwardation. The question is to what extent this is due to the influence of institutional investors who may be hedging their position by selling dividend futures (Mixon and Onur, 2014). It is crucial to remember that these are dividend futures, and the expected dividends, according to Equation 2, can increase with maturity due to the discount factor. Nevertheless, it can be said that very similar trends have been observed for dividend futures of all maturities in the period up to 2020. I would also like to emphasize the variability in the perception of the growth rate implied by dividend futures.

Figure 1: Dividend Futures



Note: Numbers represent different dividend futures contracts by maturity.
Source: Author's calculation, Bloomberg

I use the end of the yield curve for the long-run interest rate for the steady-state parameter values. In the case of $g_{long|t}$, which expresses potential growth, I use the same value as that used for the long-term interest rate smoothed by the annual moving average, with an additional 50 basis points representing the average historical spread. Alternatively, I use the endogenous long-term growth rate defined in Equation 7 and Equation 8, where lambda is equal to 0.97 as in Barsky and De Long (1993), and g_0 is equal to 4%, which reflects historical dividend growth. Regarding the length of the individual stages, I decided to use all the available dividend futures, although a higher equity risk premium may be observed due to lower liquidity, especially for later futures. Regarding the price decomposition into individual stages, S_t^1 represents a component of the price for an 11-year period in the case of the S&P 500 Index and 10 years in the case of Euro Stoxx 50 Index. S_t^2 represents a price component for 12–20 years or, in the case of the latter, 13–20 years, and S_t^3 represents a price component from the 21^{st} year to infinity.

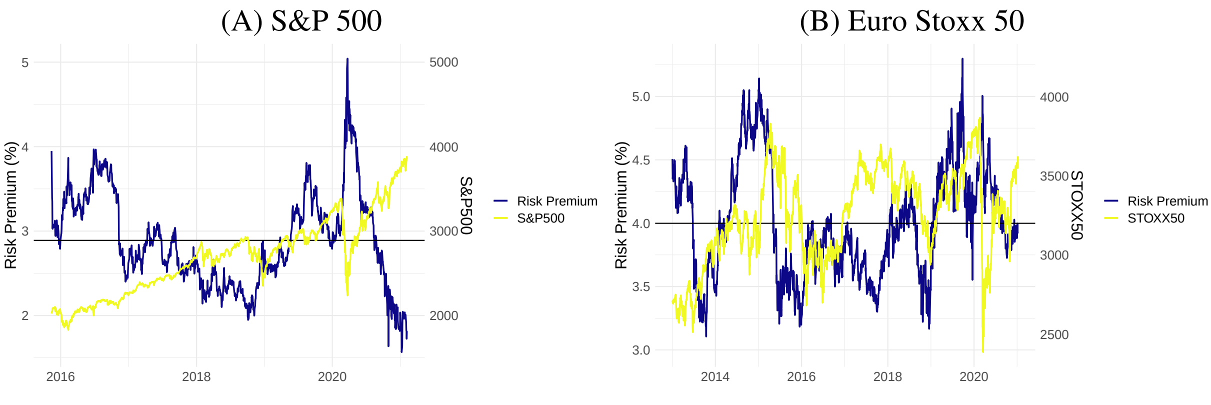
5. Empirical Results

Figure 2 shows the relationship between the calculated equity risk premium and the development of the S&P 500 Index. The model clearly identified the first half of 2020 as a period of increased equity risk premium owing to the Covid-19 pandemic. Increased uncertainty can also be observed in 2016, which is again in line with the price development of the index and may be related to Brexit and the US election. The decline in the years that followed may have been related to optimism generated by the Trump administration's tax cuts. The average level of the equity risk premium is approximately 3%, which is similar to Andrle (2019) and approximately two percentage points lower than in Damodaran (2020), as is shown in Figure A1, although it can be observed that the development itself is almost identical. The differences in the level of equity risk premium are due mainly to different steady-state growth assumptions and data sources used for expected dividends, as dividend futures imply lower dividend growth than indicated in surveys.

In the case of the Euro Stoxx 50 Index, the equity risk premium is relatively higher and a little less volatile than in the previous case (see Figure 2, panel B). This is caused by lower interest rates and the assumption regarding the estimation of long-term growth. Generally speaking, the lower interest rates would indicate less discounting in the future. However, this is offset by a higher equity risk premium. The average level of the equity risk premium is approximately 4%. One can also notice that in both cases the equity risk premium is highly persistent, with the first autocorrelation lag close to unity.

As a robustness analysis, Figure A2 (panel B) shows a sensitivity analysis regarding an alternative terminal dividend growth rate in the case of the S&P 500 Index (see Appendix A). It can be seen that both alternative specification models produce very similar results to the primary model in terms of the equity risk premium, although the level may differ. However, it should be noted that the two alternative models, both of which use endogenous and extrapolative growth rates, imply excessive and counter-intuitive volatility of the growth rate, especially during the pandemic, as shown in Figure A2 (panel A). On the other hand, robustness checks of the Euro Stoxx 50 Index show that the risk premium is gradually increasing over time, contrary to the baseline specification (Figure A3). This is probably due to a decline in interest rates associated with an only slight increase in the index. A possible explanation for this is that an increase in the risk premium offsets the decrease in interest rates. This would suggest that investors are using a nominal return benchmark rather than an excess return benchmark. Nevertheless, the equity risk premium still shows a very similar development to that observed in previous cases.

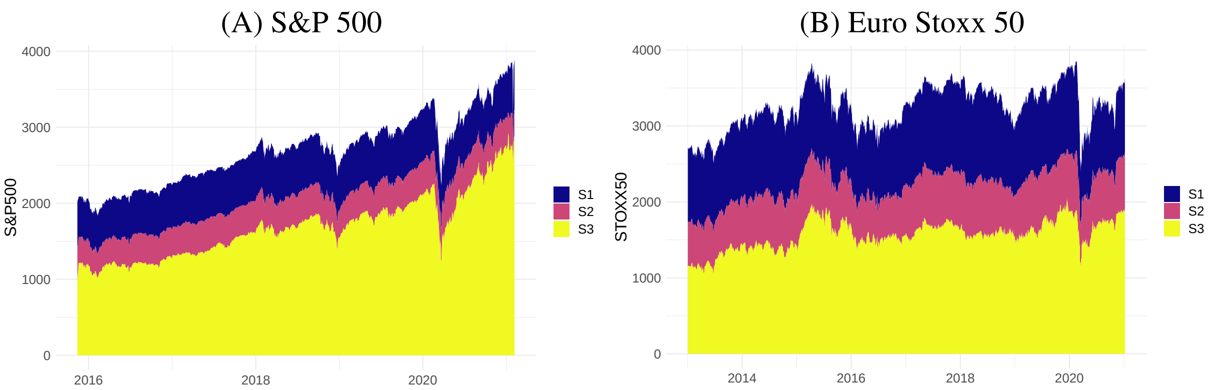
Figure 2: Implied Equity Risk Premium



Note: The black line represents the average equity risk premium over the whole sample.
Source: Author's calculation, Bloomberg

Furthermore, I show the decomposition of the indices into individual stages. S_t^1 is given directly by dividend futures. S_t^1 and S_t^2 together form the sum of the present value of expected dividends in the next 20 years and, as we can see in both cases, this represents less than one half of the total price of the index. In the case of the S&P 500 Index, most of its value is formed by the S_t^3 as can be seen in Figure 3. I should point out that this stage represents the discounted sum of future dividends twenty and more years into the future and, as such, is associated with the most significant level of uncertainty. It should also be noted that this stage was the main driver in the growth of this index in 2020. This was mainly due to the flattening of the yield curve and a decrease in the risk premium. In the case of the Euro Stoxx 50 Index, a much higher value is implied in the first 20 years, as can be seen in Figure 3. This would suggest a much more pessimistic view of the future and a higher risk aversion on the part of investors. Generally speaking, dividend payouts are usually higher in Europe, while many companies in the US do not pay dividends or keep the payout ratio low. Also one can notice that changes during the peak of the Covid-19 pandemic were driven mainly by S_t^1.

Figure 3: Index Decomposition by Stage



Source: Author's calculation, Bloomberg

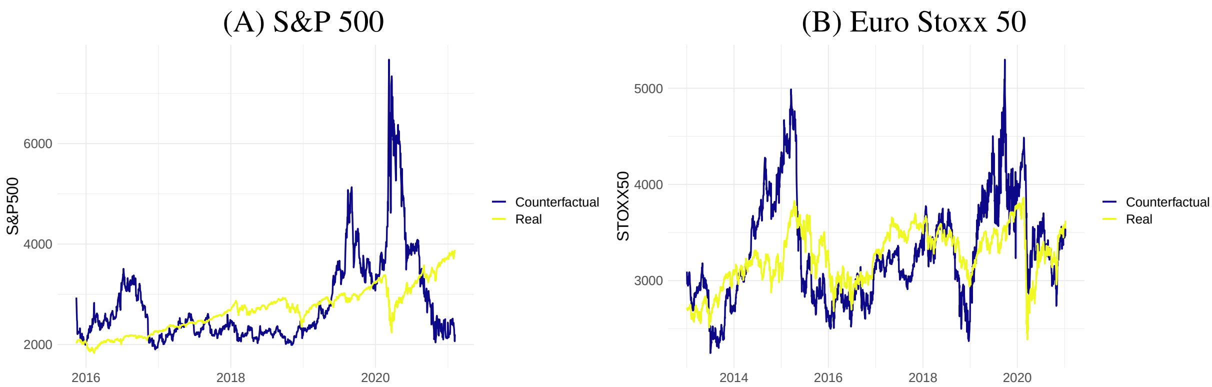
5.1 Counterfactual Analysis

Given the relative simplicity of the model, it is easy to perform counterfactual simulations. This is done by changing only a specific component of the model. All else being equal, this shows a hypothetical development. It should be noted that I do not claim these to be predictions, given the undoubted correlation of all the components. For example, a decline in the term structure of interest rates is an endogenous response of the system to the decline in the real economy and the growth of risk aversion.

Figure 4 (panel A) shows the theoretical development of the S&P 500 Index, assuming that the risk premium is constant (in this case the average value over the entire sample). The development of all the other factors is consistent with reality. Notice the extreme price hikes during the Covid-19 pandemic, caused by the sharp decline in the entire yield curve. The following development during 2020 was mainly driven by the decline in dividend futures in combination with a slight increase in the yield curve. This is a clear indicator of the prevailing optimistic market sentiment because the risk premium was basically the only source of index growth in the given period. Considered in more detail, the risk premium is the only part of the model which is not fundamentally linked to the real economy but expresses the required investor mark-up for risk and can be irrational. This notwithstanding, the assurance of policymakers that they will do their utmost to maintain the functioning of the market cannot be considered purely irrational.

Figure 4 (panel B) shows a simulation with a constant risk premium for the Euro Stoxx 50 Index. Figure 4 also illustrates that there was a significant increase in the index in 2016 due to the decline in the overall interest rate structure. In the context of the Covid-19 pandemic, the theoretical development is similar to the reality of the situation. This is probably due to the monetary authority's limited ability to react, as interest rates were already unprecedentedly low even before the Covid-19 pandemic. Another factor is a more stable development of the risk premium which prevented a more significant drop in prices at the beginning of the pandemic but also prevented higher growth.

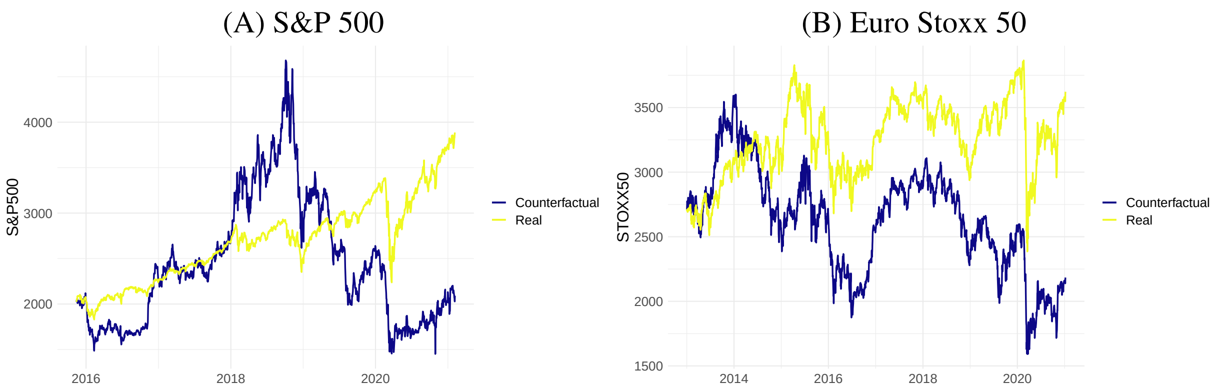
Figure 4: Counterfactual Simulation I



Note: The The equity risk premium is fixed at the average value over the sample period.
Source: Author's calculation, Bloomberg

Next, I show the theoretical development of the S&P 500 and Euro Stoxx 50 indices while maintaining a fixed yield curve and keeping the other components time-varying, as in reality. Figure 5 support the general view that falling interest rates are one of the main contributors to the growth of the above indices. In the case of the S&P 500 Index, lowering interest rates has significantly boosted index growth since 2019, and especially at the beginning of the Covid-19 pandemic. In the case of the Euro Stoxx 50 Index, this is true for the whole period under review; otherwise, the index would be declining without falling interest rates.

Figure 5: Counterfactual Simulation II



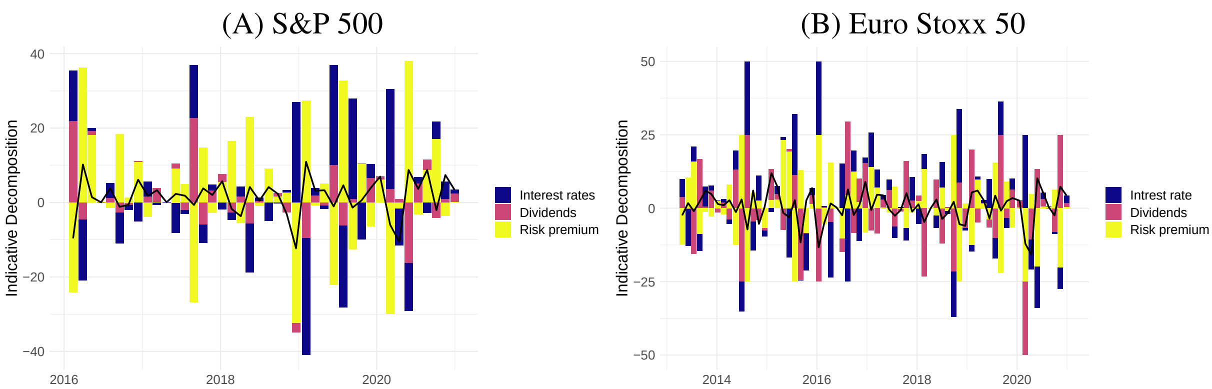
Note: The yield curve is fixed at the beginning of the sample period.
Source: Author's calculation, Bloomberg

Finally, I also focus on changes in the level of the given indices. Due to non-linearity, I cannot calculate individual percentage contributions. For this reason, I performed indicative decomposition using the results of the individual counterfactual analyses. This decomposition is calculated as follows: two variables are kept fixed at their values from the previous period (month) and one is maintained at real value in the given period. I recognize three primary drivers (variables) behind price movements. These variables are: change in the yield curve, change in expected dividends (dividend futures), and change in the risk premium. These three changes do not correspond to a real change in the index due to non-linearity, and for that reason, I decided to re-scale them to match real change. Alternatively, I calculated decomposition using the regression of monthly index changes on the principal components of dividend futures, the yield curve, and the risk premium (Appendix A). I use Principal Component Analysis decomposition to reduce the number of factors and allow for a more straightforward interpretation of the results; generally, the results are similar to those obtained using indicative decomposition (Figure A4).

Figures 6 show the decomposition of the monthly changes into individual components. The black line represents the real monthly change in the given index and the bars represent the counterfactual analysis results. Figure 6 (panel A) indicates that the most positive returns were as a result of low-risk premiums and that change in expected dividends had only a limited effect on positive returns. Figure 6 also confirms my previous intuition regarding the Covid-19 pandemic when the initial shock in 2020 Q1 was caused mainly by an increase in the equity risk premium and mitigated by a decrease in interest rates (similar to what occurred in the 2016 stock market selloff). However, there was a revision in dividend futures in the period that followed, i.e., expected dividends have been falling since March 2020, but the decline in the risk premium outweighs this decrease.

Euro Stoxx 50 Figure 6 (panel B) illustrates the limited effect of the equity risk premium in the pandemic; this is probably due to the increased equity risk premium level even before the pandemic. However, dividend expectations have changed significantly during this period. Also, the yield curve's counter-cyclical movement during this period, although smaller than in the previous case, is also illustrated. Moreover, we can also observe higher dividend volatility than in the previous case, which seems to be an important driver of price changes.

Figure 6: Indicative Decomposition



Note: The black line represents the nominal monthly percentage change of the given index.
Source: Author's calculation, Bloomberg

6. Conclusion

In this paper, I present a simple way of extracting the implied equity risk premium using the dividend discount model and the equity index dividend futures. The main contribution of this paper is the use of dividend futures which represent the risk-adjusted expectations of future dividends. This approach allows for the computation of the equity risk premium on a daily basis and, as such, can serve as another indicator for measuring market sentiment which provides an easy-to-understand interpretation. This is due to the fact that risk premium is the only part of the model which is not fundamentally linked to the real economy but expresses the required investor mark-up for risk.

However, it is still important to realize that the equity risk premium calculated in this way is residual and, much like "Solow residual," is a measure of our ignorance regarding the stock market.

The study empirically shows the development of the equity risk premium in the S&P 500 and Euro Stoxx 50 markets in the last decade using daily data. I can use this model to show the period of the Covid-19 pandemic and Brexit, and the immediate reaction of the investor risk premium to this period, as implied by the model. I illustrate the high variability of the equity risk premium – one of the main drivers of price development – during the period under review. I also show the importance of a time-varying structure of interest rates on price development. Furthermore, I present different sensitivity scenarios of alternative stock market developments using counterfactual analyses. These scenarios illustrate the impact of individual model components on the final price, including the importance of monetary policy decisions.

Overall, the study allows for a better structural interpretation of price movements which can be used, for example, to calibrate stress tests or other sensitivity analyses in relation to stock prices. In the context of financial stability, central banks and other policymakers should not be concerned with forecasting market developments per se but should be aware of the sources of price movements and the potential risks arising from them. Specifically, the presented model can be used for modeling stock market indices under various adverse scenarios, as it offers a possibility to base future projections on easy-to-understand economic narratives.

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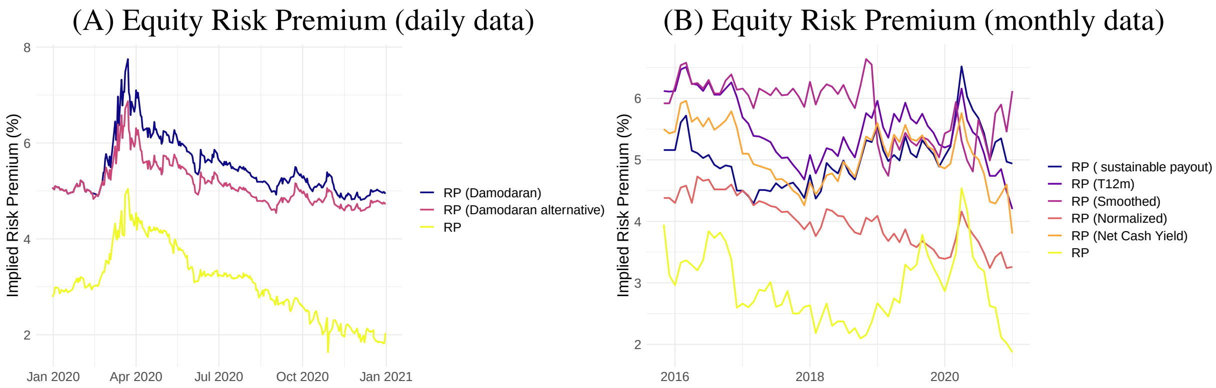
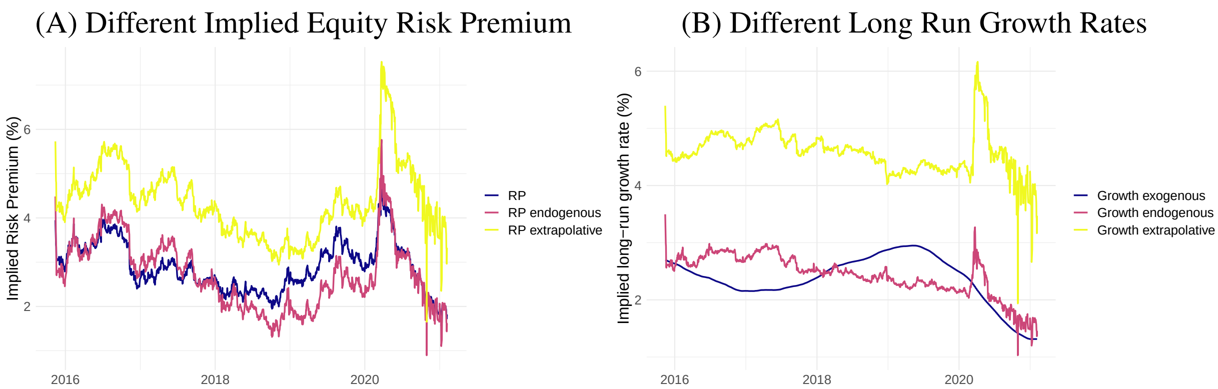
Appendix A: Robustness Checks

Figure A1: S&P500 Implied Equity Risk Premium Comparison



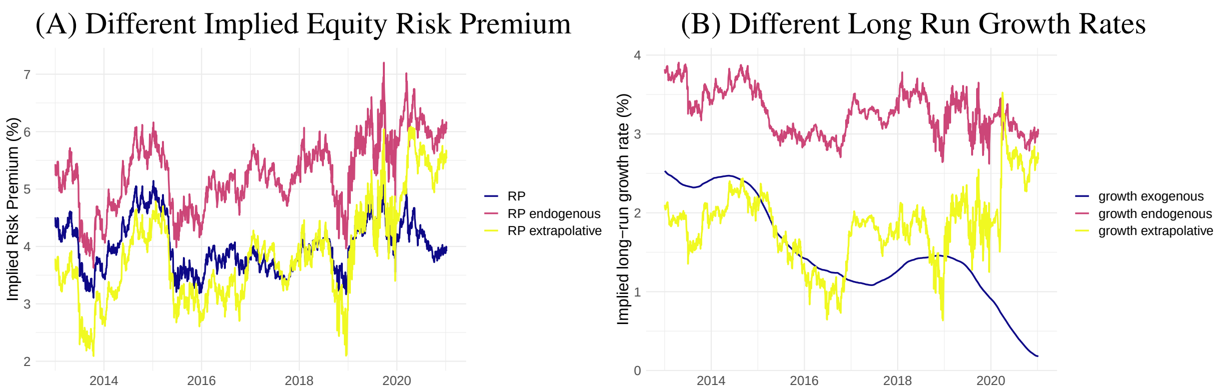
Note: The yellow line represents Implied Equity Risk Premium calculated in this paper.
Source: Author's calculation, Bloomberg, Aswath Damodaran web page (http://pages.stern.nyu.edu/ adamodar/)

Figure A2: S&P500 Robustness Checks



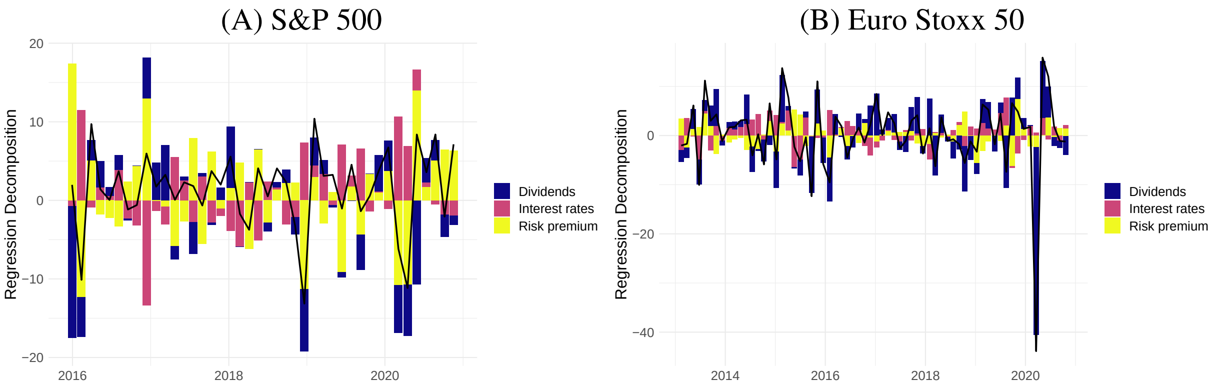
Note: Endogenous and extrapolative risk premium, long run growth rate corresponds to equations 7 and 8.
Source: Author's calculation, Bloomberg

Figure A3: Euro Stoxx 50 Robustness Checks



Note: Endogenous and extrapolative risk premium, long run growth rate corresponds to equations 7 and 8.
Source: Author's calculation, Bloomberg

Figure A4: Regression Decomposition



Note: Black line represent nominal monthly percentage change of given index. Decomposition was calculated using regression of monthly index percentage changes on principal components of dividend futures, yield curve and the implied equity risk premium.
Source: Author's calculation, Bloomberg

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