Coronavirus: Impact on Stock Prices and Growth Expectations

Niels J. Gormsen and Ralph S.J. Koijen *

August 3, 2020

Abstract

We use data from the aggregate stock and dividend futures markets to quantify how investors' expectations about economic growth evolve across horizons in response to the new coronavirus (COVID-19) outbreak and subsequent policy responses until July 2020. Dividend futures, which are claims to dividends on the aggregate stock market in a particular year, can be used to directly compute a lower bound on growth expectations across maturities or to estimate expected growth using a forecasting model. We show how the actual forecast and the bound evolve over time. As of July 20, our forecast of annual growth in dividends points to a decline of 8% in both the US and Japan and a 14% decline in the EU compared to January 1. Our forecast of GDP growth points to a decline of 2% in the US and Japan and 3% in the EU. The lower bound on the change in expected dividends is -17% in the US and Japan and -28% in the EU at the 2-year horizon. News about fiscal stimulus around March 24 boosts the stock market and long-term growth but did little to increase short-term growth expectations. Expected dividend growth has improved since April 1 in all geographies.

* `niels.gormsen@chicagobooth.edu`, `ralph.koijen@chicagobooth.edu`. University of Chicago, Booth School of Business. We are grateful to Nicola Benigni, Xavier Gabaix, Elisa Maffioli, Tyler Muir, Lasse Pedersen, Nikolai Roussanov, Amir Sufi, Stijn Van Nieuwerburgh, and Motohiro Yogo as well as seminar participants at HEC Paris, NBIM, UNSW Sydney, and the Virtual Finance Workshop (VirtualFinance.org) for discussions and suggestions. We thank Dong Ryeol Lee for excellent research assistance. Gormsen and Koijen acknowledges financial support from the Center for Research in Security Prices at the University of Chicago Booth School of Business.

1 Introduction

The outbreak of the new coronavirus has caused a pandemic of respiratory disease (COVID-19) for which vaccines are unavailable as of July 2020. The outbreak has caused major concerns about public health around the world. At the same time, there are growing concerns about the economic consequences as many households are required to stay home, or limit social interactions, to slow the spread of the virus. The impact that "pausing" the economy may have on the global economy and the financial stability of firms, the financial sector, and households is largely unknown. As a result, policymakers, businesses, and households struggle to estimate growth expectations for the years to come and assess the shape of the recovery.

As the current situation is unprecedented, and evolving rapidly, models that use macroeconomic fundamentals may be slow to update given the frequency with which macroeconomic data become available. Alternatively, we can try to extract information from asset prices such as stocks, bonds (Harvey (1989)), and credits (Gilchrist and Zakrajsek (2012)), as they are forward looking. It is therefore unsurprising that, in particular, movements in the stock market have received a lot of attention. In this paper, we provide a perspective on how to interpret movements in the stock market and what they tells us about growth expectations by combining it with asset pricing data from other markets.[1]

Equity markets in the EU, Japan, and the US dropped by as much as 30%. This is an extraordinary amount. To interpret this decline, it is useful to recall that the value of the stock market, S_t, is equal to the discounted value of all future dividends

$$S_t = \sum_{n=1}^{\infty} \frac{\mathbb{E}_t\left[D_{t+n}\right]}{1+\mu_t^{(n)}}, \tag{1}$$

where $\mathbb{E}_t D_{t+n}$ is the expected dividend in n years from today, conditional on today's information, and $\mu_t^{(n)}$ the cumulative discount rate for that cash flow. If the stock market falls, then either expected future dividends fall or investors discount future dividends at a higher rate, that is, $\mu_t^{(n)}$ rises.

[1] Ramelli and Wagner (2020) look at the cross-section of stock price reactions to COVID-19 events to understand the factors that impacted investors' demand during the onset of the crisis.

For the stock market to decline by 30% only due to revised growth expectations, the shock to future dividends needs to be large and highly persistent. It would for instance be inconsistent with a V-shaped recovery. To see this, we can sum the value of dividends during the first 10 years and find that this accounts for about 20% of the value of the stock market. This implies that if discount rates do not move and if the economic impact on dividends lasts no more than 10 years, a 30% decline in the stock market would mean that firms pay no dividends in the next 10 years - seemingly a rather extreme scenario. It would be more consistent with an L-shaped recovery in which dividends permanently drop by 30%, with no catch-up growth.

However, focusing on fundamentals only is typically not the right way to interpret movements in the stock market. The seminal work by Shiller (1981) and Campbell and Shiller (1988) shows that most of the variation in the value of the stock market is due to changes in expected returns, $\mu_t^{(n)}$, not revisions in expected future growth rates. See Cochrane (2011) for an excellent review. This insight brings good and bad news. The good news is that investors' expectations did not decline as dramatically as in the earlier calculation. The bad news, however, is that we learn little about growth expectations by taking cues from the stock market. Instead, we learn about investors' changes in discount rates that may be driven by shifts in risk aversion, sentiment, or uncertainty about long-run growth.

Our main point is that data from a related market, the dividend futures market, are useful to obtain estimates of growth expectations *by maturity*. Dividend futures are contracts that only pay the dividends of the aggregate stock market in a given year.[2] We can convert these prices to make each of the components of (1),

$$P_t^{(n)} = \frac{\mathbb{E}_t\left[D_{t+n}\right]}{1+\mu_t^{(n)}}, \tag{2}$$

directly observable. We refer to $P_t^{(n)}$ as the price of the $n-$year dividend strip at time t. If we sum all dividend strip prices, they add to the market, $S_t = \sum_{n=1}^{\infty} P_t^{(n)}$. There are two important reasons that data on dividend strip prices are informative. First, van Binsbergen et al. (2013) show that prices of dividend strips provide good forecasts of dividend growth

[2]See van Binsbergen et al. (2012), van Binsbergen et al. (2013), van Binsbergen and Koijen (2017), and Gormsen (2020) for earlier work on dividend strips and dividend futures.

and economic growth more broadly. Second, and particularly relevant during this period, dividend strips are differentiated by maturity, just like nominal, real, and corporate bonds. We use this feature of the data to provide an estimate of expected growth over the next year and to obtain a lower bound on the term structure of growth expectations by maturity.

We explore the evolution of expected growth rates during the COVID-19 crisis until July 20, 2020. We also derive a lower bound on expected dividend growth by horizon, which can be computed directly using observed prices. The lower bound is forward looking and requires neither a forecasting model nor historical data, which makes it useful in our setting, and only relies on the assumption that expected excess returns have not decreased.

We compare the lower bound observed during the COVID-19 crisis to the lower bound observed during the November 2008 of the global financial crisis (GFC). This is useful as the lowerbound during the GFS turned out to be quite tight once compared to the subsequent dividends that realized.

We also use dividend futures to better understand the overall movement in the stock market. During the onset of the crisis, the stock market drops substantially more than the 1- to 7-year dividend strips. This finding implies that the value of distant-future dividends – dividends paid out more than 7 years from today – must have dropped by more than the value of the near-future dividends. As we find it unlikely that long-run dividends, in levels, are hit harder than near-term dividends, the drop must come from discount rates.[3] Hence, prices on the market and the futures jointly suggest that discount rates initially increased substantially on long-maturity claims such as the market portfolio.[4] We formalize this analysis at the end of the paper.

As of July 20, the expected return on the market has returned to the pre-crisis level. On July 20, the S&P 500 trades at \$3251, which is \$135 lower than the peak of \$3386 on February 19. This drop can largely be explained by the first 10 years of dividends, as they are down by a total of \$112. As such, the distant-future dividends, the dividends beyond year 10, must have approximately the same value as before the crisis. If expected long-run dividends are the same as before the crisis, expected returns on the long-run dividends

[3]We refer to Eichenbaum et al. (2020) for a macroeconomic model of epidemics that is consistent with this assumption.

[4]The importance of long-horizon discount rate variation to understand movements in the aggregate stock market is consistent with (Gormsen, 2020).

must therefore also be the same as before the crisis. However, interest rates have dropped substantially, which means the expected return in excess of the interest rates is higher than before the crisis.

Our results have implications for asset pricing theories. It is well known that it is oftentimes difficult to identify the economic shocks that caused asset prices to move (Cutler et al. (1989)). The unique feature of the ongoing events is that the nature of the shock is clear, and we have a prior regarding the temporal structure. Indeed, looking at the Centers for Disease and Control and Prevention's overview of past pandemics,[5] we learn that pandemics tend to be relatively short-lived.[6] While the pandemic may spread more easily in today's interconnected world, the expectation is that a vaccine can be available within one to two years. So while the economic contraction may be very sharp, and potentially have long-lasting effects due to defaults of households, firms, parts of the financial sector, and even governments, we believe at the time of writing that it is reasonable to assume that the economic consequences are most severe in the next one or two years. Indeed, this reasoning has prompted policy proposals to flatten not only the pandemic curve, but also the recession curve (Gourinchas (2020)). We will interpret the dynamics of equity and bond markets through this lens and discuss this in more detail in Section 5.

2 The Response of Stock, Bond, and Dividend Futures Markets to COVID-19

2.1 The Response of Stock and Bond Markets

Figure 1 shows the cumulative return on the stock markets in the US, the EU, and Japan in the top panels. We use the S&P500 index as the representative stock index in the US, the Euro Stoxx 50 index in the EU, and the Nikkei 225 index in Japan. The bottom panels show the cumulative return on 30-year nominal bonds in the US, Germany, and Japan. None of the stock markets responded strongly to the outbreak in China or the lockdown of Wuhan,

[5] https://www.cdc.gov/flu/pandemic-resources/basics/past-pandemics.html.

[6] For instance, the H1N1 virus spread in 1918 and 1919, the H2N2 virus in 1957 and 1958, the H3N2 virus in 1968, and the H1N1pdm09 virus in 2009.

China, on January 23. However, once it is apparent that the outbreak spread to Italy, South Korea, and Iran, around February 20, stock markets declined sharply.

In response to the US' decision on March 12 to severely restrict travel from the EU and decisions by governments in the EU to impose lockdowns to various degrees, stock markets around the world declined by 10% or more. By March 18, stock markets have dropped more than 30% from their peak. On March 24, S&P 500 rallies almost 10% following news of fiscal stimuli and further monetary policy actions.

In search of safety, investors' demand for long-term government bonds issued by the US, Germany, and to some extend Japan, increased. Over the same period, the yield on 30-year US Treasuries decreases by almost a percentage point, driving prices of 30-year bonds up by approximately 30%. We see a similar rally in German bunds, which are the safe assets in the Euro area.

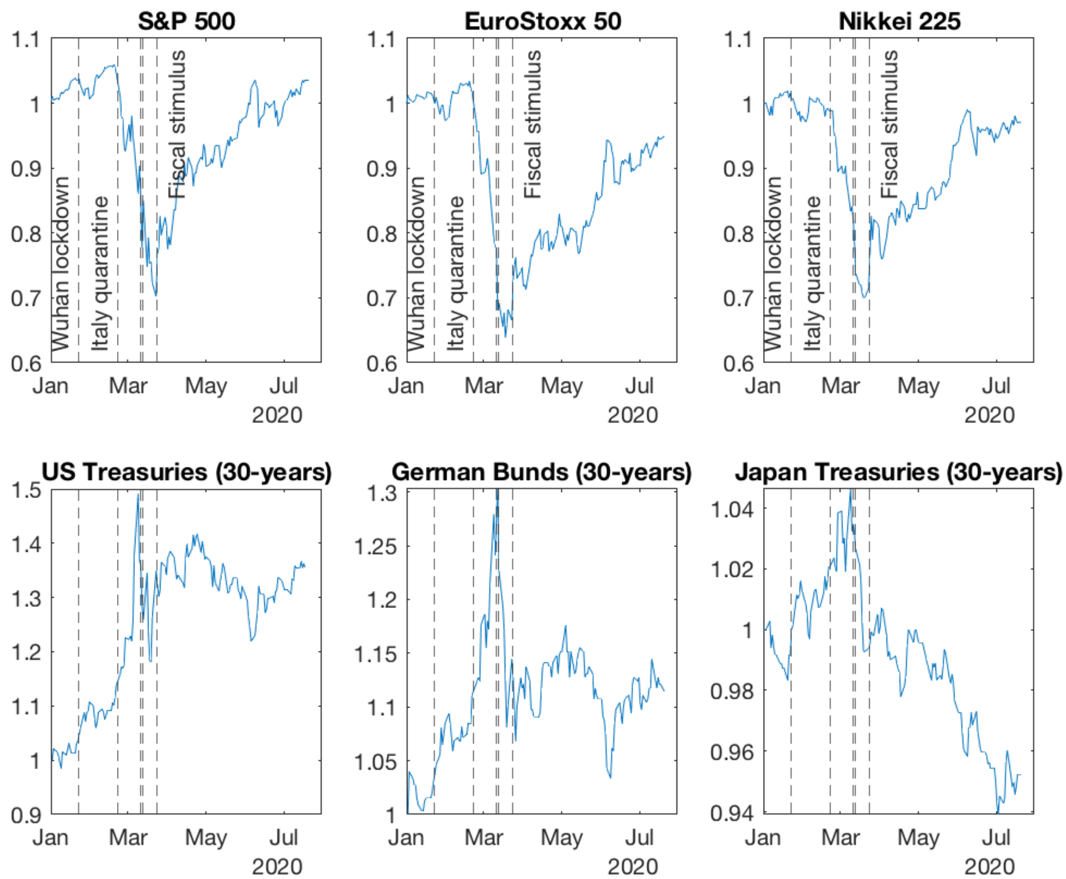
Stock returns are often measured in excess of the return on bonds. When measured in excess of 30-year bonds, the aggregate stock market falls by almost 60% at the bottom. This is a lower excess return than observed in any calendar month in modern US history. A central question for policymakers and market participants is how to read this decline in the stock market. That is, what does the decline tell us about the expected trajectory of future growth or changes in expected excess returns. In the remainder of this paper, we show that we can make progress on this question by using data on dividend futures and the stock market jointly.

2.2 The Response of Dividend Futures Markets

To better understand the expected impact of COVID-19 on the economy over the next few years, we turn to the term structure of dividend prices. The equity term structure are prices of claims to the dividends of all firms in an index in a given year. To interpret the dividend strip price, we can write (2) as

$$P_t^{(n)} = D_t \frac{G_t^{(n)}}{1 + \mu_t^{(n)}},$$

Figure 1: The response of the stock and nominal bond markets in the US and EU



This figure shows the cumulative return on the S&P 500, the Euro Stoxx 50 index, 30-year US Treasuries, and 30-year German bunds. We depict using dashed vertical lines the following five events: The lockdown of Wuhan, China on January 23, the announcement of the quarantine in Italy on February 22, the announcement by the US government that it would ban travel from the EU on March 11, the declaration of national emergency in the US on March 13, and the news that congress is close to passing a stimulus bill on March 24.

where $G_t^{(n)} = \mathbb{E}_t\left[\frac{D_{t+n}}{D_t}\right]$ is the expected growth rate between years t and $t{+}n$. In practice, we do not directly observe the dividend strip price, but instead observe the dividend futures price, which we denote by $F_t^{(n)}$. The two prices are linked by the no-arbitrage relationship $F_t^{(n)} = P_t^{(n)}(1 + y_t^{(n)})$, which implies

$$F_t^{(n)} = D_t \frac{G_t^{(n)}}{1 + \theta_t^{(n)}},$$

where $y_t^{(n)}$ is the cumulative $n-$year risk-free interest rate and $\theta_t^{(n)} = \frac{1+\mu_t^{(n)}}{1+y_t^{(n)}} - 1$ is the expected excess n-period return on $n-$period dividend risk.

We directly observe the futures price, $F_t^{(n)}$, which informs us about the market's expectation of the growth rate *by maturity* and the expected excess return, $\theta_t^{(n)}$, again, *by maturity*. The unique feature is that we can get information about growth expectations by maturity, while the stock market is informative about growth rates and expected returns across all maturities combined.

Dividend futures are exchange-traded products. Dividend futures for the S&P500, Euro Stoxx 50, and Nikkei 225 trade on the Chicago Mercantile Exchange, the Eurex Exchange, and the Singapore exchange, respectively.[7] Because the contracts expire in December, the maturity of the available contracts varies over the calendar year.[8] We therefore interpolate prices across the different contracts to obtain constant maturity prices. We use the mid-quotes at close as pricing data in the US, settlement prices, which is the volume-weighted average price during the day, in the EU, and the last trading price for a given day for Nikkei 225.

Figure 2 shows how the prices on dividend futures evolve between January 1 and July 20. The figure shows the change in prices of dividend futures relative to the price of the same-maturity claim on January 1. The top left corner shows the cumulative change in prices on March 5. Prices drop only modestly during the initial spread of the virus from January 1 to March 5. In contrast, equity markets drop by more than 10% between January

[7] Dividend futures for Nikkei 225 also trade on the Osaka exchange, although in lower volume than on the Singapore exchange.

[8] The dividend futures technically expire in March when the final dividends for the Nikkei index for a given calendar year is announced.

and early March. Since near-future dividends do not drop in value, the initial drop in the stock market must come from a drop in the value of distant-future dividends.

Dividend prices drop substantially between March 5 and March 20. The top right corner shows the change in priced from January 1 to March 20. Prices are down by more than 30% for the S&P 500 and more than 40% for the Euro Stoxx 50. The drop is biggest on the 2-year horizon for these indexes. Between March 5 and March 20, stock markets drop substantially in both the US and the EU, with the S&P 500 experiencing its biggest daily loss since 1987. Important dates are March 11, when the US limits travel from the EU, and March 13, when the US declares a state of emergency. On March 13, stock markets soar after the declaration of the national emergency. Dividend prices also increase on this day, but only at the long end.

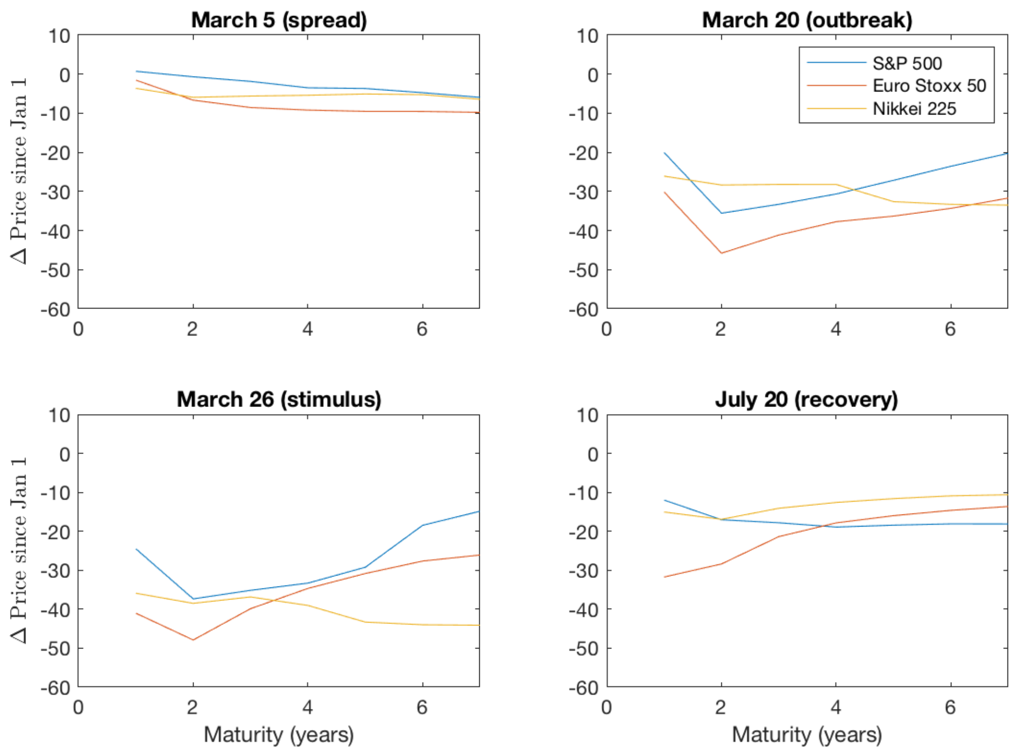
The bottom left corner shows the change in prices from January 1 to March 26. On March 25, Congress comes close to passing a 1.8 trillion dollar fiscal stimulus bill. Stock markets soar already on the March 24 following news of the bill and further monetary policy actions.[9] Overall, stock markets increase by around 10% from March 20 to March 26, presumably driven by these government interventions.[10] However, the short-term dividend futures actually decrease slightly over this period. This finding implies that fiscal stimulus lifted the stock market by lifting the value of distant-future dividends, not by improving prices of near-term cash flows.

Finally, the bottom right corner shows the change in price from January 1 to July 20. Dividend prices increases overall between March 26 and July 20. Stock prices also increase substantially over this period, with the S&P 500 almost returning to the level of January 1 2020.

[9] https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm.

[10] Congress is also rumored to include a ban on paying dividends until September 2020 for firms receiving financial support, something that is likely to decrease the value of the 2020 dividend claim but has less of an impact on the 2-year claim.

Figure 2: The Development of the Dividend Term Structure over the COVID-19 Outbreak



This figure shows the relative price of dividend of dividend futures with different maturity. We consider the percentage change in prices since January 1. The dividend futures are claims on the dividend paid out on the index in a given year. We consider the S&P 500 index, the Euro Stoxx 50 index, and the Nikkei 225 index. Maturity measured on the horizontal axis is expressed in years. For instance, the top left figure shows that, between January 1 and March 5, dividend futures prices fall by only a few percent for the 1-year claim but by as much as 10% for the 7-year claim.

3 What Do Dividend Futures Tell About Growth Expectations?

3.1 A Lower Bound on Dividend Growth

We provide a simple lower bound on the expected growth rate in dividends that can be computed using market prices only. If we consider a change in the price of a dividend future over a short period of time from t to t', $t' > t$, we have

$$\Delta F_{t'}^{(n)} = \frac{\Delta G_{t'}^{(n)}}{\Delta \Theta_{t'}^{(n)}},$$

where $\Delta x_{t'} = \frac{x_{t'}}{x_t}$ and $\Theta_t^{(n)} = 1 + \theta_t^{(n)}$.

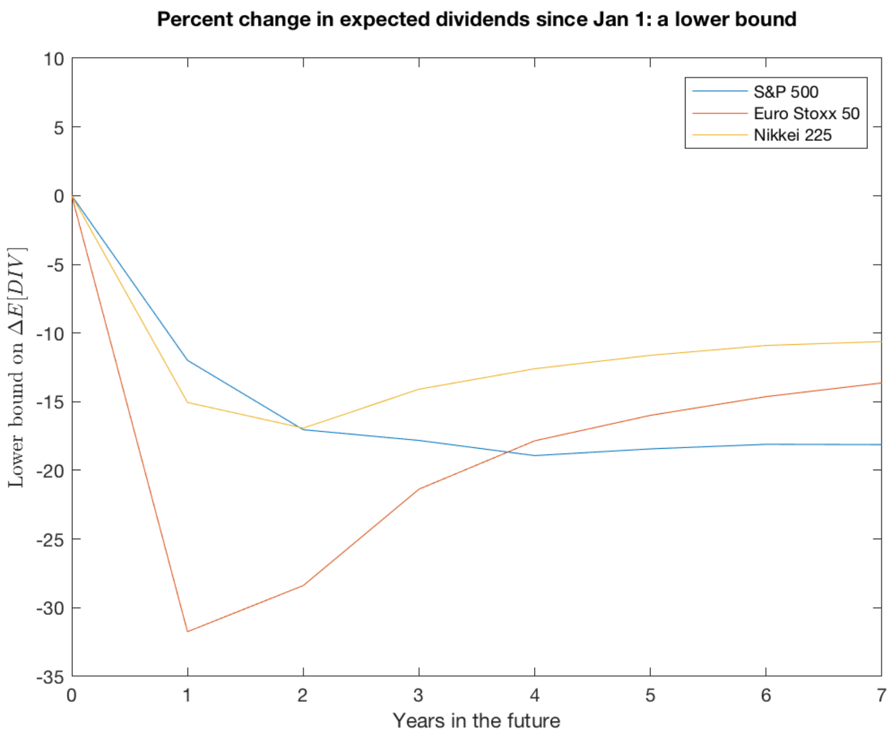
To obtain a lower bound on the change in growth expectations, our key assumption is that the expected excess return, which for instance reflects investors' risk aversion or sentiment, did not decline since the outbreak, $\Delta \Theta_{t'}^{(n)} \geq 1$. This implies that we can bound the change in expected growth from below by

$$\Delta G_{t'}^{(n)} - 1 \geq \Delta F_{t'}^{(n)} - 1,$$

which depends only on market prices on the right-hand side that are readily available. Hence, the change in expected growth over the next n years, $\Delta G_{t'}^{(n)}$, is bounded from below by $\Delta F_{t'}^{(n)}$. We provide more details on the necessary technical assumptions in the Appendix.

The lower bound is shown in Figure 3. The lower bound on dividend growth expectations is revised down by as much as 17% in the US and Japan, and 28% in the EU, at the 2-year horizon. It is important to keep in mind that the lower bound represents the revision in expected growth rates relative to previous expectations, not a lower bound on the actual growth rate. If investors expected a nominal growth rate of 6% annually prior to the outbreak, the expected growth on the 2-year horizon would be more than 12%. Revising the 2-year growth expectations down by 18% would thus imply a negative growth of "only" 6% over a 2-year horizon. In addition, we measure a lower bound that is equal to the actual expectations only when expected excess returns did not go up. We next discuss a methodol-

Figure 3: Lower bound on revisions in expected growth at different horizons



This figure shows a lower bound on revision in expected dividend growth at different horizons. The revisions are measured relative to expectations on January 1. The figure shows the bound for the S&P 500 in blue, the bound for Euro Stoxx 50 in red, and the bound for Nikkei 225 in yellow. The lower bound bottoms out between 1 and 2 years into the future, with expected dividends being revised down by as much as 17% in the US and Japan and 28% in the EU at the 2-year horizon. The lower bound increases from years 2 to 7 in EU and Japan, which is consistent with investors expecting catch-up growth after the recession. We emphasize that the estimates represent lower bounds and that actual expected growth is likely higher.

ogy, which requires additional assumptions, that we use to compute an estimate of expected growth.

3.2 Comparison to the Global Financial Crisis of 2008

We compare the market's response to COVID-19 to the GFC of 2008. On March 23, the VIX is at a similar level as the one observed during the GFC. Stock prices have also dropped as much as in the fall of 2008, at least when measured in excess of 30-year treasuries. These observations underline the severity of the impact of the COVID-19 outbreak on financial markets.

Figure 4 shows the lower bound during the GFC. The blue line plots the lower bound on revisions in expected dividends between July 31 2008 and November 31 2008. The red line plots the subsequent realized dividends measured relative to a pre-crisis trend of around 4% growth.[11] For the S&P 500, the lower bound on changes in expected dividends lines up well with the realized dividends at the short-end. For Euro Stoxx 50, realizations are slightly below the bound at the short end, above the bound in the middle, and around the bound at the long end.[12] For Nikkei 225, the realizations line up well with the lower bound on the short end and the middle but are higher on the long end. It is comforting that even during a period of high financial turbulence, the future prices appear well linked to fundamentals and align well with realizations.

Figure 4 also plots the lower bound following the outbreak of COVID-19. On March 23, which is the day the stock market reaches the bottom, the bound is lower than observed during the financial crisis, but the curve indicates more catch-up growth, particularly in Europe.

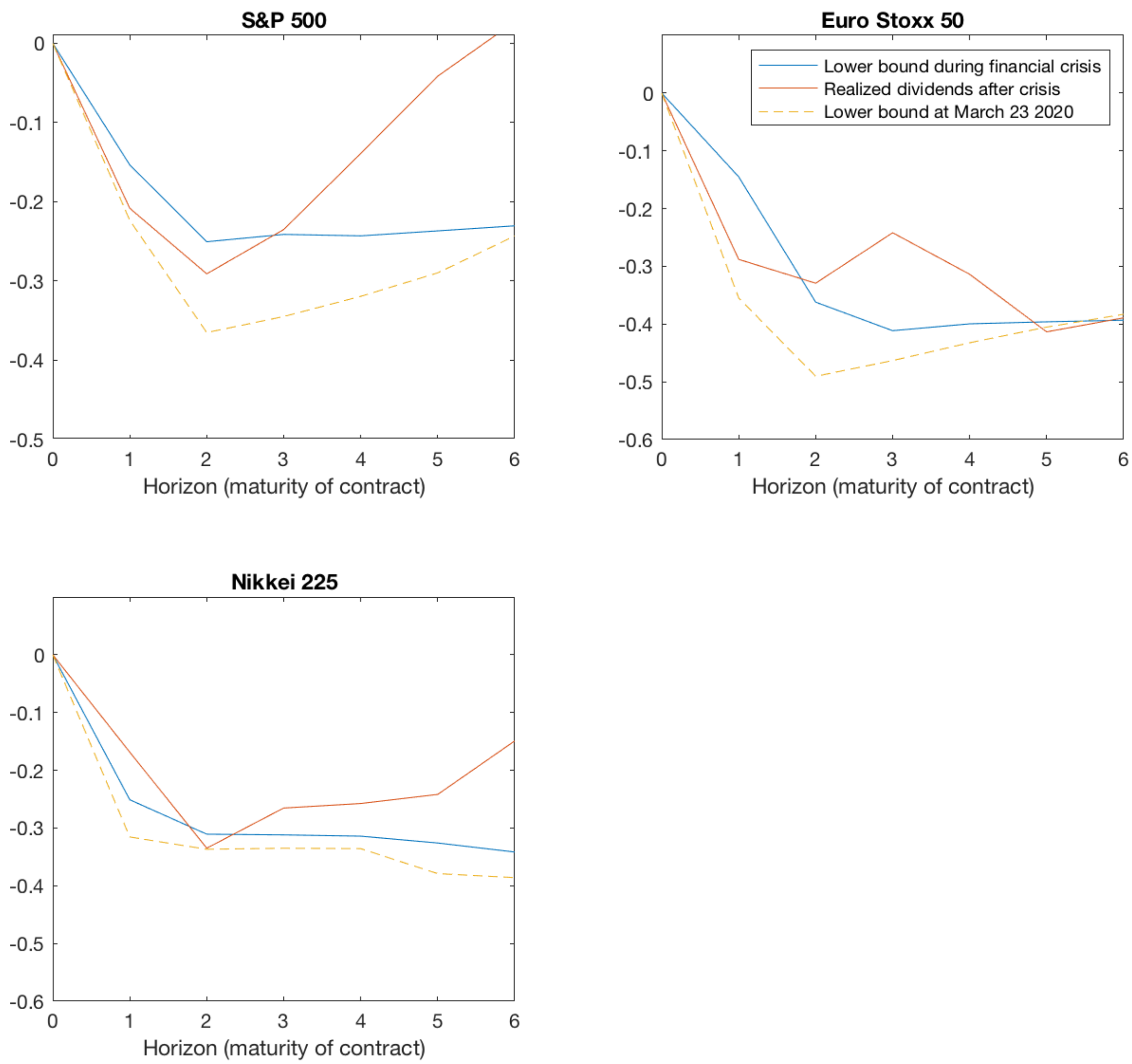
3.3 Estimating Dividend Growth Expectations

Next, we construct an actual estimate of expected dividend growth. We first define the equity yields on index i as:

[11] We measure the growth rates as the real-growth in dividends observed between 1947 and 2007, which is close to 2% plus 2% for expected long-run inflation in 2007.

[12] We note, however, that the low realized dividends on the long end could reflect the European sovereign debt crisis of 2011, which was probably unexpected in 2008.

Figure 4: Comparing the Lower bound to the lower bound observed during the Global Financial Crisis



The blue line shows the lower bound on changes in expected dividend growth between between July 31 and November 31 in 2008. The line shows that dividend growth was revised down with up to 25% on the 2-year horizon for the S&P 500. The red line shows the realized dividends x years into the future (relative to a pre-crisis trend of 4% nominal). The realized dividends where approximately 30% below the pre-crisis trend after 2 years for the S&P 500. The dotted yellow line shows the lower bound on changes in expected dividend growth between January 1 and June 8 2020. The lower bound is as lower than observed during the financial crisis. The figure shows results for the S&P 500 to the top left, for Euro Stoxx 50 to the top right, and for Nikkei 225 to the bottom left.

$$e_{it}^{(n)} = \frac{1}{n} \ln \left(\frac{D_t}{F_t^{(n)}} \right),$$

where n is measured in years, see van Binsbergen et al. (2013). Using a training sample from 2006 to 2017, we run a pooled regression of realized dividend growth rates on the S&P 500, the Euro Stoxx 50, and Nikkei 225 onto the 2-year equity yield of the associated index:

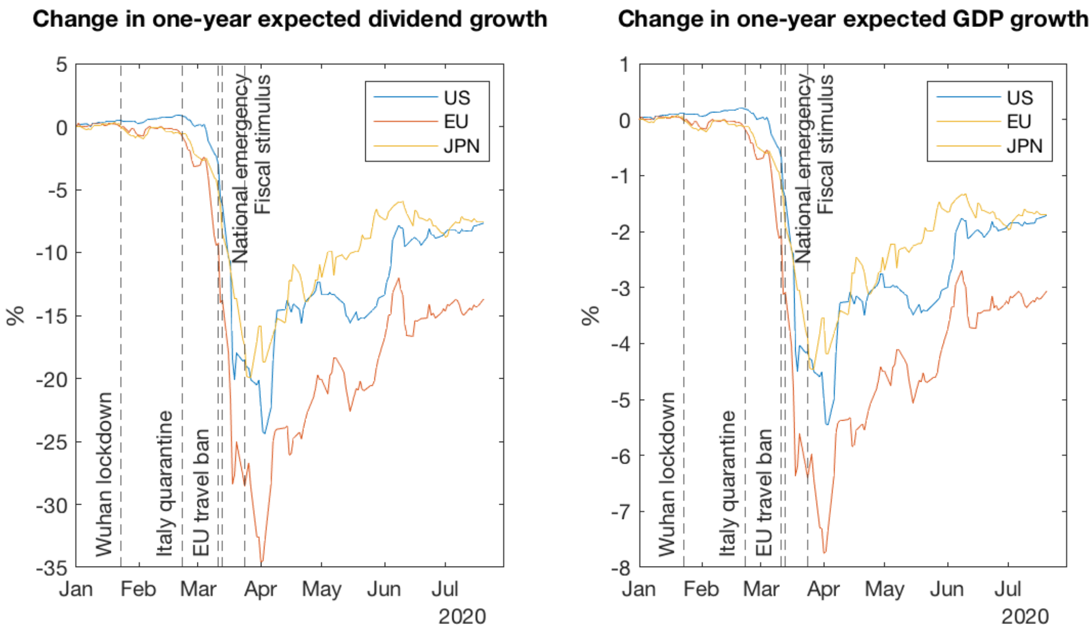
$$\Delta_1 D_{i,t} = \beta_{0i}^D + \beta_1^D e_{it}^{(2)} + \epsilon_{i,t+4}, \tag{3}$$

where t is measured in quarters, i refers to either the S&P 500, Euro Stoxx 50, or Nikkei 225, and $\Delta_n x_t \equiv \frac{x_{t+4n}}{x_t} - 1$. We then use the parameter estimates in this regression to estimate expected dividend growth at every trading day since January 1 2020. Dividends on the left hand side are measured in nominal terms. The R^2 in this forecasting regression is 0.58. We report regression details in Table 1 in the Appendix B.

The left panel of Figure 5 shows the dynamics of expected dividend growth in the US, the EU, and Japan until July 20. [13]Growth expectations did not respond much to the lockdown in Wuhan, China. However, once lockdowns are imposed in Italy, growth expectations start to deteriorate. The travel restrictions on visitors to the US from the EU leads to a sharp deterioration of growth expectations, particularly in the EU and the US. This is occurs once again following the declaration of the national emergency and the subsequent actions by the Federal Reserve on March 15. Following the US fiscal stimulus program and further monetary policy actions, GDP growth has stabilized somewhat in the US and Japan but continued to deteriorate in the EU. By July 20, expected dividend growth over the next year declined by 8% for the S&P 500 and the Nikkei 225 indexes and by 14% for the Euro Stoxx 50 index. The estimate of GDP growth over the next year is down by 2% in the US and Japan and 3% in the EU.

[13]An additional reason for the changing link between dividend futures and future GDP growth is that governments and regulators may impose restrictions on firms' payout policies in return for financial support or to safeguard the financial system in case of banks and insurance companies.

Figure 5: Expected Dividend and GDP Growth from Dividend Futures



This figure shows the change in expected dividend and GDP growth relative to expected value at January 1, 2020. The figure shows expected growth in the US in blue, the EU in red, and Japan in yellow. Key events are indicated by the vertical dashed lines. The expected dividend growth is revised slowly in response to the outbreak, particularly in the US where it was revised down by less than 5% at March 11. By July 20, expected dividend growth is down by 8% in the US and Japan and 14% in the EU. Expected GDP growth over the next year is down by 2% in the US and Japan and 3% in the EU. Details of the estimation are in Section 3.3.

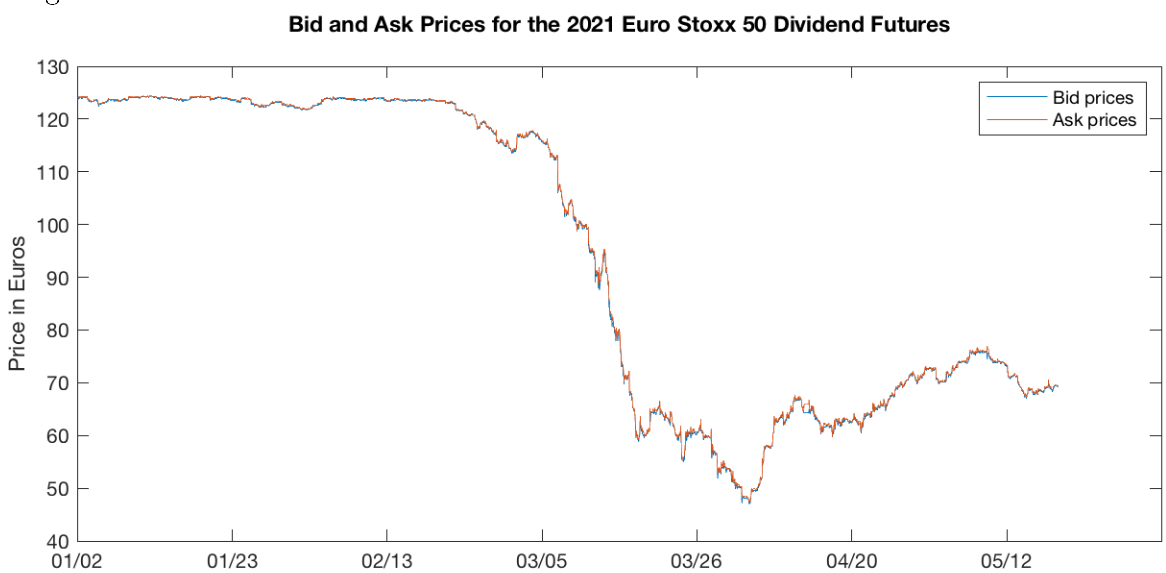
We conclude with a word of caution. We emphasize that these estimates are based on a forecasting model estimated using historical data. In these unprecedented times, there is a risk that the historical relation between future growth and current asset prices changes, meaning that these estimates come with uncertainty.

3.4 The Liquidity of Dividend Futures Markets

We conclude this section with a brief discussion of the liquidity of dividend futures markets. This is relevant also as other markets, including Treasuries, experienced severe stress in March of 2020 (He et al. (2020)).Dividend futures for the Euro Stoxx 50 have traded on the Eurex exchange since 2008. The size of the market has increased steadily since its inception as shown in Figure 10. At the end of 2019, there are around 1 million contracts outstanding. Each contract is for a 100 dividend points and trades at around EUR 12,000 depending on the maturity. This gives a total notional outstanding of around EUR 12 billion. The total number of contracts increases from around 800,000 to 1,200,000 during the spring of 2020, but the notional measured in EUR drops because the value of the futures decreases. Figure 11 shows the number of contracts traded daily. The trading volume increases during the COVID-19 crisis, peaking at 100,000 daily contracts. As a comparison, the average daily traded contracts in 2019 is around 20,000. This heightened volume alleviates concerns that the market dried up during the crisis.

More directly, we can study the impact of bid-ask spreads on our calculations. Between January 1 and May 19, the bid-ask spread for the 2021 claim is on average 0.27% in the middle of the day. The bid-ask spread increases with maturity to around 1.2% for the 2027 claim. We note that bid-ask spreads vary over day and tend to be larger in the morning, before the cash market opens, and in the evening, after the cash markets closes. Figure 6 shows the bid and ask prices for the 2021 claim. We measure the average bid and ask prices over each 15-min interval during opening hours of the cash market in Frankfurt (that is, from 9:00 to 17:30). The bid and ask prices are close at all points in the sample.

Figure 6: Bid and Ask Prices for the 2021 Euro Stoxx 50 Dividend Claim



This figure shows the bid and ask prices of the 2021 Euro Stoxx 50 dividend futures. The figure shows the average price over each 15-minute interval. We only consider the prices during the time of the day where the Frankfurt Stock Exchange is open for trading in the cash equity market (9:00-17:30). Sample is Jan 1 to May 19 2020.

4 From Dividend Growth Expectations to GDP Growth Expectations

4.1 Dividend and GDP Growth

We can use dividend futures to compute a lower bound and point estimate for GDP growth expectations. Indeed, dividend expectations are related to GDP expectations as dividends summarize the profits and production of listed firms, which in turn is part of the GDP. However, there is obviously also independent variation in both series.

To illustrate the relation between the two series at the business-cycle frequency, we extract the cyclical component of real dividends and real GDP using the methodology developed in Hamilton (2018)

$$z_t = d_0 + \sum_{j=8}^{11} d_i z_{t-j} + c_t,$$

where z_t corresponds to either log real dividends or log real GDP. The residual, c_t, corresponds to the cyclical component.

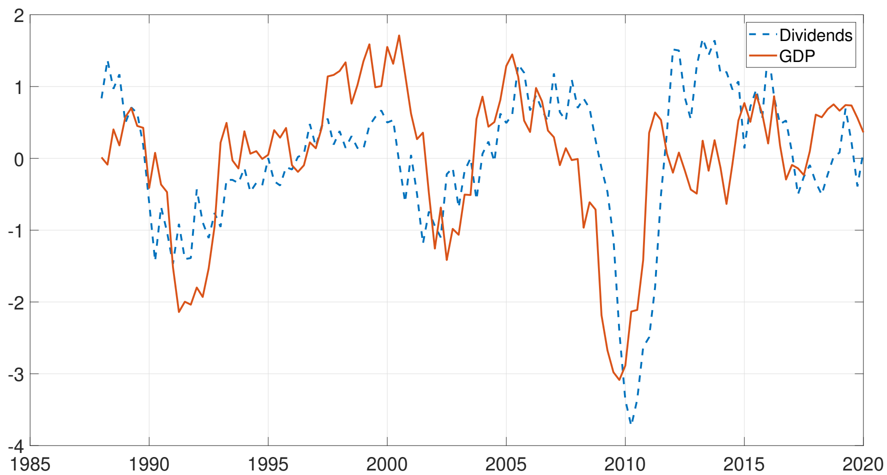
Figure 7 presents the results from the first quarter in 1985 to the fourth quarter in 2019.[14] We standardize each of the series. The two cyclical components move strongly together with a time-series correlation of 54%. We note that the two series are not perfectly synchronized and that the series appear more strongly related during economic downturns, that is, when the series are negative. This is precisely what we care about in the current environment, which makes dividend futures particularly relevant to estimate investors' expectation of GDP growth as well.

4.2 A Lower Bound on GDP Growth

To calculate the lower bound on changes in expected GDP growth, we multiply our lower bound on dividend growth by a country-specific constant b_i that maps dividend growth into GDP growth:

[14] We adjust the aggregate dividend series for Microsoft's special dividend in November 2004, which otherwise would show up as a substantial outlier.

Figure 7: Cyclical components of log real dividends and log real GDP.



$$E_t\left[\Delta_n Y_{it}\right] - 1 \geq \left(\Delta F_{i,t'}^{(n)} - 1\right) \times b_i, \tag{4}$$

where $E_t\left[\Delta_n Y_{it}\right]$ is the change in expected GDP growth at horizon n for country i. The constant b_i measures how much GDP changes when dividends change. One way to estimate b_i is to regress GDP growth on dividend growth. However, this estimate is likely to be biased downwards due to asynchronicities between the series shown in Figure 7 and other independent variation in dividend growth. A downward bias in b_i would be problematic as it leads to an upward bias in our lower bound during economic downturns. To ensure that our lower bound is conservative, we instead run the regression

$$\Delta_1 D_{it} = a_{0i} + a_{1i}\Delta_1 Y_{it} + \varepsilon_{t+4}, \tag{5}$$

and use $b_i = \frac{1}{a_{1i}}$. In this way, asynchronicities between GDP and dividends, and other independent variation in GDP, leads to a lower estimate of a_i and a higher estimate of b_i. This results in a more conservative lower bound.

We run separate regressions in the US, the EU, and Japan. In the US, we use the 1985 to 2019 sample of real growth in GDP and dividends. In the EU, we use a shorter 2003 to 2019 sample of real growth in GDP and dividends on the Euro Stoxx 50. In Japan, we use the 1995-2019 sample. We use real series to avoid putting too much weight on the early US sample with high inflation.[15] The resulting estimates of b_i are 0.67 in the US, 0.33 in the EU, and 0.46 in Japan. The lower bound is plotted in Figure 8. The lower bound suggest a decline in GDP growth expectations of 7% in Japan, 8% in the US and slightly more than 10% in the EU. As a point of reference, we compare these estimates to Baker et al. (2020b). They use estimates from Baker et al. (2020a) and calibrate it to the COVID-19 shock in the stock market and its volatility, and predict a year-on-year contraction in output of 11% in 2020Q4, which is slightly more negative than our lower bound implied by dividend futures.

4.3 GDP Growth Expectations

To estimate GDP expectations, we could follow the procedure of section 3.3 and use the equity yields to forecast GDP growth. However, to obtain the most accurate estimate, we want to account for (i) the small asynchronicities between GDP and dividends documented in Figure 7 and (ii) the potentially stronger relation between the two series when growth is below average, which most closely mimics the current situation.

The sample with dividend futures is too short to effectively deal with these issues and we therefore prefer a slightly different approach. We first use the long US sample to map dividend growth into GDP growth, and we then use this mapping to transform our dividend growth expectations from section 3.3 into expectations about GDP growth. We note that one could make other reasonable modeling assumptions that may lead to different estimates.

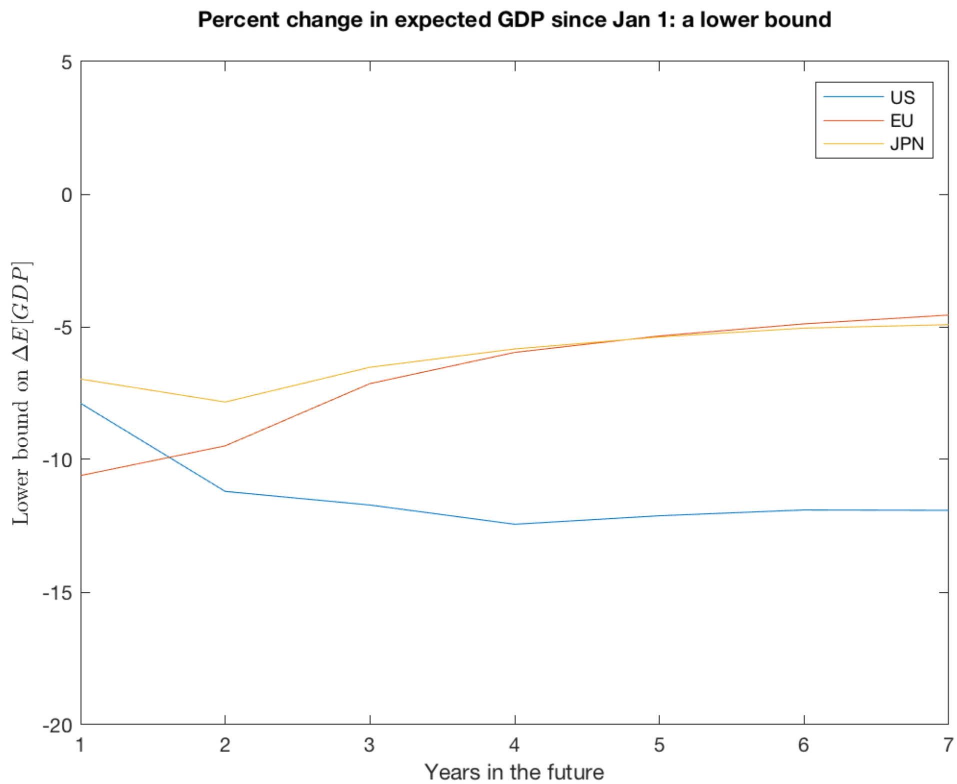
We first map real GDP growth to real dividend growth using the following regression in the 1985-2019 US sample:

$$\Delta_n Y_t = A_n + B_n \Delta_n D_t + e_{t+4n},$$

only using data when $\Delta_n D_t < \overline{\Delta_n D_t}$, with $\bar{x} \equiv \frac{1}{T}\sum_t x_t$, and Y_t denoting real GDP. There are two important features of this regression. First, by only considering observations where realized growth is below average, we estimate the downside relation between the two series,

[15] The lower bound is nonetheless still a lower bound on nominal growth.

Figure 8: A lower bound on GDP growth expectations by maturity as implied by dividend markets



The figure shows a lower bound on changes in expected GDP at the 1 to 7-year horizon. The changes are measured relative to expectations on January 1. The figure shows that expected GDP may have been revised down by as much as 12% in the US, 11% in the EU, and 8% in Japan. It is revised down the most on the 1- to 2-year horizon. This estimate is a lower bound meaning actual expectations are likely be higher (see text for description).

which is what is relevant in our context. Second, by using longer horizons, n, we can mitigate the effect of small asynchronicities.

As our benchmark case, we estimate B_n using 2-year growth ($n = 2$) in the 1985 to 2019 US sample. The baseline estimate is 0.22, meaning that dividends move approximately four times as much as GDP in downturns (see Table 2 in the Appendix for details). The baseline estimate is robust to using a longer sample period and to using 3- instead of 2-year growth, as reported in the Appendix B. The estimate is lower if we consider 1-year growth, which illustrates once more that GDP and dividend growth are not perfectly synchronized. If we consider the unconditional relation between GDP and dividend growth, the slope coefficient is only half as large, suggesting a weaker upside relation between GDP and dividend growth.

Having estimated the relation between GDP and dividends, we forecast GDP growth as:

$$E_t \left[\Delta_1 Y_{it} \right] = A_i + B_2 \beta_1^D e_{i,t}^{(2)},$$

where the A_i is irrelevant as we forecast the change in expectations since January 2020, which only depends on the slope coefficients and the equity yield. We use the same estimate of B_n, which is based on US data, for the US, the EU, and Japan, as we have a longer sample available for the US. We emphasize once more that these estimates are based on a forecasting model estimated using historical data. In unprecedented times, there is a risk that historical relations change, implying that these estimates come with uncertainty.

The right panel of Figure 5 shows the dynamics of expected dividend growth in the US, the EU, and Japan until July 20. The turning points are, by design, the same as for expected dividend growth. When dividend futures are at their lowest point at the end of March, GDP growth is expected to decline by almost 8% in the EU, close to 6% in the US, and almost 5% in Japan. As the dividend futures recovered since then, the estimate of GDP growth over the next year is down by 2% in the US and Japan and 3% in the EU by July 20.[16]

[16]An additional reason for the changing link between dividend futures and future GDP growth is that governments and regulators may impose restrictions on firms' payout policies in return for financial support or to safeguard the financial system in case of banks and insurance companies.

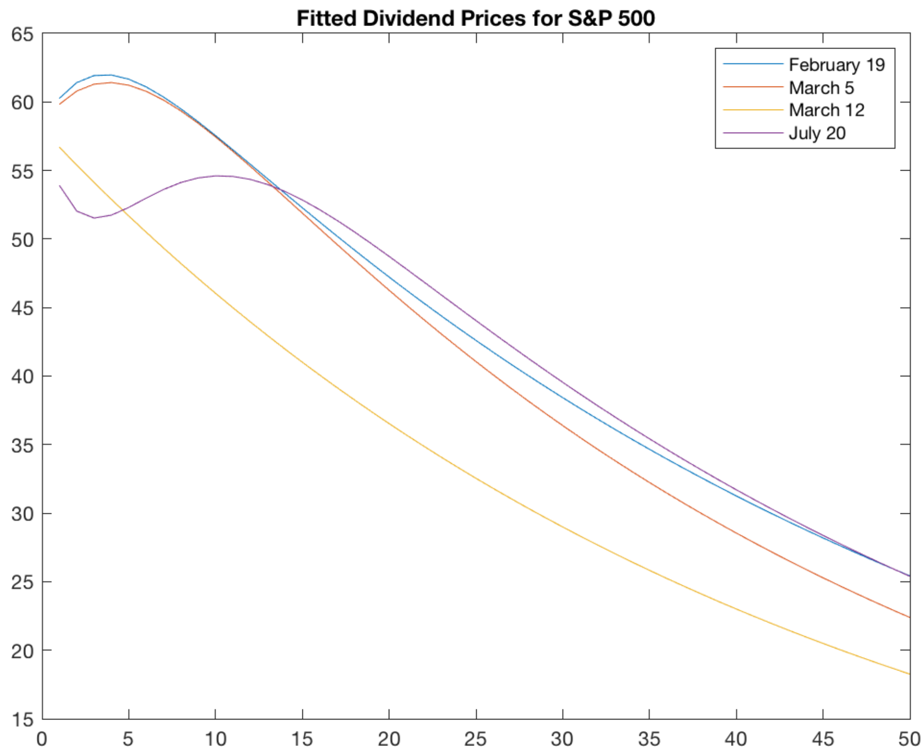
5 Reconciling the Price of the Stock Market with Dividend Strip Prices

We use dividend futures to learn about the pricing of the stock market and in particular how it developed during the COVID-19 crisis. To this end, we fit a simple model for dividend prices that we require to simultaneously price the dividend futures as well as the aggregate stock market. Starting from (1), we observe the dividend prices for the first 10 years and we observe S_t. We model expected growth minus the expected excess return, $g_t^n - \theta_t^n$, as a function of maturity. The functional form that we fit in each period follows Nelson and Siegel (1987).

The results for the S&P 500 are presented in Figure 9. In the initial phase of the stock market drop, from the peak on February 19 to March 5, the market declines due to a drop in the value of the distant-future dividends. As we maintain the assumption that distant-future dividends are expected to fall less than near-future dividends because of the nature of pandemics, the large drop in the value of distant-future dividends cannot come from decreases in expected dividends but must instead be due to an increase in discount rates. Such increases in discount rates on distant-future claims is commonly observed during times of stress (Gormsen (2020)). From March 5 to 12, a period in which growth expectations changed sharply, we see that prices on both near- and distant-future dividends fall sharply. Finally, from March 12 to July 20, a period during which the stock market recovers, we see that the value of distant-future dividends increases, whereas the value of the very near-future dividends continues to decrease. Since the value of the distant-future dividends largely returns to pre-crisis levels, it seems reasonable to conjecture that the discount rates on these distant-future dividends also have returned to pre-crisis levels. Taken together, Figure 9 illustrates how the crash of the stock market was driven by a drop in the value of both the near- and distant-future dividends, whereas the rebound was driven largely by a recovery in the value of distant-future dividends. We provide similar analysis for Euro Stoxx 50 and Nikkei 225 in Figure 12 in the Appendix.

These results have implications for asset pricing theories. It is well known that it is oftentimes difficult to identify the economic shocks that caused asset prices to move (Cutler et al. (1989)). The unique feature of the ongoing events is that the nature of the shock

Figure 9: Reconciling the stock market and dividend price responses



This figure shows estimated prices of dividends for different maturity. We fit the term structure of dividend prices to the functional form on Nelson and Siegel (1987) under the restriction that the price of all the dividends sum to the market. We estimate the prices separately on February 19, March 5, March 12, and July 20. Maturity measured on the horizontal axis is in years.

is clear, as well as the temporal structure. Although there is uncertainty about the long-term consequences, it seems reasonable to assume that the short-term economic growth consequences are more severe than the consequences after, say, five years. Moreover, the initial decline in the aggregate stock market in the US, with a small response to short-term dividend prices, suggests that modest shocks to short-term expectations can trigger large and persistent changes in expected excess returns. As such, shocks to near-future dividends appear risky in the eyes of investors, a fact that may help explain the downward sloping equity term structure and the high returns to firms that produce near-future dividends (Dechow et al., 2004; Gormsen and Lazarus, 2019).

6 Conclusion

In periods of economic and financial distress, getting frequently-updated and forward-looking measures of the expected path of the economy is key for policy makers and market participants. We show that dividend futures can constitute a useful tool in this regard. We show how dividend futures in the US, EU, and Japan can be used to derive a lower bound on expected growth in dividends and GDP, as well as an estimate of expected growth during the evolving COVID-19 crisis.

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A Technical Details of the Lower Bounds

In this appendix, we detail the assumptions we use to derive a lower bound on dividend (in Section A.1) and GDP growth rates (in Section A.2).

A.1 Dividend Growth

We derive the lower bound for the one-period dividend growth expectations and the arguments directly extend to longer-term growth expectations. By no arbitrage, the price of a one-period dividend futures, $F_t^{(1)}$, is given by

$$F_t^{(1)} = \frac{\mathbb{E}_t[M_{t+1}D_{t+1}]}{\mathbb{E}_t[M_{t+1}]},$$

where M_{t+1} denotes the stochastic discount factor. We rewrite the equation as

$$\frac{F_t^{(1)}}{D_t} = \frac{\mathbb{E}_t\left[M_{t+1}\frac{D_{t+1}}{D_t}\right]}{\mathbb{E}_t[M_{t+1}]},$$

and using $\mathbb{E}\left[XY\right] = \mathbb{E}\left[X\right]\mathbb{E}\left[Y\right] + Cov\left(X, Y\right)$, we have

$$\begin{aligned}\frac{F_t^{(1)}}{D_t} &= G_t^{(1)} + \frac{Cov\left(M_{t+1}, \frac{D_{t+1}}{D_t}\right)}{\mathbb{E}_t[M_{t+1}]},\\ &= \frac{G_t^{(1)}}{\Theta_t^{(1)}},\end{aligned}$$

where

$$\Theta_t^{(1)} = \left[1 + \frac{Cov\left(M_{t+1}, \frac{D_{t+1}}{D_t}\right)}{\mathbb{E}_t[M_{t+1}]G_t^{(1)}}\right]^{-1},$$

is the (gross) risk premium on dividend growth. Our central assumption is that following the crisis at $t' > t$, investors's risk aversion increases, implying $\Theta_{t'}^{(1)} \geq \Theta_t^{(1)}$. As a result, we have

$$\frac{F_{t'}^{(1)}}{F_t^{(1)}} = \frac{G_{t'}^{(1)}}{G_t^{(1)}} \frac{\Theta_t^{(1)}}{\Theta_{t'}^{(1)}}$$
$$\leq \frac{G_{t'}^{(1)}}{G_t^{(1)}},$$

which yields the lower bound

$$\frac{G_{t'}^{(1)}}{G_t^{(1)}} \geq \frac{F_{t'}^{(1)}}{F_t^{(1)}}. \tag{6}$$

A.2 GDP Growth

To derive a lower bound on GDP growth, we start from a regression as in (5), where we regress dividend growth on GDP growth

$$\frac{D_{t+1}}{D_t} - 1 = \alpha_0 + \alpha_1 \left[\frac{Y_{t+1}}{Y_t} - 1 \right] + \epsilon_{t+1}.$$

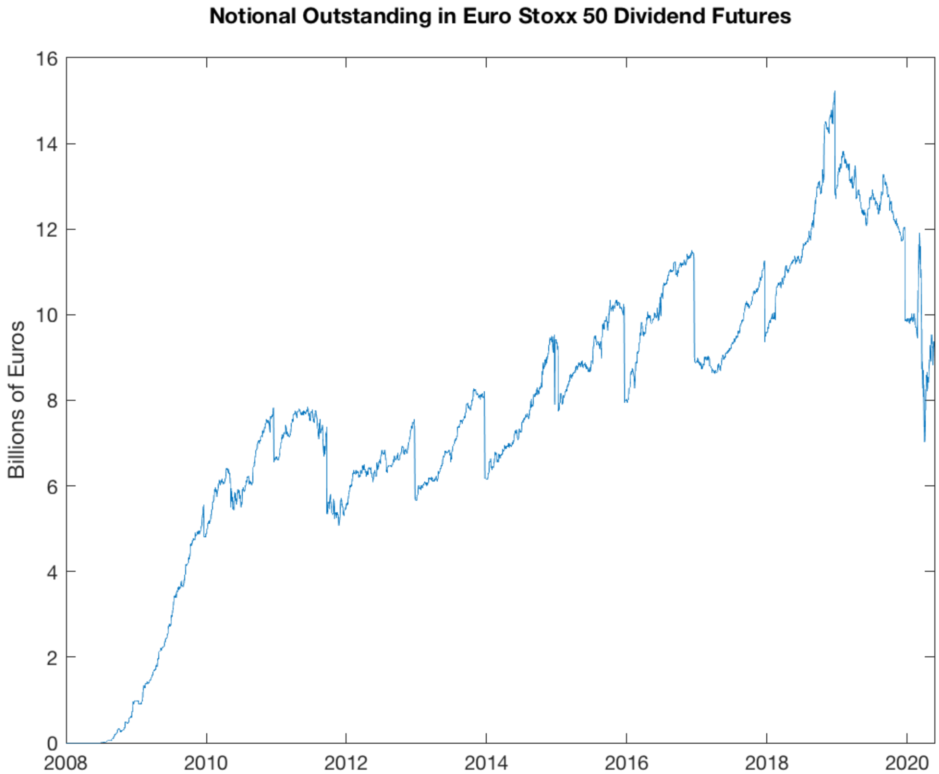
Taking conditional expectations and rewriting gives

$$\frac{G_{t'}^{(1)}}{G_t^{(1)}} = \frac{1 + \alpha_0 + \alpha_1 E_{t'} \left[\frac{Y_{t+1}}{Y_t} - 1 \right]}{1 + \alpha_0 + \alpha_1 E_t \left[\frac{Y_{t+1}}{Y_t} - 1 \right]},$$
$$\simeq 1 + \alpha_1 \left(E_{t'} \left[\frac{Y_{t+1}}{Y_t} \right] - E_t \left[\frac{Y_{t+1}}{Y_t} \right] \right)$$

using that $\alpha_0 \simeq 0$ and that $\frac{1+x}{1+y} - 1 \simeq x - y$ for (x, y) small. The above step assumes that expectations about ϵ are not updated between $t$and t'. Inserting into 6 and using $\frac{1+x}{1+y} - 1 \simeq x - y$ again gives

$$\frac{\mathbb{E}_{t'} \left[\frac{Y_{t+1}}{Y_t} \right]}{\mathbb{E}_t \left[\frac{Y_{t+1}}{Y_t} \right]} - 1 \geq \frac{1}{\alpha_1} \left[\frac{F_{t'}^{(1)}}{F_t^{(1)}} - 1 \right].$$

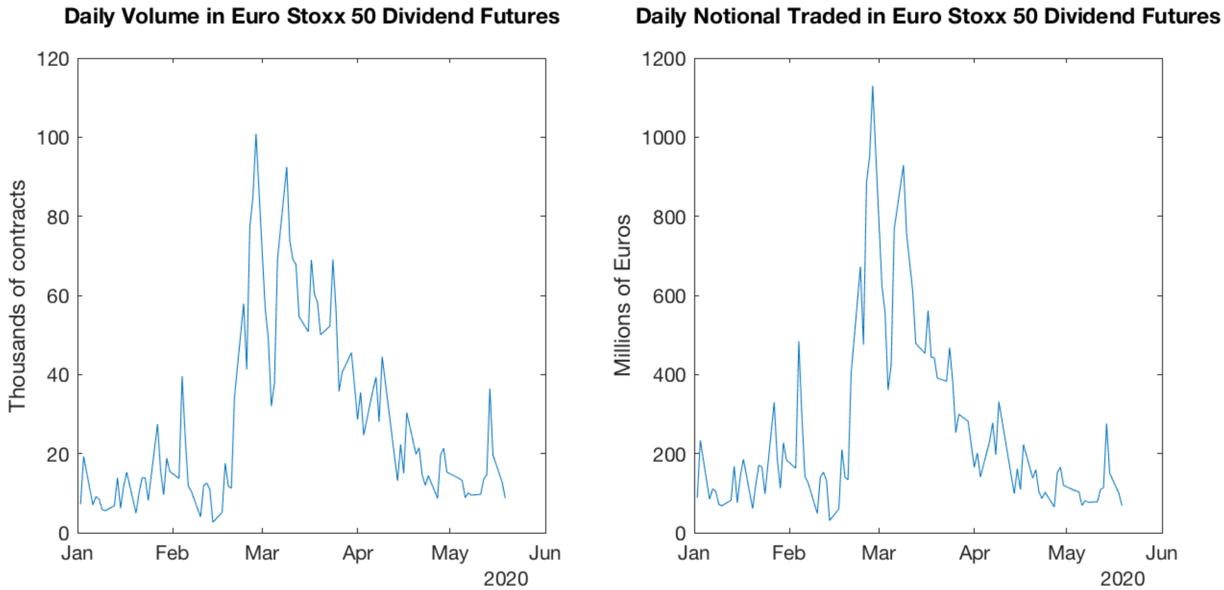
Figure 10: Notional Outstanding for Euro Stoxx 50 Dividend Futures



This figure shows the total notional outstanding on Euro Stoxx 50 dividend futures on the Eurex exchange.

B Additional Figures and Tables

Figure 11: Daily Volume in the Market for Euro Stoxx 50 Dividend Futures



The left side of this figure shows the daily volume traded in the market for Euro Stoxx 50 dividend futures. Each contract is for 100 dividend points. The right side of the figure shows the total value of the contracts traded on a given day. Sample is Jan 1 to May 19 2020.

Table 1: Predictive Regressions of Dividend Growth on Dividend Yields

This table shows results from regressions similar to (3). In a pooled sample across S&P 500, Euro Stoxx 50, and Nikkei 225, we regress realized dividend growth onto the ex-ante two-year yield and a dummy equal to 1 for Euro Stoxx 50 observations and a dummy equal to 1 for Nikkei 225 observations. HAC standard errors based on (Lazarus et al., 2019) are presented in parenthesis. Observations are quarterly.

	Intercept	EU dummy	Nikkei 225 dummy	$e_{it}^{(2)}$	R^2	# Obs
$\Delta_1 D_{i,t}$	0.035	0.007	0.043	-0.82	0.58	143
	(0.02)	(0.03)	(0.03)	(0.11)		

Figure 12: Reconciling the stock market and dividend price responses in Europe and Japan

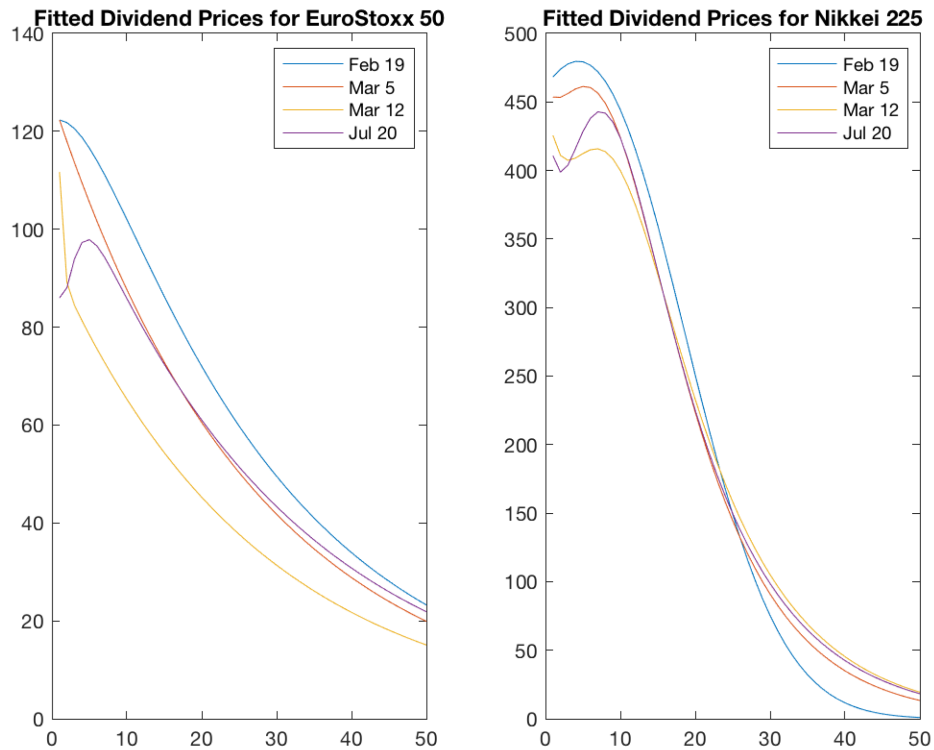


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Table 2: Mapping Dividends to GDP

This table shows the slope coefficient B_n for a regression of GDP growth onto dividend growth at different horizons (n), conditions and sample periods. The baseline coefficient is estimated in the 1985-2019 sample using using rolling 2-year growth and only considers observations where realized dividend growth is below the time-series average. Dividend growth is real dividend growth for S&P 500 and GDP growth is real GDP growth in US. HAC standard errors based on (Lazarus et al., 2019) are presented in parenthesis. Observations are quarterly.

	Baseline:	Robustness					
Horizon (years)	2	1	3	2	3	2	3
Condition:	Downside	Downside				Unconditional	
Sample:	1985-2019	1985-2019		1958-2019		1985-2019	
B_n	0.22	0.14	0.31	0.23	0.27	0.13	0.12
s.e.	(0.03)	(0.05)	(0.04)	(0.07)	(0.11)	(0.06)	(0.07)
R^2	0.50	0.18	0.67	0.19	0.23	0.14	0.12
Observations	62	66	62	125	131	240	236