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Financial Markets and the COVID-19 Pandemic

Niels J. Gormsen and Ralph S.J. Koijen

Booth School of Business, University of Chicago, Chicago, Illinois, USA;
email: niels.gormsen@chicagobooth.edu

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Abstract

We review the literature on the impact of the COVID-19 pandemic on financial markets. We first document several key facts about equity and fixed-income markets during this period. We then discuss various literatures that analyze broad movements in prices, market dislocations, and the impact of fiscal and monetary policy interventions. We conclude by discussing potential directions for future research.

1. INTRODUCTION

We review the literature on the impact of the COVID-19 pandemic on financial markets. This is no easy task given the vast literature that emerged in a short period of time following the unprecedented events that happened in 2020 in terms of the pandemic, subsequent government policy interventions, the macro economy, and financial markets.

As a result, we focus in this review more narrowly on three important themes: the broad impact on equity and fixed-income markets, market dislocations, and the impact of fiscal and monetary policy. What makes this episode particularly interesting and important from an asset pricing and macro-finance perspective is that the nature of the shock is well understood, which is typically a major challenge. By the nature of pandemics, the short-term impact is expected to exceed the long-run impact on the economy. After all, in the short run, economic activity is negatively affected by (the fear of) infections and social distancing policies, including lockdowns. In the long run, due to the expected development of vaccines and other treatments, economic activity will resume and the economy recovers.

We analyze the impact on financial markets through this lens, and we first document key asset pricing facts in Section 2 using data from equity, dividend futures, and fixed-income markets. In Section 3, we summarize the theoretical and empirical literature on equity markets. In Section 4, we discuss the literature on market dislocations during the period of extreme stress in March of 2022 and the impact of government interventions. We conclude in Section 5 with open questions that can be explored in future research.

One of the main takeaways from the review is that we need new theories to understand fluctuations in stock prices. The large fluctuations we observed during the pandemic cannot be easily explained by news or by theories revolving around persistent shocks to risk aversion, macroeconomic risks, or errors in expectations about fundamentals. One of the main questions for asset pricing going forward, therefore, is to explain why stock prices move so strongly without clear economic news.

2. MOTIVATING FACTS

We summarize key facts about asset prices during the COVID-19 pandemic. We discuss the data sources in Section 2.1 and the facts in Section 2.2.

2.1. Data

We obtain data from several sources.[1] We download daily stock returns for the US market portfolio from Ken French's data library. We obtain daily returns on the 30-year fixed maturity Treasury index from the Center for Research in Security Prices (CRSP) bond database.[2] We obtain real and nominal yields from the St. Louis FED database. We obtain prices on dividend futures from Bloomberg, following Gormsen & Koijen (2020).

2.2. Facts

We summarize several key facts about the dynamics of asset prices during the COVID-19 pandemic, and the period thereafter, in **Figure 1**. In **Figure 1*a***, we plot the dynamics of the aggregate US stock market during the COVID-19 pandemic (*red line*). We start at the peak prior to the

[1] Ken French's data library is available at **https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html**. The St. Louis FED database is available at **https://fred.stlouisfed.org/**.

[2] We use the 30-year nominal bond from the crsp.m_treasuries data set on Wharton Research Data Services.

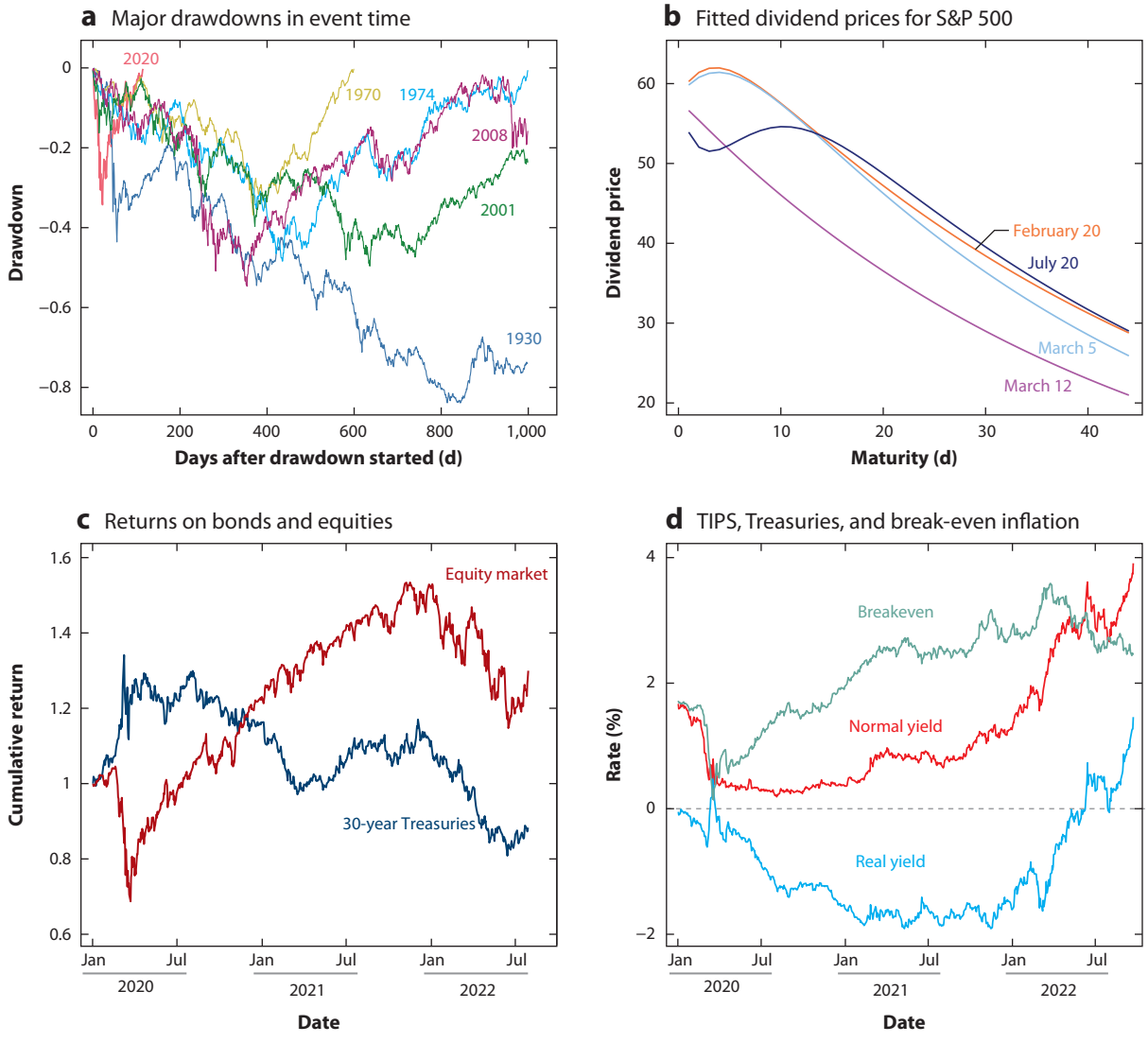

Figure 1

The dynamics of asset prices during the COVID-19 pandemic and other downturns. Panel *a* plots the cumulative return on the aggregate stock market during all drawdowns since 1926 that are at least as severe as the COVID-19 drawdown. Panel *b* plots the prices of dividend strips across maturities for four key dates during the COVID-19 pandemic. Panel *c* plots the cumulative return on the aggregate stock market and 30-year Treasuries. Panel *d* plots the yield on 5-year nominal bonds, 5-year real bonds, and their difference, the 5-year break-even inflation rate. Panel *b* adapted with permission from Gormsen & Koijen (2020). Abbreviations: S&P, Standard and Poor's; TIPS, Treasury Inflation-Protected Securities.

pandemic and plot the cumulative return until the cumulative return fully recovers. Two facts stand out. First, the market falls very sharply and declines by more than 34%. Second, the recovery is fast, and the entire decline and recovery take only 116 trading days. To put this in perspective, we plot all drawdowns since 1926 in the US stock market that are at least as large as the one observed during the COVID-19 pandemic. There are only five of such episodes in close to a century

of data, namely in 1930, 1970, 1974, 2001, and 2008. In all cases, the decline was more gradual and the recovery took much longer.

The fact that stock prices dropped quickly is unsurprising given the nature of the shock. Once investors realized the severity of the pandemic and the speed of transmission, markets adjusted quickly. What is surprising is (*a*) how much markets declined in the first place and (*b*) how little time it took for the market to recover. The second observation is particularly surprising given that it is not until December 11, 2020, that the first vaccine in the United States (developed by the Pfizer–BioNTech partnership) received Emergency Use Authorization (EUA). The vaccine developed by Moderna received EUA a week after that.[3] That said, stock markets are forward-looking, and Acharya et al. (2021) show that the stock market gained more than $1 trillion on just 3 days[4] on which good news was announced about the trials of Pfizer–BioNTech and Moderna, respectively. This finding suggests that at least some part of the recovery can be related to news about vaccines, but it is unlikely to explain the full recovery and the strong rally in 2021.

In **Figure 1*b***, we provide a complementary perspective using dividend futures, following Gormsen & Koijen (2020).[5] Dividend futures are claims on dividends on an index or individual securities at a particular year in the future. We use these data to compute the prices of dividend strips at various maturities. To extend the figure beyond the maturity for which dividend futures are available, we use the restriction that the sum of all dividend claims has to be equal to the value of the aggregate stock market. We then fit Nelson & Siegel (1987) curves to interpolate the prices. We refer to Gormsen & Koijen (2020) for further details.[6]

We plot the curves on four key dates in 2020: February 20th, March 5th, March 12th, and July 20th. February 20th is the start of the drawdown and provides a natural point of reference to benchmark the other curves. Between February 20th and March 5th, the market falls, and this is entirely driven by the valuation of long-term dividend claims. This finding suggests that this is a shock to investors' risk appetite or sentiment, with little connection to fundamentals. After all, given the nature of the shock, we expect the impact on expected cash flows to be most pronounced in the short run. Once vaccines and treatments have been developed, the economy is expected to recover and the impact on expected long-term dividend is therefore more muted.

From March 5th to March 12th, the market falls sharply, and now both short- and long-term claims decline significantly. The decline in short-term claims presumably mostly reflects revisions in cash flow expectations (as the impact of discount rates is small for 1- or 2-year claims). Since expected long-term cash flows are unlikely to be materially reduced by the pandemic, the decline in long-term claims likely reflects a further decline in investors' risk appetite or sentiment.

Even without the analysis of dividend futures, it is implausible that the 35% drop in stock prices is entirely driven by expected cash flows. After all, the first 10 years of dividends only accounts for approximately 20% of the value of the stock market, so a 35% decline due to just fundamentals would imply that US firms would, for instance, pay zero dividends for the next decade and, in addition, significantly reduce dividends thereafter. This scenario seems unlikely, even in real time (Gormsen & Koijen 2020), which leaves an important role for risk appetite or sentiment.

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[3] China approved the CanSino vaccine on June 24, 2020, and Russia the Sputnik V vaccine on August 11, 2020.
[4] The dates are May 18th, July 14th, and November 9th of 2020.
[5] For earlier work on dividend strips and futures, we refer readers to van Binsbergen, Brandt & Koijen (2012), van Binsbergen et al. (2013), van Binsbergen & Koijen (2017), and Gormsen (2021).
[6] Cejnek, Randl & Zechner (2021) study firms' dividend policies during the COVID-19 pandemic. After documenting the impact on dividend futures, the authors show that firms with high levels of leverage and those that are more directly exposed to the COVID-19 pandemic experienced a larger decline in the value of long-term dividends. Firms with high operating cash flows experienced a smaller decline in the value of short-term dividends.

Between March 12th and July 20th, the market recovers. On July 20th, dividend strip prices nicely reflect how markets value the impact of the pandemic once investors' sentiment has normalized. Long-term dividend prices are fully recovered and are in fact slightly higher compared to before the pandemic. Short-term dividend prices, up to approximately 10 years, are significantly lower, however. Based on the nature of the shock, this is the pattern we expect to see in firms' fundamentals, as the impact is most pronounced in the short run.

A key aspect of the above analysis is that short-term claims are more directly related to expected cash flows than long-term claims, for which prices are highly influenced by discount rates. The short-term claims are therefore useful for estimating expected growth rates in real time. In Gormsen & Koijen (2020), we use dividend futures to provide a lower-bound on growth expectations. In Gormsen, Koijen & Martin (2021), we then sharpen the bound using new data on dividend options. In both cases, we conclude that fundamentals cannot be the sole explanation for the decline in the value of the aggregate stock market.

The questions raised by **Figure 1*a*,*b*** are (*a*) why the market fell as much as it did and (*b*) why it recovered so quickly. In the following sections, we summarize some of the relevant literature that makes progress on these important questions.

In **Figure 1*c***, we add two more facts. First, equity markets continued to rally during the pandemic until the beginning of 2021. Second, long-term nominal Treasury bonds rallied as the stock market fell, then moved little for several months, and declined at the end of the sample. The fact that stock and bond prices do not move in tandem throughout most of the period (cumulative returns are, in fact, negatively correlated) implies that the decline in interest rates cannot explain the rally in stock markets. While interest rates are low by historical measures during this period, interest rates did not move much for most of the stock market rally.[7] In 2022, during which new variants of the virus emerge, equity and bond markets fall. This is in part driven by rising price levels and high levels of inflation as well as geopolitical uncertainty related to Russia's invasion of Ukraine.

In **Figure 1*d***, we plot the dynamics of the yields on 5-year nominal and inflation-indexed Treasury bonds. The difference between these yields is the 5-year break-even inflation rate. This panel illustrates once more that interest rates (both nominal and real yields) were stable during 2021, while the stock market rallied. Toward the end of 2021, inflationary pressures are building, leading to an increase in the break-even inflation rate. During this period, both real rates and nominal yields increase sharply.

An important question for future research is to understand the underlying causes of these high rates of inflation and to trace them back to more primitive demand (e.g., pandemic-related stimulus) and supply side factors (e.g., supply chain frictions). Understanding those determinants is critical to guide future policy. Asset prices can be particularly informative to identify those forces as asset prices are forward-looking and respond at high frequencies to news.

3. THE IMPACT ON EQUITY MARKETS

In this section, we summarize the literature that studies the impact of the COVID-19 pandemic on equity markets. In Section 3.1, we first discuss some of the prominent macro-finance models that have been proposed to understand the joint dynamics of epidemics, the real economy, and financial markets. In Sections 3.2 and 3.3, we summarize the mostly empirical literature on this

[7]The low-rate environment may have had an indirect effect on the stock market. If investors reach for yield and gradually transition from safe Treasuries to riskier equities, then this flow from bonds to stocks can move prices if the aggregate stock market is inelastic (see Gabaix & Koijen 2022).

topic, both in terms of the aggregate stock market (Section 3.2) and the cross-section of stock returns (Section 3.3).

3.1. Incorporating Pandemics in Macro-Finance Models

Eichenbaum, Rebelo & Trabandt (2021) study the interaction between the economic decisions of households and the dynamics of an epidemic. The evolution of the epidemic is modeled as an extension of the canonical susceptible, infected, and recovered (SIR) model of Kermack & McKendrick (1927).

Instead of an exogenous rate of transmission, as in Kermack & McKendrick (1927), purchasing consumption goods and working raise the rate of transmission. In response, susceptible people reduce consumption and labor supply, which results in an economic downturn. In an extension of the model, the healthcare system may get overwhelmed if many people are infected at the same time. If this happens, it is optimal to reduce consumption and labor supply more aggressively.

Eichenbaum, Rebelo & Trabandt (2021) show that the competitive equilibrium is not Pareto optimal, as people do not internalize the impact of their consumption and labor supply decisions on the evolution of the virus. After calibrating the model, Eichenbaum, Rebelo & Trabandt (2021) highlight the benefits of aggressive containment policies early on in the epidemic. While this increases the economic cost, it raises overall welfare by reducing the number of people who die during the epidemic by approximately half a million lives in the United States.

Jones, Philippon & Venkateswaran (2021) also present a macroeconomic model in which consumption and work increase the risk of transmission. An important feature of the model is that people can work from home, which mitigates the risk of transmission but comes at the cost of lowering productivity. These productivity losses decline as households gain experience in working from home. This learning-by-doing feature enriches the dynamics of the model, and it provides yet another reason why the costs of pandemics are higher in the short run.

There are two externalities in the model. First, households do not take into account the risk that they infect others, and second, there is a congestion externality in case the healthcare system gets overwhelmed. Jones, Philippon & Venkateswaran (2021) show that the wedge between private and social incentives is particularly large during the onset of the pandemic, as the possibility of future infection weakens the incentive to be careful today.

The government can implement mitigation policies to counter this "fatalism effect." Jones, Philippon & Venkateswaran (2021) also explore a multi-sector version of the model in which sectors differ in their exposure risks and the cost of working from home. After calibrating the model, they find that the model's predictions are consistent with data on disease and economic outcomes.

The previous models focus on the joint dynamics of the macro economy and the epidemic. Hong, Wang & Yang (2021) instead study the joint dynamics of firm valuations and the epidemic. There are two unique sources of aggregate risk in the model. First, the rate of transmission is stochastic, and second, the arrival date of the vaccine is unknown as well. Firms can undertake costly mitigation efforts to reduce the negative impact of infections on earnings. While those efforts lower today's earnings, the positive impact on expected future earnings implies that mitigation efforts can increase firm valuations. The optimal mitigation efforts are also affected by uncertainty in transmission rates due to the option value of waiting.

Focusing on the model's implications for asset prices, Hong, Wang & Yang (2021) find that price-earnings ratios can be higher during a pandemic. The sharp reduction in earnings, in part due to mitigation efforts, is only temporary, and earnings recover once a vaccine is discovered. The temporary impact on fundamentals is consistent with the evidence discussed in Section 2 and, in particular, the dividend strip prices in July 2020 (**Figure 1*b***).

Acharya et al. (2021) develop a macro-finance model to estimate the value of a vaccine and ending the pandemic using data on the joint dynamics of stock markets and expected time to deployment of a vaccine. As discussed in Section 2, stock markets responded sharply on days on which vaccine progress was announced. The estimates in Acharya et al. (2021) imply that reducing the expected time to deployment of a vaccine by a year results in a 4–8% increase in the stock market. Using the model and empirical estimates, Acharya et al. (2021) find that the value of a cure ranges between 5–15% of wealth. The value of a cure is increasing in the uncertainty about the duration of the pandemic.

3.2. Aggregate Stock Returns

Early contributions to the literature on the aggregate stock market include work by Zhang, Hua & Ji (2020) and Topcu & Gulal (2020). Zhang, Hua & Ji (2020) study the properties of several risk measures using data from aggregate stock markets across various countries, while Topcu & Gulal (2020) study how the pandemic affects equity markets in emerging markets from March 10th to April 30th of 2020.

Baker et al. (2020) put the sharp decline of the US stock market in a broader perspective by comparing the COVID-19 pandemic to previous pandemics in 1918–1919, 1957–1958, and 1968. Baker et al. (2020) show that other pandemics did not result in such extreme daily returns. This sharply contrasts with the COVID-19 pandemic, as news about the evolution of the virus is the dominant driver of large daily US stock returns (both positive and negative) during the period from February 24th to April 30th of 2020. As earlier pandemics had similar, if not worse, health effects,[8] Baker et al. (2020) suggest that the sensitivity of the stock market to pandemic-related news is due to government restrictions on commercial activity that were unlike the policy response to earlier pandemics.

In related work, Alfaro et al. (2020) find that part of the stock market volatility from January 22nd to April 10th of 2020 can be explained by news about the trajectory of the pandemic. An unanticipated doubling of projected infections leads to a decline in the aggregate stock market between 4% and 11%. Firms in industries that are more affected by social distancing are more sensitive to news about the path of the pandemic. Alfaro et al. (2020) then link the decline in market values to county-level employment data. A key finding is that counties with firms that do relatively well in terms of their valuations experience a higher growth rate of jobless claims per worker. A potential interpretation is that firms that are able to adjust their costs by cutting back on labor do relatively well in terms of valuations, yet the counties in which such firms are located then experience greater initial jobless claims.

Arteaga-Garavito et al. (2022) extend this line of work by using data on official announcements of medical conditions across 21 countries and news distributed via Twitter by major newspapers. Following an announcement, equity prices on average jump up, even in case of bad news. No noticeable impact is seen on bond markets. A potential interpretation is that the resolution of uncertainty lowers the risk premium on equities.

The authors then estimate a model of contagion to capture how global news spreads across financial markets. The authors use this model to estimate the price of contagion risk and find it to be large and significant. Based on this evidence, Arteaga-Garavito et al. (2022) argue that mitigation policies can have a positive impact on the evolution of the pandemic and on market valuations.

[8]Baker et al. (2020) note that the Spanish flu pandemic had an excess mortality rate in the United States that was 14 times as large as the excess mortality rate of the COVID-19 pandemic through June 23, 2020.

While news about the evolution of the virus and a potential cure do play a role in explaining market fluctuations, the large decline and rapid recovery cannot be fully explained by these factors (at least not using the measures proposed in the literature so far). This makes it particularly interesting to explore the role of investors' beliefs during the pandemic.

Giglio et al. (2021) study how investors' expectations about economic growth and the stock market changed during the period from February to April of 2020. Building on the authors' earlier work (Giglio et al. 2019), Giglio et al. (2021) survey Vanguard clients at three key points in time: before the crash, after the market fell by more than 20%, and after the market rallied by more than 25% from the bottom.

The authors find that short-term beliefs about economic growth and the stock market are more pessimistic following the crash. Also, the perceived probability of a stock market and GDP disaster nearly doubles. Such pessimistic beliefs about stock returns reduce the demand for equities and can amplify the market's decline. The authors show that those investors who were most optimistic in February in fact reduced their beliefs the most and sold the most equity. That said, the magnitudes are small. For instance, optimistic investors allocated 73% of their portfolio to equities in February and actively reduced their equity share (on average) by 1.05%.

In related work, Landier & Thesmar (2020) study the dynamics of analysts' earnings forecasts and discount rates implied by equity valuations. A key finding is that the 10% decline between February 15th and May 11th of 2020 can be fully explained by revisions in analysts' expectations. However, the forecasts smoothly and monotonically transition to a lower level, leaving the sharp decline and rapid recovery in equity prices unexplained. After all, the market declined by almost 35% and then recovered by more than 25% in between February 15th and May 11th. These large fluctuations in equity prices require a 1.5% increase and decline in long-run discount rates in a span of 2 months, which is remarkable for long-run discount rates, as we discussed before.

Landier & Thesmar (2020) decompose changes in the long-run discount rate into fluctuations in interest rates, leverage, and a risk premium effect. The leverage effect and the risk premium both raise the long-run discount rate during the onset of the pandemic, which is partially offset by the decline in interest rates. The subsequent recovery is entirely due to the leverage effect and the decline in the risk premium. The interest rate is flat during this period and does not explain the normalization in the long-run discount rate.

Cox, Greenwald & Ludvigson (2020) provide a decomposition of the stock market decline and recovery using a dynamic asset pricing model. The model attributes stock price fluctuations to economic fundamentals, interest rates, corporate earnings shares, and discount rate fluctuations due to movements in the price of stock market risk. Cox, Greenwald & Ludvigson (2020) conclude that the sudden decline and rapid recovery cannot be explained by fundamentals, interest rates, or corporate profit shares, thus assigning the price movements to the price of risk driven by large fluctuations in risk aversion or sentiment. This result is consistent with the broader message emerging from this literature.

Cox, Greenwald & Ludvigson (2020) also study the role of the Federal Reserve. They find that while conventional monetary policy cannot explain much of the variation, unconventional monetary policy appears to be more impactful.

Knox & Vissing-Jørgensen (2022) decompose movements in stock prices into movements coming from expected future cash flows, risk-free rates, and risk premia. The authors provide a methodology to do the decomposition in real time based on dividend futures, option prices, and long-run inflation-indexed bonds. The authors find that most of the fluctuations in stock prices are driven by the risk premium component, echoing the discussion above, although long-term interest rates also play a role.

Boudoukh et al. (2021) study the dynamics of risk during the pandemic through a principal component analysis of equity, bond, and foreign exchange markets. The authors find that the volatility of the first principal component greatly increased at the onset of the pandemic and show that the benefits to global diversification diminished during the crisis. The authors relate the development in the global factor structure to the pandemic through textual analysis of news articles.[9]

3.3. The Cross-Section of Stock Returns

The papers discussed so far focus mostly on the aggregate stock market. We next turn our attention to the cross-section of firms. While many of the themes are similar, the literature emphasizes an important difference in the role of expected cash flows and discount rates in understanding price dynamics. In particular, whereas discount rates appear to have driven most fluctuations in the aggregate stock market during the pandemic, cash flow shocks appear to have played a relatively larger role for cross-sectional differences in price changes.

Ramelli & Wagner (2020) are among the first authors to study the impact on the cross-section of firms[10] and focus on three distinct periods in 2020: (*a*) January 2nd to January 17th, (*b*) January 20th to February 21st, and (*c*) February 24th to March 20th. The first main finding is that firms with more exports or supply chain exposure to China experienced lower returns during the first two periods. More broadly, US firms with more international exposure (as measured by the fraction of non-US revenues) had lower returns during the second period. The second main finding is that firms with low levels of cash and high levels of leverage experienced lower returns during the third period.

In related work, Fahlenbrach, Rageth & Stulz (2021) explore the value of financial flexibility during the pandemic. Firms are considered to be more financially flexible when they have more cash, less short-term debt, and less long-term debt in December 2019. Fahlenbrach, Rageth & Stulz (2021) find that firms with more financial flexibility experienced a smaller decline in their stock price and that financial flexibility was particularly valuable for firms that are more exposed to the pandemic. In addition, Fahlenbrach, Rageth & Stulz (2021) find that the difference in stock prices persists during the recovery. This finding implies that a temporary shock to revenues has long-lasting consequences for firms with little financial flexibility.

Pagano, Wagner & Zechner (2021) use the COVID-19 pandemic to test the implications of rare disaster models (Barro 2006, Gabaix 2012). Pagano, Wagner & Zechner (2021) first develop a model in which investors learn about the probability of disaster and, once a disaster occurs, about its persistence. Firms that are more exposed to the disaster experience a larger decline in valuations, in part driven by an increase in expected returns. To take the model to the data, Pagano, Wagner & Zechner (2021) use data from Koren & Peto (2020) to measure an industry's immunity to social distancing requirements. The patterns in realized returns and option-implied measures of expected returns broadly align with the theory.

Papanikolaou & Schmidt (2022) zoom in on the impact of supply-side frictions by measuring the differential impact on employment, expected revenue growth, stock prices, and default risk of firms' employees ability to work remotely.[11] Firms that face more work disruptions, as employees

[9]For additional analysis of return volatility during the pandemic, we refer readers to Cheng (2020) and Jackwerth (2020).

[10]Mazur, Dang & Vega (2020) provide an early descriptive analysis of the cross-sectional impact of the COVID-19 pandemic on equity markets.

[11]Papanikolaou & Schmidt (2022) also differentiate between critical and noncritical industries, where critical industries provide essential infrastructure. Those critical industries are not as much affected by government restrictions.

cannot work remotely, experience larger declines in employment, analysts' expected revenues, and stock prices and a larger increase in the probability of default. The expectations data reveal that analysts expected the pandemic to be short-lived, although the work exposure variable still predicts differences in revenue expectations in the next 2 years (2021 and 2022).

Papanikolaou & Schmidt (2022) also provide an interesting new perspective on the apparent disconnect between the recovery of the stock market and the performance of the real economy in the spring of 2020. In particular, Papanikolaou & Schmidt (2022) show that the composition of listed firms is heavily skewed toward industries with low work exposure and that those firms experience fewer disruptions in terms of employment and revenue. Listed firms are thus not fully representative of the broader economy. Lastly, by focusing on different demographic groups, Papanikolaou & Schmidt (2022) show that the probability of nonemployment increases the most for women and lower-earning groups. To the extent that the employment effects are long-lasting, these findings can be important in explaining future income inequality.

Like Alfaro et al. (2020), Bretscher et al. (2020) also explore how companies headquartered in different counties are differentially affected by COVID-19. Using a difference-in-differences strategy, they find that daily returns are on average 27 basis points lower in the 10 days following the first recorded case. As these firms sell their goods and services throughout the country and internationally, this effect is likely due to negative supply shocks.

Several of the papers discussed so far make progress on disentangling the impact of demand and supply shocks on equity valuations. Hassan et al. (2022) extend this literature by analyzing the firms' perspective using text-based measures from earnings calls. An important contribution of the paper is to construct these new measures that complement traditional data from income statements and balance sheets. The advantage of this approach is that textual analysis may provide new ways to analyze economic mechanisms, at least as perceived by firms, and thus inform policy decisions.

Equipped with these data, Hassan et al. (2022) explore the impact of demand and supply shocks on equity valuations and firm-level investment in 82 countries. A key finding is that demand and supply impacts are both important in explaining stock returns in 2020. However, negative demand shocks appear to be the main driver of the substantial decline in firm-level investment.

Albuquerque et al. (2020) use the COVID-19 shock to test theories of environmental and social (ES) policies. Firms with high ES ratings may fare better during the COVID-19 crash in terms of both the level and the volatility of stock prices for (at least) two reasons. First, high ES firms have more loyal customers with more inelastic demand in the product market. Second, high ES firms may be held by investors with a particular demand for firms with those characteristics, and those investors may have less volatile demand shocks during times of stress.[12]

Albuquerque et al. (2020) find that high ES firms indeed experience higher returns on average and less volatile returns during the market's drawdown. By using additional measures based on advertising expenditures and ES preferences of institutional investors, Albuquerque et al. (2020) document that customers' loyalty (or inelastic demand) in the product market appears to be particularly important for the level of stock prices, as those firms appear to be able to raise margins during times of stress, while loyal investors are important to explain differences in the volatility of stock returns.

Pastor & Vorsatz (2020) study the performance and flows into US actively managed mutual funds. First, Pastor & Vorsatz (2020) show that active funds underperformed their passive

[12] For a methodology to connect investors' demand shifters and tastes to equity valuations and return volatility, see Koijen & Yogo (2019).

benchmarks during the period from February 20th to April 20th of 2020. This result runs counter to the idea that active managers outperform during market downturns, when investors' marginal utility is high, which has been proposed in the literature to justify their underperformance on average (net of fees). Second, and complementing the analysis of Albuquerque et al. (2020), Pastor & Vorsatz (2020) find that funds with better sustainability ratings from Morningstar have higher benchmark-adjusted performance. Also, funds with better star ratings from Morningstar perform better. Third, Morningstar's sustainability scores also positively predict net flows during the crisis period. As sustainability ratings remain an important determinant of flows during times of stress, Pastor & Vorsatz (2020) conclude that investors view sustainability as a necessity instead of a luxury good.

Ding et al. (2021) provide a comprehensive overview of the determinants of stock returns during the COVID-19 downturn using data across 6,700 firms in 61 countries covering more than 90% of the world's market capitalization. They explore the impact of financial conditions (e.g., cash holdings and capital structure variables), international exposure to COVID-19 via customers and supply chains, corporate social responsibility, corporate governance, and ownership structure. Several of these themes are connected to papers we discussed before, and the findings broadly align. That said, the work by Ding et al. (2021) stands out in terms of its breadth, in terms of both the size of the sample and the determinants considered.

In addition, Ding et al. (2021) show that firms with less entrenched management have higher returns during the COVID-19 crash. In terms of ownership, firms controlled by families, large corporations, and governments have higher returns, while those with higher levels of ownership by hedge funds and other asset managers have lower returns.

Dechow et al. (2021) argue that the timing of cash flows can be a useful indicator for how exposed a given firm is to the pandemic. Everything else equal, a firm with short cash flow duration is more exposed to the pandemic, assuming that the effect of the pandemic is relatively short-lived. Consistent with this conjecture, the authors indeed find that firms with shorter cash flow duration performed worse at the onset of the pandemic.

The studies discussed so far cover a large fraction of equity markets, although financial firms are often excluded. However, given the fragility of the financial sector during the 2008 financial crisis, this sector is of particular importance. We conclude by discussing two papers that focus on different parts of the financial sector during the COVID-19 pandemic.

First, Acharya, Engle & Steffen (2021) study the decline of banking stocks during the market's drawdown. Given the nature of the shock, banks with large ex ante exposures to undrawn credit lines and large ex post drawdowns experience more negative stock returns.[13] Importantly, this form of balance-sheet liquidity risk is not well captured by traditional measures of bank risk or systemic risk such as SRISK. Banks with higher capital buffers are less affected by this drawdown channel.

Second, Koijen & Yogo (2022a) study the life insurance sector during the COVID-19 crisis. While traditionally considered to be a safe and stable industry, the balance sheets of life insurers were stressed during the 2008 global financial crisis (Koijen & Yogo 2015). One important reason is that life insurers transitioned from underwriting products that are largely exposed to idiosyncratic health and life risks to products that are exposed to aggregate risks, such as variable annuities. Variable annuities are long-dated savings products that bundle traditional mutual

[13] Acharya, Engle & Steffen (2021) show that the new measure of balance-sheet liquidity risk is also priced during the onset of the financial crisis from Q3 2007 to Q2 2008. While liquidity risk is important during both crises, the liquidity risk measure is affected by aggregate rollover risk (due to wholesale finance) during the financial crisis and by aggregate drawdown risk (due to credit lines) during the COVID-19 crisis.

funds with long-dated minimum return guarantees. As these products cannot be perfectly hedged with standard derivatives, insurance companies are exposed to mismatch risk and experience losses when interest rates and equity prices decline.

While this fragility was first on display during the 2008 global financial crisis, Koijen & Yogo (2022a) show that variable annuity insurers underperform the S&P 500 and even the financial sector as a whole during the COVID-19 crash. In fact, life insurers' stock price performance is closer to that of the airline industry. Across insurance companies, Koijen & Yogo (2022b) show a strong correlation between the stock price performance during the 2008 global financial crisis and the COVID-19 pandemic. For European insurers, a similar correlation is observed across crisis periods, in this case the 2008 global financial crisis, the European sovereign debt crisis, and the COVID-19 pandemic. This ongoing fragility can be traced back to the long-dated nature of the liabilities and the ongoing low-rate environment that stresses life insurance companies and pension funds alike.

4. MARKET DISLOCATIONS

Fixed-income markets were subject to substantial stress and illiquidity during the height of the crisis in March 2020. This stress resulted in large fluctuations in prices on fixed-income securities as well as price dislocations and temporary failures of the law of one price. These patterns were present both in the Treasury market and in the corporate bond market. We refer to O'Hara & Zhou (2023) for a detailed discussion of fixed-income markets.

The papers reviewed below largely agree on the chain of events. Starting in early March, bond investors—including households, foreign agencies, and hedge funds—started withdrawing from positions in fixed-income markets, which put downward pressure on prices. Market makers also reduced their positions in fixed-income markets and stopped providing liquidity. Ultimately, liquidity ran out, bid-ask spreads increased, and the law of one price failed. Most of these issues were resolved shortly after the Federal Reserve intervened to stabilize markets.

While the events in the Treasury and corporate bond markets share many of the same features, there are differences in the nature of the market stress and in how the Federal Reserve may have been able to alleviate them. We therefore review each market on its own.

4.1. Treasury Markets

Papers on the Treasury market focus on pricing in the middle of March 2020. During these weeks, the 10-year yield on US Treasuries increased by approximately 60 basis points. He, Nagel & Song (2022) note that this increase in yields is unusual, as Treasury yields historically have decreased in crises. The literature broadly argues that the sudden increase in yields is the result of selling pressure and highly constrained intermediaries.

4.1.1. Selling pressure in Treasury markets. Vissing-Jørgensen (2021) finds that the main selling pressure came from mutual funds. In total, mutual funds sold approximately $300 billion in the first quarter of 2020. Mutual funds were forced to liquidate bonds in response to outflows, and funds facing larger outflows sold more Treasury bonds. Ma, Xiao & Zeng (2022) emphasize that bond mutual funds disproportionately sold Treasuries to obtain the cash needed to meet withdrawals, as Treasuries are one the most liquid components of the portfolio.[14] The main driver of mutual fund withdrawals was the household sector, which withdrew almost $300 billion in the

[14]Ma, Xiao & Zeng (2022) show that mutual funds follow a liquidity pecking order to meet outflows. They first sell liquid assets, such as Treasuries, before selling less liquid corporate bonds.

first quarter of 2020 (Vissing-Jørgensen 2021). Vissing-Jørgensen notes that withdrawals from mutual funds by households are themselves unlikely to be driven by liquidity needs, as households simultaneously deposited approximately $700 billion in money market mutual funds.

Vissing-Jørgensen (2021) also documents substantial selling pressure from foreign official agencies. Foreign agencies sold $182 billion worth of Treasuries in the first quarter of 2020, with most of the selling taking place in the two middle weeks of March. Of these $182 billion, $110 billion were linked to liquidity needs.[15]

Finally, there was selling pressure coming from hedge funds unwinding certain trading strategies involving Treasuries. Many hedge funds invested in the Treasury basis trade, which takes a long position in Treasuries in the cash market and a short position in Treasury futures. As the basis moved against the trade in the early part of the crisis, hedge funds were forced to limit their positions, which resulted in selling pressure in Treasuries (see Barth & Kahn 2020; Schrimpf, Shin & Sushko 2020; Vissing-Jørgensen 2021). Vissing-Jørgensen (2021) estimates that hedge funds sold $183 billion in the first quarter of 2020 based on data from the US Securities and Exchange Commission (SEC). Vissing-Jørgensen (2021) also notes, however, that the total selling was likely larger because only those hedge funds selling to US investors have to report to the SEC.

These findings highlight three sources of selling that add up to approximately $700 billion in the first quarter of 2020. A significant fraction of this selling pressure can be tied to liquidity needs of financial institutions. The literature broadly argues that the selling pressure was large enough to create substantial market stress and liquidity issues, to which we turn next.

4.1.2. Market stress and evidence of constrained intermediaries. He, Nagel & Song (2022) document that inconvenience yields on Treasuries increased substantially during the crisis. The spread between the 10-year Treasury rate and the Overnight Index Swap (OIS) swap rate increased from 20 to 40 basis points in March 2020. He, Nagel & Song show that this increase is consistent with a model in which dealers with tight balance sheet constraints shy away from Treasuries to avoid the associated balance sheet cost. He, Nagel & Song also note that the increase in the inconvenience yield runs counter to the 2008 global financial crisis, when inconvenience yields became more negative (that is, Treasuries earn a convenience yield). The difference between the two episodes is that dealers entered the global financial crisis with a short position in Treasuries and scrambled to buy Treasuries as the crisis unfolded.

The evidence on inconvenience yields presented by He, Nagel & Song (2022) is important because it directly points to liquidity issues in the Treasury market. In principle, the increase in yields on Treasuries could reflect fundamental news, like credit or inflation risk, in which case the Federal Reserve may not want to intervene. In contrast, the increase in inconvenience yields directly points at market stress and strengthens the argument for intervention by the Federal Reserve.

4.1.3. Impact of interventions by the Federal Reserve. The literature finds that the Federal Reserve managed to calm markets by buying Treasuries. During the first quarter of 2020, the Federal Reserve purchased a total of $1 trillion of Treasuries, which the literature argues has a causal impact on lowering yields (Vissing-Jørgensen 2021).

[15] Vissing-Jørgensen (2021) notes that foreign agencies did not sell at the peak of the 2008 global financial crisis. This discrepancy between the two crises may reflect a bigger need for cash during the COVID-19 crisis or that foreign agencies over time have increased the amount of US Treasuries in their portfolios (Vissing-Jørgensen 2021).

Vissing-Jørgensen (2021) makes an important distinction between the announcement of an intent to buy Treasuries versus the actual buying of Treasuries and argues that it is the actual buying of Treasuries that calms the market. To understand the argument, note that two big quantitative easing (QE) announcements occurred on March 15th and March 23rd. On March 15th, the Federal Reserve announced an intent to buy $500 billion in Treasuries. On March 23rd, the Federal Reserve announced an intent to make unlimited Treasury purchases and $300 billion in lending partly via the secondary market for corporate bonds. However, Vissing-Jørgensen shows that neither of these announcements appeared to have an impact on yields on Treasury bonds. In contrast, Treasury yields did decrease substantially after the Federal Reserve increased the pace at which it purchased Treasuries, which happened around March 19th. The strong correlation between yields and the amount of Treasuries bought leads Vissing-Jørgensen to conclude that the Federal Reserve calmed markets by taking Treasuries onto its balance sheet (and off the balance sheet of other investors).

4.2. Credit Markets

Corporate bond markets also experienced severe stress during March 2020. As in the Treasury market, the stress appeared to arise from a combination of selling pressure and intermediary constraints. The literature finds that interventions by the Federal Reserve again played an important role in calming the market.

4.2.1. Liquidity issues in corporate bond markets. The literature emphasizes several liquidity issues in corporate bond markets. For instance, bid-ask spreads and transaction costs increased substantially during the first weeks of March. O'Hara & Zhou (2021) find that transaction costs tripled from early February to mid-March for the average trade. For trades in large quantities (block trades), the increase is even larger, with transaction costs being six times higher in mid-March than in early February (see also Kargar et al. 2021). These patterns are even more pronounced for customer-to-customer trades. Customer-to-customer spreads were smaller than customer-to-dealer spreads before the crisis, but during the height of the crisis, customer-to-customer spreads were more than twice as large as the customer-to-dealer spreads. O'Hara & Zhou (2021) and Kargar et al. (2021) consider customer-to-customer deals prohibitively expensive and an unviable source of liquidity during the crisis.

O'Hara & Zhou (2021) emphasize the importance of market makers, and their constraints, in the development of the crisis. They find that market makers unwound their corporate bond positions during the first weeks after the outbreak, exacerbating selling pressure. Moreover, market makers withdrew from the market more broadly. While most trades are usually customer-to-dealer trades, most trades were customer-to-customer trades during the height of the crisis, which, as mentioned, happened at exceptionally high transaction costs (see also Kargar et al. 2021).

Haddad, Moreira & Muir (2021) document large price dislocations and failures of the law of one price. Haddad, Moreira & Muir show that bond spreads were substantially above credit default swap (CDS) spreads. They also document that prices of bond exchange-traded funds (ETFs) were well below the net asset value (NAV) of the funds. Surprisingly, these dislocations were most pronounced on safe fixed-income assets. For instance, the wedge between the bond spread and the CDS spread was larger for safe bonds, and the deviations from NAV were larger for ETFs with safer underlying securities. Haddad, Moreira & Muir (2021) interpret the results as evidence that investors liquidated safe, and more liquid, assets first, consistent with the evidence from Ma, Xiao & Zeng (2022).

Falato, Goldstein & Hortaçsu (2021) similarly emphasize challenges for open-end bond funds and bond ETFs. The authors document large outflows from bond funds and ETFs during the

crises. In total, bond funds and ETFs experienced a cumulative outflow of close to 10% of the value of the assets. Given that the total NAV of bond mutual funds and ETFs is close to 40% of the bond market, these withdrawals amount to a large fraction of the total value of outstanding bonds. Falato, Goldstein & Hortaçsu (2021) highlight the potential market fragility inherent in having such a large fraction of bond value managed by bond funds and ETFs. In particular, because corporate bonds are fairly illiquid, open-end bonds funds and ETFs are potentially subject to fire sales, or runs. Given the size of the bond funds and ETFs, such runs represents a source of fragility for fixed-income markets.

4.2.2. Impact of interventions by the Federal Reserve. The literature argues that the Federal Reserve managed to calm markets through multiple interventions. The literature particularly emphasizes the reintroduction of the Primary Dealer Credit Facility (PDCF) on March 17th and the announcement of the Secondary Market Corporate Credit Facility (SMCCF), which involved a facility to purchase up to $300 billion in corporate bonds in the secondary market, on March 23rd.[16] Upon the introduction of the PDCF on March 17th, primary dealers increased their positions in corporate bond markets (O'Hara & Zhou 2021). However, bond yields did not decrease until after the introduction of the SMCCF on March 23rd. On the 3 days following the announcement, average yield spreads (relative to Treasuries) on new issuances fell by a total of 100 basis points (Boyarchenko, Kovner & Shachar 2022). The literature generally interprets the SMCCF announcement as having a causal impact on bringing down yields.

An important finding from O'Hara & Zhou (2021) and Boyarchenko, Kovner & Shachar (2022) is that the SMCCF had a differential impact on prices across eligible and ineligible bonds. Boyarchenko, Kovner & Shachar (2022) find that for bonds eligible for the SMCCF, spreads dropped by an additional 60 basis points in addition to the 100 basis points mentioned above. The authors also find a differential impact across included and nonincluded bonds, even when fixing the issuer of the bonds. This differential effect leads the authors to conclude a causal impact of the announcement of the purchase program on bond yields. Gilchrist et al. (2020) similarly document a direct impact of the announcement of the SMCCF on bond yields. They find that raw bond yields decreased by 70 basis points following the announcement. The effect is 20 basis points larger for eligible bonds than for ineligible bonds. They find a modest effect of 5 basis points once the actual purchases of corporate bonds started. Bid-ask spreads also dropped substantially following the announcement. Haddad, Moreira & Muir (2021) and Falato, Goldstein & Hortaçsu (2021) document that apparent mispricing and deviations from the law of one price disappeared after the Federal Reserve announced the SMCCF program, similarly arguing for a causal effect.

In summary, the literature emphasizes the following two key aspects of the Federal Reserve's interventions. First, the SMCCF worked mostly through an announcement effect. In contrast to the Treasury market, in which the Federal Reserve had to actually purchase Treasuries to stabilize the market, the corporate bond market appeared to recover immediately following the announcement of the SMCCF, even before the Federal Reserve made material purchases [and the market appeared to respond only weakly to actual purchases (Gilchrist et al. 2020)]. Second, a key new aspect of the Federal Reserve's interventions is its willingness to absorb the excess supply of risky corporate bonds by directly taking these on its balance sheet. The Federal Reserve essentially acted as a market maker, with O'Hara & Zhou (2021) coining the phrase that the Federal Reserve is the "market maker of last resort."

[16]The Federal Reserve simultaneously introduced a number of additional facilities, including a facility to purchase bonds in the primary market.

4.2.3. Corporate bond issuance during the crisis. Becker & Benmelech (2021) document substantial issuance in the corporate bond market over the course of the crisis. Issuance increased immediately when the COVID-19 outbreak happened. Thus, even though the corporate bond markets suffered from liquidity issues, firms were still able to obtain funding in that market. The initial increase was, however, quite modest. Issuances increased substantially following the announcement of the SMCCF, suggesting that the Federal Reserve's interventions not only stabilized prices but also allowed firms to obtain more funding via bond markets.

Overall, the authors conclude that the corporate bond market is a viable source of funding for corporations during times of crises—more so than, for instance, syndicated loan markets. Boyarchenko, Kovner & Shachar (2022) similarly document an increase in issuance activity following the announcement of the SMCCF. Gormsen & Huber (2022) document that firms' perceived cost of debt also decreased during 2020 relative to previous years.

5. OPEN QUESTIONS FOR FUTURE RESEARCH

The unique nature of the COVID-19 shock and the dramatic movements in financial markets challenge our understanding of key issues in asset pricing and raise important questions for future research. We conclude this review by summarizing several directions of research that we consider to be interesting, important, and ripe for exploration.

5.1. Understanding Fluctuations in Equity Markets

The pandemic was associated with large fluctuations in stock prices that are not easily explained by leading macro-finance theories. While the sharp decline in equity prices can perhaps be explained by an increase in risk aversion or macroeconomic risk, or a decline in investors' sentiment, the rapid recovery poses more of a challenge. After all, for prices to normalize as quickly, one would need an unexpectedly sharp decline in risk appetite or macroeconomic risk, or a large unexpected improvement in investors' sentiment, which is unlikely in standard calibrations.[17]

As discussed, news about vaccines and monetary policy explain only a small part of the recovery. The pandemic makes the disconnect between stock prices and news particularly clear, because we know the nature of the shock and therefore have a better sense of the relevant news events. That said, the disconnect is part of a broader pattern identified as early as Cutler, Poterba & Summers (1989), in which most fluctuations in asset prices were not associated with concrete economic news.

Leading asset pricing theory often relies on persistent shocks to preferences, beliefs, and risks to generate excess volatility in prices. However, given the transitory nature of the pandemic, such mechanisms cannot easily explain the fluctuations in stock prices during the pandemic. Rather, the behavior of stock prices, and the nature of the shock, suggests that transitory shocks may be important for understanding asset prices and excess volatility. Further exploring the mechanisms through which transitory shocks have a meaningful impact on the demand for stocks may be a promising avenue for future research. In addition, it is important to understand how such demand shocks ultimately affect prices, which depends on the elasticity of the aggregate stock market (Gabaix & Koijen 2022).

News about monetary policy is often argued to have played a role in the recovery. Haddad, Moreira & Muir (2022), for instance, argue that the introduction of the SMCCF was interpreted

[17] Gandhi, Gormsen & Lazarus (2022) use option prices to estimate the term structure of expected returns and volatility. They find that volatility and expected stock returns decreased faster following the crisis than what investors originally expected at the peak of the crisis. Understanding the primitive drivers of such shifts in expectations is an important question for future research.

by investors as a signal that the Federal Reserve would provide stronger price support in case of extreme stock market crashes [in the spirit of the Fed Put (Cieslak & Vissing-Jørgensen 2021)].[18] However, prices jumped only modestly upon the introduction of the SMCCF, limiting how much this announcement may have influenced the recovery. Moreover, it remains an open question how monetary policy would be able to generate fluctuations in stock prices of the magnitude observed during the pandemic. Recent work on this question includes that by Bianchi, Lettau & Ludvigson (2022) and Caballero & Simsek (2022).

Another potential explanation for the quick recovery is via beliefs and overly volatile expectations about future fundamentals. However, while the quick recovery is unlikely to have been expected by many investors, the fluctuations in stock prices cannot be tied back to excessively volatile expectations about cash flows [see the review by Landier & Thesmar (2020)]. Theories revolving around excessively volatile cash flow expectations therefore do not appear to explain the crash and recovery.

In conclusion, we need new theories to understand the fluctuations we observed in stock markets during the pandemic. The fluctuations during the pandemic are unique because we know the underlying trigger for these fluctuations, and we can therefore assess and rule out existing theories. But, we reiterate that the fluctuations are part of a broader pattern in which most fluctuations in prices are hard to tie back to fundamental news. Understanding the drivers of fluctuations in financial markets thus remains one of the key questions for asset pricing and macro-finance going forward.

5.2. Have Markets Become More Sensitive to News?

The results in Baker et al. (2020) suggest that markets responded more strongly to this pandemic than to previous pandemics. This is an intriguing result that naturally raises the question: Why is this the case? Does the differential response reflect broader changes in how markets function, the role of government interventions, or the spread and processing of information [for instance, due to modern (social) media]?

More generally, this finding raises the question of whether modern stock markets respond differentially to news compared to the past. Baker et al. (2021), for instance, argue that news and uncertainty about economic policy are causing an increasingly larger number of stock market jumps in the United States. These observations motivate further research into whether or not markets are becoming more sensitive to news.

5.3. Fragility in Fixed-Income Markets

The events outlined in Section 4 suggest that fixed-income markets were fragile with respect to a seemingly modest selling pressure. One important question that arises from these events is how dealers and market makers can be better prepared for future crises. Duffie (2020) suggests strengthening the resilience in the Treasury market through a central clearing system that can help to mitigate the lack of liquidity observed in March 2020. Kashyap, Kohn & Wessel (2021) suggest taking steps to reduce the overall selling pressure in future situations by improving the structure of open-end funds. The illiquid nature of corporate bonds makes open-end funds subject to runs, as discussed in Section 4.2.1. Kashyap, Kohn & Wessel (2021) suggest that this vulnerability can

[18] Using option prices, Haddad, Moreira & Muir estimate that the expected conditional price support in the most extreme crashes increased by a factor of five following the introduction of SMCCF. These results echo the findings by Cox, Greenwald & Ludvigson (2020), who similarly argue for a role of unconventional monetary policy in explaining the rebound.

be mitigated by introducing swing pricing, which is a system that allows managers of open-end funds to adjust the NAV of the fund in response to flows. By doing so, managers can ensure that first movers pay some of the cost associated with their trading activity, and this in turn limits the risk of runs on open-end funds (see also Jin et al. 2022).

5.4. Retail Investing and Social Networks

Retail trading received renewed attention during the pandemic. Most prominently, the share price of GameStop increased dramatically in January 2021. This increase was in part driven by a short squeeze coordinated via online platforms (most noticeably Wall Street bets).

This event highlights that retail investors that are modest in size can have a large price impact, an observation that challenges the idea that stock prices are highly elastic (see also Gabaix & Koijen 2022). The event also asks the question of how network effects influence the spread of beliefs and trading behavior in financial markets. Pedersen (2022) shows how social networks can give rise to a number of well-known asset pricing anomalies, such as momentum and bubbles, and how social networks influence trading volume and volatility. Li (2022) further studies the role of network effects using data on prices, beliefs, and portfolio holdings of various classes of investors during the GameStop episode, arguing that the structure of the network and investor composition played an important role.

The role of retail investing is further explored by Greenwood, Laarits & Wurgler (2023). The authors document a strong link between the stimulus checks and trading in stocks that are popular among retail investors. These results are consistent with an important role for retail investing in asset pricing and may in part explain the stock market rally observed in 2021.

5.5. Government Policies and Asset Prices

The COVID-19 crisis required substantial government interventions in the form of unconventional monetary policy and fiscal policy. Given the government's footprint in the economy and financial markets, understanding the role—and limits—of government policy is an important area for future research. One example is that, following the COVID-19 pandemic, there are important questions about countries' fiscal capacity.

Martin & Nagler (2020) find that the initial fall in stock prices at the onset of the pandemic was more pronounced in countries with higher levels of public debt. This pattern is consistent with the idea that high-debt countries were constrained in their ability to adequately absorb the pandemic shock to the economy. The large increase in real and nominal interest rates observed during 2022 has further stressed countries' fiscal capacity.

For the United States, Jiang et al. (2019) argue that the current level of US debt is supported by artificially low interest rates. Jiang, Richmond & Zhang (2022) use a demand system to analyze global imbalances and estimate the fiscal capacity of different countries. The authors find that the demand for US debt in absolute terms is more elastic than for other countries. However, relative to GDP, the demand for US debt is relatively inelastic, suggesting that more deficit spending can lead to substantially higher interest rates. Jiang, Richmond & Zhang estimate that, as of 2019, issuing 5% of GDP would result in a 1% increase in interest rates. These estimates appear broadly consistent with observations during the pandemic.

As the pandemic evolved and economies reopened, inflation rates increased around the world. The sudden increase in inflation has sparked concerns about potentially losing the inflation anchor (Reis 2021). More generally, the events have sparked a debate about the role of inflation expectations shaping actual inflation (Armantier et al. 2021; Weber, Gorodnichenko & Coibion 2022). From the perspective of financial markets, the events sparked renewed interest in understanding

the link between inflation and asset prices (see, e.g., Fang, Liu & Roussanov 2022). Hilscher, Raviv & Reis (2022) use novel data on inflation swaps to estimate the probabilities of future inflation. Doing so, the authors find that the risk of persistently high inflation increased substantially during 2021. This analysis shows how data on asset prices, which are forward-looking in nature, can be a valuable input into the current debate about future inflation.

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LITERATURE CITED

Acharya VV, Engle RF, Steffen S. 2021. *Why did bank stocks crash during COVID-19?* Work. Pap., Stern Sch. Bus., New York Univ.

Acharya VV, Johnson T, Sundaresan S, Zhang S. 2021. *The value of a cure: an asset pricing perspective*. NBER Work. Pap. 28127

Albuquerque R, Koskinen Y, Yang S, Zhang C. 2020. Resiliency of environmental and social stocks: an analysis of the exogenous COVID-19 market crash. *Rev. Corp. Finance Stud.* 9:593–621

Alfaro L, Chari A, Greenland A, Schott PK. 2020. *Aggregate and firm-level stock returns during pandemics, in real time*. Work. Pap., Harvard Bus. Sch., Cambridge, MA

Armantier O, Koşar G, Pomerantz R, Skandalis D, Smith K, et al. 2021. How economic crises affect inflation beliefs: evidence from the COVID-19 pandemic. *J. Econ. Behav. Organ.* 189:443–69

Arteaga-Garavito MJ, Croce MM, Farroni P, Wolfskeil I. 2022. *When the markets get CO.V.I.D: COntagion, Viruses, and Information Diffusion*. Work. Pap., Univ. Bocconi, Italy

Baker SR, Bloom N, Davis SJ, Kost K, Sammon M, Viratyosin T. 2020. The unprecedented stock market reaction to COVID-19. *Rev. Asset Pricing Stud.* 10:742–58

Baker SR, Bloom N, Davis SJ, Sammon MC. 2021. *What triggers stock market jumps?* NBER Work. Pap. 28687

Barro RJ. 2006. Rare disasters and asset markets in the twentieth century. *Q. J. Econ.* 121(3):823–66

Barth D, Kahn J. 2020. *Basis trades and Treasury market illiquidity*. Off. Financ. Res. Brief 20-1, Off. Financ. Res., Washington, DC

Becker B, Benmelech E. 2021. *The resilience of the US corporate bond market during financial crises*. NBER Work. Pap. 28868

Bianchi F, Lettau M, Ludvigson SC. 2022. Monetary policy and asset valuation. *J. Finance* 77(2):967–1017

Boudoukh J, Liu Y, Moskowitz TJ, Richardson MP. 2021. *The systematic risk of global asset returns in times of crisis: (how) is COVID-19 different?* Work. Pap., Stern Sch. Bus., New York Univ.

Boyarchenko N, Kovner A, Shachar O. 2022. It's what you say and what you buy: a holistic evaluation of the corporate credit facilities. *J. Financ. Econ.* 144(3):695–731

Bretscher L, Hsu A, Simasek P, Tamoni A. 2020. COVID-19 and the cross-section of equity returns: impact and transmission. *Rev. Asset Pricing Stud.* 10:705–41

Caballero RJ, Simsek A. 2022. *A monetary policy asset pricing model*. NBER Work. Pap. 30132

Cejnek G, Randl O, Zechner J. 2021. The COVID-19 pandemic and corporate dividend policy. *J. Financ. Quant. Anal.* 56(7):2389–410

Cheng IH. 2020. Volatility markets underreacted to the early stages of the COVID-19 pandemic. *Rev. Asset Pricing Stud.* 10(4):635–68

Cieslak A, Vissing-Jørgensen A. 2021. The economics of the Fed put. *Rev. Financ. Stud.* 34(9):4045–89

Cox J, Greenwald DL, Ludvigson SC. 2020. *What explains the COVID-19 stock market?* Work. Pap., New York Univ.
Cutler DM, Poterba JM, Summers LH. 1989. What moves stock prices? *J. Portf. Manag.* 15(3):4–12
Dechow PM, Erhard RD, Sloan RG, Soliman MT. 2021. Implied equity duration: a measure of pandemic shutdown risk. *J. Account. Res.* 59(1):243–81
Ding W, Levine R, Lin C, Xie W. 2021. Corporate immunity to the COVID-19 pandemic. *J. Financ. Econ.* 141:802–30
Duffie D. 2020. *Still the world's safe haven? Redesigning the US treasury market after the COVID-19 crisis.* Work. Pap. 62, Hutchins Cent., Brookings Inst., Washington, DC
Eichenbaum MS, Rebelo S, Trabandt M. 2021. The macroeconomics of epidemics. *Rev. Financ. Stud.* 34:5149–87
Fahlenbrach R, Rageth K, Stulz RM. 2021. How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis. *Rev. Financ. Stud.* 34:5474–521
Falato A, Goldstein I, Hortaçsu A. 2021. Financial fragility in the COVID-19 crisis: the case of investment funds in corporate bond markets. *J. Monet. Econ.* 123:35–52
Fang X, Liu Y, Roussanov N. 2022. *Getting to the core: inflation risks within and across asset classes*. NBER Work. Pap. 30169
Gabaix X. 2012. Variable rare disasters: an exactly solved framework for ten puzzles in macro-finance. *Q. J. Econ.* 127(2):645–700
Gabaix X, Koijen RS. 2022. *In search of the origins of financial fluctuations: the inelastic markets hypothesis*. Work. Pap., Harvard Univ., Cambridge, MA
Gandhi M, Gormsen NJ, Lazarus E. 2022. *Does the market understand time variation in the equity premium*? Work. Pap., Univ. Chicago
Giglio S, Maggiori M, Stroebel J, Utkus S. 2019. *Five facts about beliefs and portfolios*. NBER Work. Pap. 25744
Giglio S, Maggiori M, Stroebel J, Utkus S. 2021. The joint dynamics of investor beliefs and trading during the COVID-19 crash. *PNAS* 118(4):e2010316118
Gilchrist S, Wei B, Yue VZ, Zakrajšek E. 2020. *The Fed takes on corporate credit risk: an analysis of the efficacy of the SMCCF*. NBER Work. Pap. 27809
Gormsen NJ. 2021. Time variation of the equity term structure. *J. Finance* 76(4):1959–99
Gormsen NJ, Huber K. 2022. *Corporate discount rates*. Work. Pap., Univ. Chicago
Gormsen NJ, Koijen RS. 2020. Coronavirus: impact on stock prices and growth expectations. *Rev. Asset Pricing Stud.* 10:574–97
Gormsen NJ, Koijen RS, Martin IWR. 2021. Implied dividend volatility and expected growth. *AEA Pap. Proc.* 111:361–65
Greenwood R, Laarits T, Wurgler J. 2023. Stock market stimulus. *Rev. Financ. Stud.* In press. **https://doi.org/10.1093/rfs/hhad025**
Haddad V, Moreira A, Muir T. 2021. When selling becomes viral: disruptions in debt markets in the COVID-19 crisis and the Fed's response. *Rev. Financ. Stud.* 34(11):5309–51
Haddad V, Moreira A, Muir T. 2022. *Whatever it takes? The impact of conditional policy promises.* Work. Pap., Univ. Calif. Los Angeles
Hassan TA, Hollander S, van Lent L, Schwedeler M, Tahoun A. 2022. *Firm-level exposure to epidemic diseases: COVID-19, SARS, and H1N1*. Work. Pap., Boston Univ.
He Z, Nagel S, Song Z. 2022. Treasury inconvenience yields during the COVID-19 crisis. *J. Financ. Econ.* 143(1):57–79
Hilscher J, Raviv A, Reis R. 2022. *How likely is an inflation disaster?* Work. Pap., Univ. Calif. Davis
Hong H, Wang N, Yang J. 2021. Implications of stochastic transmission rates for managing pandemic risks. *Rev. Financ. Stud.* 34:5224–65
Jackwerth J. 2020. What do index options teach us about COVID-19? *Rev. Asset Pricing Stud.* 10(4):618–34
Jiang Z, Lustig H, Van Nieuwerburgh S, Xiaolan MZ. 2019. *The US public debt valuation puzzle*. NBER Work. Pap. 26583
Jiang Z, Richmond RJ, Zhang T. 2022. A portfolio approach to global imbalances. *J. Finance*. Forthcoming
Jin D, Kacperczyk M, Kahraman B, Suntheim F. 2022. Swing pricing and fragility in open-end mutual funds. *Rev. Financ. Stud.* 35(1):1–50

Jones C, Philippon T, Venkateswaran V. 2021. Optimal mitigation policies in a pandemic: social distancing and working from home. *Rev. Financ. Stud.* 34:5188–223
Kargar M, Lester B, Lindsay D, Liu S, Weill PO, Zúñiga D. 2021. Corporate bond liquidity during the COVID-19 crisis. *Rev. Financ. Stud.* 34(11):5352–401
Kashyap A, Kohn D, Wessel D. 2021. *What is swing pricing?* Rep., Brookings Inst., Washington, DC
Kermack WO, McKendrick AG. 1927. A contribution to the mathematical theory of epidemics. *Proc. R. Soc. A* 115(772):700–21
Knox B, Vissing-Jørgensen A. 2022. *A stock return decomposition using observables.* Finance Econ. Discuss. Ser. 2022-014, Fed. Reserve Board, Washington, DC
Koijen RS, Yogo M. 2015. The cost of financial frictions for life insurers. *Am. Econ. Rev.* 105(1):445–75
Koijen RS, Yogo M. 2019. A demand system approach to asset pricing. *J. Political Econ.* 127(4):1475–515
Koijen RS, Yogo M. 2022a. The fragility of market risk insurance. *J. Finance* 77(2):815–62
Koijen RS, Yogo M. 2022b. Global life insurers during a low interest rate environment. *AEA Pap. Proc.* 112:503–8
Koren M, Peto R. 2020. Business disruptions from social distancing. *PLOS ONE* 15(9):e0239113
Landier A, Thesmar D. 2020. Earnings expectations during the COVID-19 crisis. *Rev. Asset Pricing Stud.* 10:598–617
Li F. 2022. *Retail trading and asset prices: the role of changing social dynamics*. SSRN Work. Pap. 4236966
Ma Y, Xiao K, Zeng Y. 2022. Mutual fund liquidity transformation and reverse flight to liquidity. *Rev. Financ. Stud.* 35(10):4674–711
Martin T, Nagler F. 2020. *Sovereign debt and equity returns in the face of disaster*. Work. Pap., Univ. Bocconi, Italy
Mazur M, Dang M, Vega M. 2020. COVID-19 and the March 2020 stock market crash. Evidence from S&P1500. *Finance Res. Lett.* 38:101690
Nelson CR, Siegel AF. 1987. Parsimonious modeling of yield curves. *J. Bus.* 60(4):473–89
O'Hara M, Zhou XA. 2021. Anatomy of a liquidity crisis: corporate bonds in the COVID-19 crisis. *J. Financ. Econ.* 142(1):46–68
O'Hara M, Zhou XA. 2023. Things fall apart: fixed income markets in the COVID-19 crisis. *Annu. Rev. Financ. Econ.* 15:55–68
Pagano M, Wagner C, Zechner J. 2021. *Disaster resilience and asset prices.* Work. Pap., Univ. Naples, Italy
Papanikolaou D, Schmidt LDW. 2022. Working remotely and the supply-side impact of COVID-19. *Rev. Asset Pricing Stud.* 12:53–111
Pastor L, Vorsatz MB. 2020. Mutual fund performance and flows during the COVID-19 crisis. *Rev. Asset Pricing Stud.* 10:791–833
Pedersen LH. 2022. Game on: social networks and markets. *J. Financ. Econ.* 146(3):1097–119
Ramelli S, Wagner AF. 2020. Feverish stock price reactions to COVID-19. *Rev. Corp. Finance Stud.* 9:622–55
Reis R. 2021. *Losing the inflation anchor.* Discuss. Pap., Cent. Econ. Policy Res., London
Schrimpf A, Shin HS, Sushko V. 2020. *Leverage and margin spirals in fixed income markets during the COVID-19 crisis.* BIS Bull. 2, Bank Int. Settl., Basel, Switz.
Topcu M, Gulal OS. 2020. The impact of COVID-19 on emerging stock markets. *Finance Res. Lett.* 36:101691
van Binsbergen J, Brandt M, Koijen R. 2012. On the timing and pricing of dividends. *Am. Econ. Rev.* 102(4):1596–618
van Binsbergen J, Hueskes W, Koijen R, Vrugt E. 2013. Equity yields. *J. Financ. Econ.* 110(3):503–19
van Binsbergen JH, Koijen RS. 2017. The term structure of returns: facts and theory. *J. Financ. Econ.* 124(1):1–21
Vissing-Jørgensen A. 2021. The Treasury market in spring 2020 and the response of the Federal Reserve. *J. Monet. Econ.* 124:19–47
Weber M, Gorodnichenko Y, Coibion O. 2022. *The expected, perceived, and realized inflation of US households before and during the COVID-19 pandemic*. NBER Work. Pap. 29640
Zhang D, Hua M, Ji Q. 2020. Financial markets under the global pandemic of COVID-19. *Finance Res. Lett.* 36:101528