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Stock Markets Under Covid-19

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ABSTRACT

This paper reviews the literature that addresses the stock pricing implications of Covid-19 outbreak. Stock prices dropped substantially in March 2020 as a reaction to the onset of the Covid-19 pandemic; however, they recovered quickly from April/May2020. Markets only incorporated the pandemic risk from late February 2020. During the crisis period, both the discount rate and expectation of growth were the most important (but not the only) reasons for the movement of stock prices. The Fed interventions also helped markets to recover one-third of their lost returns during Covid19. Finally, investors' preferences and capital shifted to more ESG-friendly firms both during and after the crisis, implying that ESG firms performed well during the time of Covid-19.

I. Introduction

The economic turmoil associated with the Covid-19 pandemic has had wide-ranging and severe impacts upon financial markets. These impacts also attracted a lot of attention from researchers who have generated many studies developments in asset prices during the early stage of Covid-19. This paper aims to review the literature addressing this matter, specifically focusing on the stock market.

In this paper, we cover i) the markets' behavior during and after the Covid-19 crash on March 2020, ii) the reasons for a sudden drop in price in March 2020 and recovery in April/May 2020,

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iii) the central bank's reaction to Covid-19 shock in 2020 and liquidity injection, and iv) heterogeneous reaction of different industries the early stage of Covid-19. The paper can thus be used as a foundation to guide researchers and practitioners who would like to study different aspects of the stock markets' behavior under the Covid-19 pandemic.

Despite the severe impact of Covid-19, the stock markets initially did not anticipate the severity of the crisis during the early stage of the outbreak (Loughran and McDonald, 2020; Jackwerth, 2020; Cheng, 2020). Figure 1 shows the cumulative returns of various stock markets along with the VIX volatility index following the timeline during the outbreak of Covid-19.

As can be seen in Figure 1, the market neither reacted in January 2020 when the first cases appeared, nor later in the first 3 weeks of February 2020 during the Wuhan lockdown and surging cases in Italy. On Monday February 24, 2020, the S&P 500 and FTSE 100 dropped more than 3%, as the coronavirus outbreak spread substantially worsened outside China over the weekend. This was followed by benchmark indices falling sharply in continental Europe after steep declines across Asia. The Euronext 100 fell by approximately 4%. There was a considerable fall in the price of oil and a substantial increase in the price of gold, which reached its 7-year high. On February 28, 2020, stock markets worldwide reported their largest single-week declines since the 2008 financial crisis.

During this period, the VIX index increased from 15% to 40%. Following a second week of turbulence on March 6, stock markets worldwide closed down for some days. At the same time, US bond yields and oil prices fell to their lowest levels. After OPEC and Russia failed to agree on oil production cuts on March 5, and Saudi Arabia and Russia both announced increases in their oil production on March 7, oil prices fell by 25%. On March

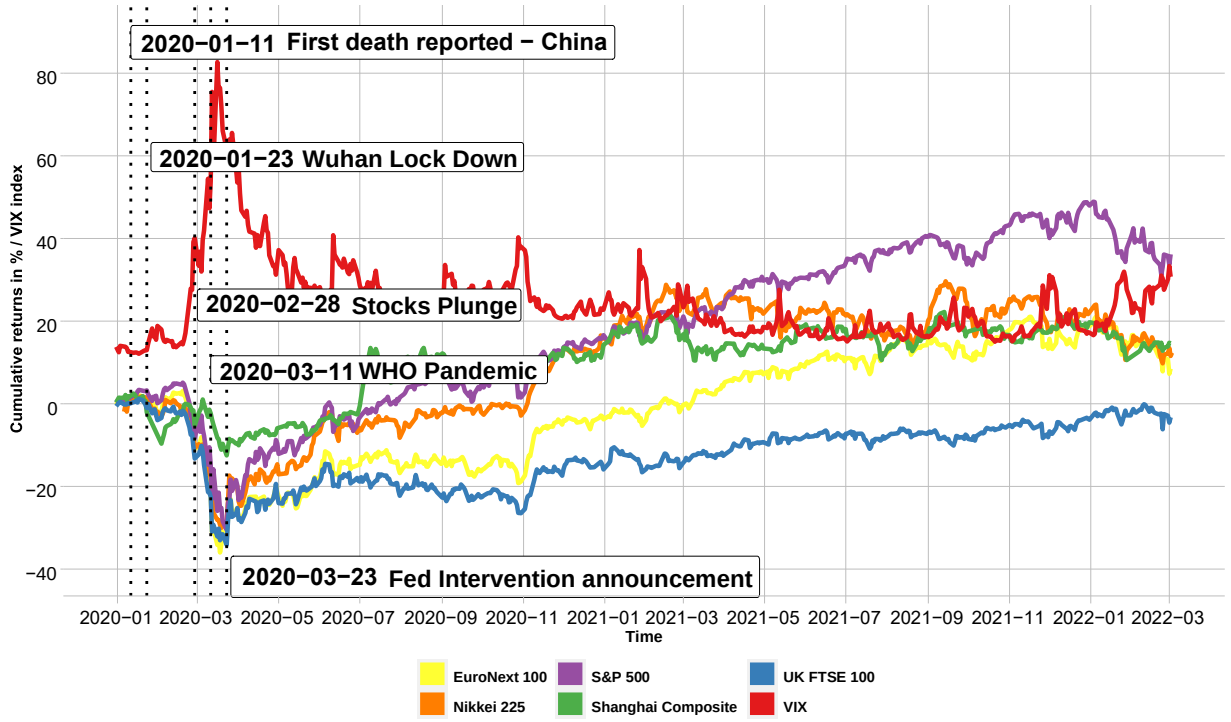

Figure 1. Stock market development at the country levels; source: Authors' calculations with data from Yahoo Finance.

11, the WHO declared Covid-19 to be a pandemic. On March 9, the S&P 500 fell 7% in four minutes after the exchange opened, triggering a circuit breaker for the first time since the financial crisis of 2007–08, and halting trading for 15 minutes. At the end of trading, stock markets worldwide dropped substantially. The implied volatility of equities (VIX) reached over 80% by mid-March. At its worst in mid-March, markets were down 30% to 40%. Nevertheless, the Shanghai Composite Index was an exception, as it only fell by a cumulative return of 10%. On March 15, the Fed cut its benchmark interest rate by a full percentage point, to a target range of 0 to 0.25%. On March 23, the Fed came out with additional announcements regarding quantitative easing. Central banks around the world (including the ECB) performed similar actions by the end of March. This was the turning point for stock markets, which (after an initial sharp increase) slowly started to recover. The VIX Index also fell from its peak. Over the summer, many countries opened up, as prospects for a vaccine by early 2021 came about, and economies started to recover. By September 2020, the S&P 500 was back to its pre-pandemic level while it takes longer time for

the EuroNext 100 (March 2021), and FTSE 100 (March 2022) to recover to their pre-pandemic level. In this period, the reaction of each stock market also suffered from the contagion risk from the other markets (Samitas, Kampouris, and Polyzos, 2022).

In this paper, we present a literature review of the financial literature that attempts to analyze this impact of the Covid-19 pandemic on the stock markets. A substantial bulk of this literature uses classical asset pricing theories to explain the reaction of stock prices during 2020. For example, several contributions find that the dramatic change in cash flow largely contributed to a reduction in asset prices during the crisis period. According to Gormsen and Koijen (2020) and Böni and Zimmermann (2020), among others, markets revised their expectation on dividend growth and earnings growth downward. Although this cash flow revision drove stock prices downward, this stream of literature documents that it only had an effect on the expectation of the short-term cash flow of the next three years from 2020. In May 2020, markets still seemed to believe that the long-term growth after four years from 2020 will remain intact from Covid-19.

Another body of literature focuses on a discount rate channel as an explanation for the market turmoil (Landier and Thesmar, 2020; Cox, Greenwald, and Ludvigson, 2020). Markets revised stocks' risky profile by increasing the discount rate from an average level of 10% before March 2020 to 13% in March 2020, but quickly came back to the normal level of 10% in May 2020. This revision on the discount rate is one of the reasons creating a "V" shape in the stock's prices (Landier and Thesmar, 2020).

Notably, however, we cannot conclude that only the cash-flow and discount-rate channels can fully explain the stock price reactions to Covid-19 during 2020. The conclusions of these two streams of literature, i.e., low short-term future growth expectations, together with the revisions of the discount rate back to their normal level in May 2020, should have indicated a recovery on the stock markets, yet, a full recovery did not occur. Nevertheless, the stocks markets passed the pre-crisis level in the summer of 2020. So, we can hypothesize that cashflow expectations and discount-rate effects alone cannot fully explain this behavior. Even so, such a hypothesis can only be tested if we put the discount rate and the expected cash flow growth rate into the same asset pricing model, and test whether they can fully explain the markets' reaction. We have not yet seen such a test in the literature. Moreover, the results from the literature on the growth rate and discount rate channels cannot be easily combined with each other because the studies do not use a similar asset pricing models to derive them.

In addition, we see that liquidity had a huge impact on market prices both in the crisis and in the recovery phrase. Liquidity can be seen as an additional channel to cash-flow and discount rate that helps explain the stocks' price behavior during and after the sudden drop of March 2020. Several contributions investigate how a liquidity spiral can drive down stocks' price quickly (e.g., among others Foley, Kwan, Philip, and Ødegaard, 2021) and study the impact of the Fed intervention and fund flow to the market price under Covid-19 (see Caballero and Simsek, 2020; Cox et al., 2020; Putnins, 2020; Pástor and Vorsatz, 2020; Putnins, 2020). For example, Putnins (2020) claims that one-third of the recovery return after COVID-19 can be related to the Fed interventions of cutting interest rates and making large-scale asset buy-backs.

A large body of research also focuses on the heterogeneous effect of the crisis on the firms within different industries or having different characteristics (Ramelli and Wagner, 2020; Donadelli, Kizys, and Riedel, 2017; Carletti, Oliviero, Pagano, Pelizzon, and Subrahmanyam, 2020; Landier and Thesmar, 2020; Albuquerque, Koskinen, Yang, and Zhang, 2020; Ding, Levine, Lin, and Xie, 2021). The general conclusion here is that firms which are financially flexible, ESG-friendly and resilient to social distancing performed better during and after the time of Covid-19.

Our survey is also related to a large stream of literature on the behavior of financial markets under disaster, pandemic, and rare events such as: Rietz (1988); Liu, Pan, and Wang (2005); Barro (2006); Bollerslev and Todorov (2011); Wachter, Barro, Campbell, Chernov, Duffee, Gabaix, Glasserman, Gourio, Harvey, Kiku, Lehmann, Juillard, Piazzesi, Roussanov, Tsai, and Veronesi (2013); Niederhoffer (1971); He and Krishnamurthy (2013); Shelor, Anderson, and Cross (1990); Worthington and Valadkhani (2004); Brounen and Derwall (2010); Burdekin (2020); Barro, Ursúa, and Weng (2022). As every disaster is different in their nature, investors react differently to them. Covid-19 can be seen as an unprecedented rare event, as modern society has never experienced such serious restraints during such a lasting period of time. The pandemic redefined the working environment, the supply chain relationships, and the way humans co-exist with a long-lasting disaster. This phenomenon has a substantial impact on the risk's perception, the growth's perception, and the liquidity on the market. These elements in turn impact the asset prices. The importance of studying the impact of Covid-19 on asset prices is also emphasized by a large body of research over the last 2 years of the pandemic. Therefore, this survey provides a valuable overview of the developments in the stock markets during the pandemic, and the reasons behind them.

According to the scope of our paper, we organize the rest of this paper as follows. Section 2 presents a discussion on whether the markets were too slow to recognize the pandemic risk. Section 3 provides the explanations behind the stock market reactions to Covid-19 under the cash-flow and discount-rate framework. Section 4 focuses on the role of liquidity, the Fed Intervention and the fund flow under Covid-19. These two can quickly ameliorate the investors' view and sentiment on the markets thus creating a rapid "V" shape recovery after March 2020. Section 5 investigates different stocks price behaviors under Covid-19 when we breakdown stocks into: i) industries, ii) financial flexibility and ESG characteristics, and iii) resilient-to-pandemic characteristics. Lastly, Section 6 presents the concluding remarks. The paper is structured according to the timeline of the events, the reasons behind them and the differences across industries during Covid-19 onset in 2020.

II. The initial reaction of the stock markets on Covid-19

Despite its dramatic impact in 2020, pandemic risk seems not to have been one of the risks that companies in 2018-2019 were concerned about. Public companies in the United States are required to file annual reports (Form 10-K) that, among other things, disclose the risk factors that could negatively affect the price of their stock. Although the risk of a pandemic was well-known before the current crisis (e.g. SARS, MERS, swine flu) for shareholders, according to Loughran and McDonald (2020), less than 21% of the filings contain any reference to pandemic-related terms. Because pandemics have been identified as a significant global risk (also economically and financially), it seems that this number should have been higher. In a study of the cross-section of stock price reactions to the Covid-19, Ramelli and Wagner (2020) provide distinction among three early phases of the pandemic in 2020: Incubation (January 2 to January 17), Outbreak (January 20 to February 21) and Fever (February 24 to March 20). They show that during the Incubation and Outbreak phases market participants were mostly concerned about the crisis effect of the international trade, while only in the Fever phase larger systemic issues were recognized.

Several papers address the question of whether the volatility markets reacted to the outbreak of the pandemic. For example, Cheng (2020) investigated futures price premiums, defined as futures prices minus real-time statistical forecasts of future VIX values. It was only at the end of February that they turned sharply negative and remained negative until mid-April. A futures price below the

fair statistical forecast suggests an anomaly for standard equilibrium asset pricing models. VIX futures prices should exceed fair statistical forecasts because long futures investors should pay a premium over the forecast to hedge against possible increases in uncertainty and market downturns. Therefore, futures price premiums, defined as futures prices minus forecasts, should be positive. They typically were as recently as February 21, 2020 but by March 2, 2020 premiums had fallen and turned negative, implying undervalued futures prices in the context of these models. VIX futures prices fell further below statistical forecasts in early March as financial market volatility increased and news about the pandemic grew worse over time. Cheng (2020) points out that further research needs to be done in order to explore the reasons for this under-reaction, as it poses a puzzle for standard asset pricing theories, where one potentially important clue is the heterogeneity in how different groups responded to COVID-19 in their trading behavior.

Jackwerth (2020) discusses the risk neutral distribution of S&P 500 options at various dates both before and after the outbreak. Risk-neutral distributions of the S&P 500 are informative about the COVID-19 pandemic beyond what one can learn from other markets. Index option prices translate into risk-neutral distributions, which contain richer information than index and VIX values. According to Jackwerth (2020), after Covid-19 had been declared a pandemic on March 12, 2020 the impact became fully visible with a pronounced bimodality for longer-maturity options on March 16, 2020 revealing a sizeable crash scenario. The demand for "crash protection" ahead of the index crash was only limited, with retail customers buying this protection as the index was already recovering.

Altig, Baker, Barrero, Bloom, Bunn, Chen, Davis, Leather, Meyer, Mihaylov, Mizen, Parker, Renault, Smietanka, and Thwaites (2020) study different measures of economic uncertainty including implied stock market volatility, newspaper-based policy uncertainty, Twitter chatter about economic uncertainty, subjective uncertainty about business growth, forecaster disagreement about future GDP growth, and a model-based measure of macro uncertainty. Echoing the conclusion of the papers mentioned above, they find that the implied stock market volatility increased substantially from late February 2020, reaching its peak in the middle of March 2020.

Using a novel statistical testing approach, Contessi and De Pace (2021) identify periods of instability and distress across stock markets in 18 different countries and provide evidence of an initially slow diffusion of stock market distress followed by rapid collapses. The peaks of statistical instability occur first in China on January 24, 2020 and Thailand on February 26, 2020, then spread

to European countries between March 12 and March 16, 2020, finally reaching USA on March 23,2020. In Europe and USA these peaks occur at the same time the stock market indices hit their lowest levels.

To sum up, although market participants had clear indications of an outbreak in January and early February 2020, together with knowledge on how previous pandemics influenced the stock markets, they did not react until late February 2020. In other words, despite the fact that the effects of the pandemic were to some degree predictable, the market reaction was perplexing.

III. Cash-flow expectation and discount rate under Covid-19

The Covid-19 crisis created a sudden drop in prices in March 2020. The natural question in the literature is: Through which mechanism did the Covid-19 pandemic impact the stocks markets? The literature shows that at a wide level the change in the forecast of Covid-19 cases affected the market return. At the stock-based level, there are at least 3 mechanisms that can explain the V-shape reaction in the stock market. The first two are the change in expected cash flow and discount rate during the crisis in March/April 2020 and after. The third one is the liquidity shock at the crisis-time and the liquidity injection by the Fed to recover the market. In this section to discuss the first two fundamental channels affecting stocks' price which are the cash flow and discount rate channel. Then in Section IV, we discuss the impact of liquidity injection from the Fed to the market.

3.1. Change in predicted Covid-19 cases and the reaction of market prices

Intuitively, a rise in the number of Covid-19 infection cases causes major social disruptions and may lead to a social lock-down adversely impacting the financial markets. Alfaro, Chari, Greenland, and Schott (2020) discuss the impact of both the projected and realized number of Covid-19 infection cases on the market return in the US. They find that the change in projected cases was more important than the change in realized cases. Markets price-in the impact of projected cases early before the realized cases. The expected Covid-19 cases in the beginning of the pandemic can easily be a signal of more lock-down. This, in turn, means a restraint on the production, and consumption hence a decrease in expected cash flow. The lock down also will add more uncertainty's perception to investors which can in fact increase their risk aversion and impact

the asset prices. Finally, the overall pessimistic sentiment in the markets will induce investor to a fly to safety behavior thus create a huge demand of liquidity on the market. This demand can thus create a liquidity spiral and then a rapid fall in asset prices following Grossman and Miller (1988). Empirically, Foley et al. (2021) document a liquidity spiral by contagious margin call during March 2020. The liquidity spiral creates a big drop and quickly recover.

Alfaro et al. (2020) ran the following model:

$$\Delta ln(Index_t) = \alpha + \gamma_1 \Delta ln(\widehat{C_t^{-2,-1}}) + \gamma_2 \Delta ln(C_t^{-2,-1}) + \gamma_3 X_t + \varepsilon_t \quad , \tag{1}$$

where $\Delta ln\widehat{C_t^{-2,-1}}$ is the daily change in predicted cases, $\Delta lnC_t^{-2,-1}$ is the daily change in real cases, X_t is a vector of control variables and $\Delta ln(Index_t)$ is the daily change in the Wilshire 5000 index of either the closing price or open price. The parameter γ_1 (γ_2) captures the impact of an increase in double the number of projected (realized) cases in the index return. Alfaro et al. (2020) run several regression specifications with different control variables. They show that γ_1 is statistically significant and varies from -4% to 11%. However, γ_2 is positive, small, and only significant in one regression specification. This means that the markets had already discounted the prices of stock when information regarding projected cases appeared, as the realized case numbers were not important for the market. In one case where γ_2 was statistically significant, the positive sign implied that the markets over-reacted, then actually made a small recovery when the realized cases number was known.

3.2. The cash flow channel or discount channel, or both?

According to Campbell and Shiller (1988)'s decomposition, an unexpected drop in the price/return of a stock should either be related to change in the expected cash flow, or a change in the discount rate of this stock. During the time of Covid-19, there is a dramatic change in cash flow and in the discount rate.

3.2.1. Cash flow channel

A pandemic such as Covid-19 creates major social disruptions that have a negative impact on every company's business operation. Therefore, we should expect a decrease in the generated cash flow for most companies in the future. Such a sudden reduction in cash flow/earning expectations

will of course pull down a company's stock price following the Campbell and Shiller (1988) decomposition.

Gormsen and Koijen (2020) build a model using dividend futures contracts to extract the dividend strip, and then the lower bound of dividend growth. They show that in July 2020, on average, the expectation of annual dividend growth of the US market had gone down 8% compared to the same level in January 2020. Böni and Zimmermann (2020) use the Gordon (1959) model and D/P, P/E, P/B ratios to calibrate the dividend growth rate. They found out that the decrease in dividend growth is the main driver of the return's drop during the Covid-19 period.

Landier and Thesmar (2020) use the analyst forecast of earning (EPS) to study the impact of Covid-19 on stock prices. On average, they discovered that as of May 2020, analysts revised their earnings forecast down by 16% in comparison with their forecast in January 2020. Figure 2 illustrates this finding. Interestingly, analysts were only concerned with short-term cash flow over the next three years, but not any longer. Indeed, as of May 2020, the expected earnings growth for 2023 and 2024 decreases only marginally. Landier and Thesmar (2020) later show that the decrease in EPS is one of the main causes of the drop in stock's returns.

To summarize, there exists a consensus in the literature regarding decreased expected cash flows during Covid-19. This drop in expected cash flow led to a decline in stock returns in March. As of May 2020, analysts still had a low expectation for EPS growth.

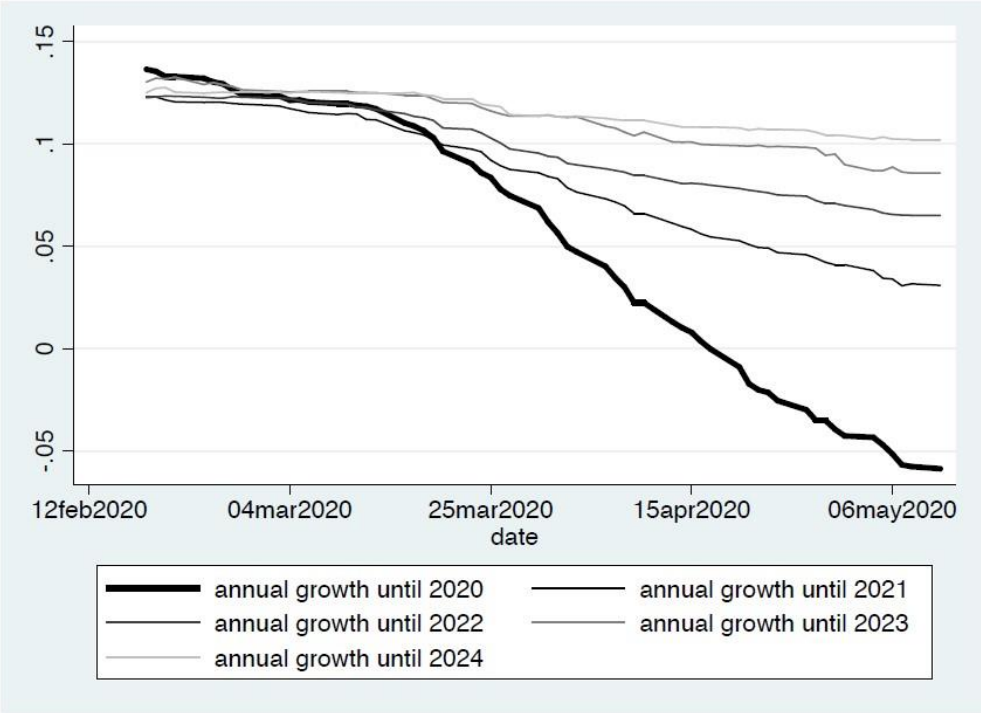

Figure 2. Annual Earning Revision; source: Landier and Thesmar (2020)

3.2.2. Discount rate channel

The discount rate is another reason that can help explain the drop in prices under the Covid-19 period. In a classical asset pricing framework, the discount rate is negatively correlated with the price. Prices will go down when the discount rate goes up, thus following the Campbell and Shiller (1988) decomposition.

As a reward for risk, the discount rate is a product of risk and risk aversion. During a crisis, the discount rate usually goes up. This is because people either become more risk averse, or the risk of the assets increases, or both. Cox et al. (2020) show that risk aversion has increased during Covid-19 period, hence increasing the discount rate.

Landier and Thesmar (2020) show that the average discount rate in the US market increased in March 2020 from 10% to 13%. However, as of May 2020, this average discount rate was going down to a normal level of 10%, with Figure 3 illustrating this observation. When the average

discount rate went up to 13% in March, the market went down by more than 30%. When the discount rate fell by 10%, the market went up again.

Landier and Thesmar (2020) decompose the change in the discount rate into three components. These are the change in risk-free rate, the change in risk-premium and the change in premium due to leverage. They conclude that during the crisis period in March 2020, the 3% increase in the discount rate in the US market was due to the increase in risk-premium, in addition to an increase in premiums due to the leverage effect. Contrarily, the Fed decision to decrease 1% of the interest rate helped to reduce the discount rate.

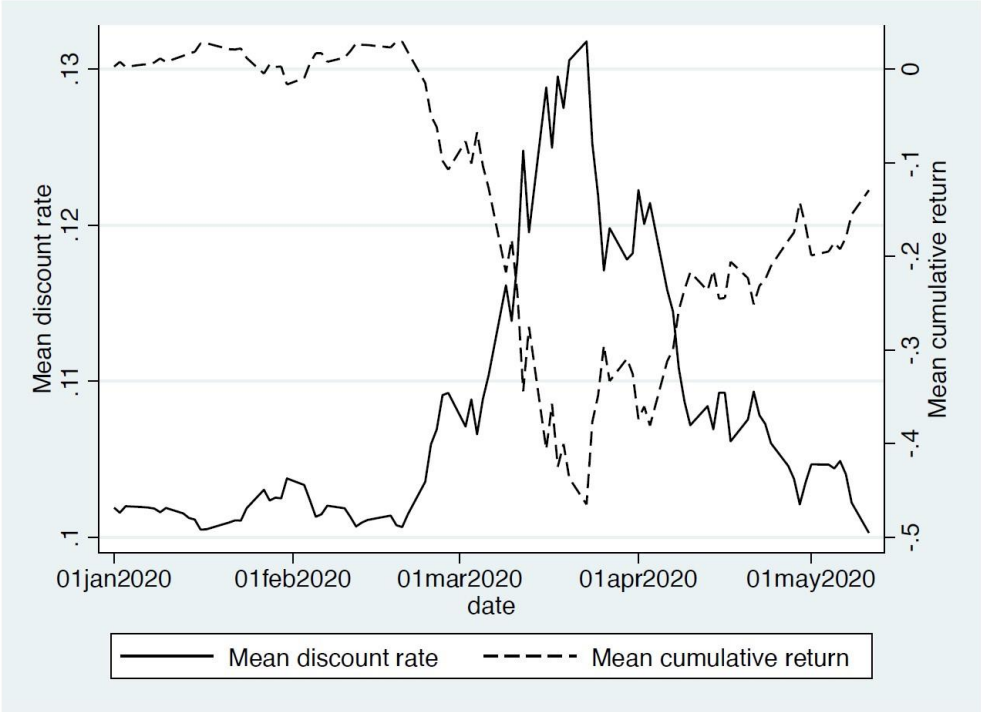

Figure 3. The dynamic of discount rate; source: Landier and Thesmar (2020)

As of May 2020, the risk-premium part in the discount rate returned to its normal level before March 2020. The premium due to leverage effect was 1% higher than its level before March 2020. In the meantime, the risk-free rate was 1% lower than its level before March.

Overall, these two effects cancel out each other. Therefore, as of May 2020, Landier and Thesmar (2020) show that the discount rate came back to its normal level before March 2020.

Another interesting question to ask is which component (discount rate or cash flow) had a stronger impact on stock prices during the Covid-19 period (March 2020), and under the recovery period (April and May 2020). The literature has two different views on this matter.

Böni and Zimmermann (2020) apply the Gordon (1959) model to the financial ratio data to back up the expected long-term dividend growth rate and discount rate. They then study the impact of these two components on stock returns. They reach the conclusion that the change in expected long-term dividend growth was more important than the change in the discount rate.

Nonetheless an opposite conclusion was obtained by Landier and Thesmar (2020), who calibrated a model, with analysts' forecast of EPS to back up the discount rate. To study the impact of the revision of EPS and the change in discount rate on stock returns, they estimate a regression using these two as explanatory variables. They conclude that the change in discount rate was more important than the change in the EPS in their model.

Finally, using a dynamic asset pricing model, Cox et al. (2020), show that the main driving force of asset return during the Covid-19 period (March 2020) and the recovery (April-July 2020) was the discount rate via the risk aversion channel. Indeed, in their model, the fluctuation of risk aversion is the reason for the "V" shape in market returns from March to July 2020.

IV. Reaction of the Fed to Covid-19 and fund flow

In this section, we focus on the liquidity mechanisms, which influence the "V" shape movement in the stock markets. They are Fed's monetary policy and investors fund flows.

4.1. The Fed Intervention and its effect

The sudden drop of stocks markets in March 2020 created a real liquidity crisis. Foley et al. (2021) show that a liquidity spiral severely impacts the market during that time. Stress on liquidity also happens on the treasury market (He, Nagel, and Song, 2022). The Fed Policy hence served as a means of liquidity to support the market.

On March 15, 2020 the target range for Federal Funds Rate was set to 0.00–0.25%. The Federal Reserve's balance sheet ballooned following their March 15, 2020 announcement to carry out quantitative easing to increase the liquidity of U.S. banks. It reached around

8.95 trillion U.S. dollars as of March 15, 2022. This measure was taken to increase the money supply and stimulate economic growth in the wake of the damage caused by the COVID-19 pandemic. The third monetary actions performed in USA during 2020 and 2021 is "helicopter money" issuing three times a $1,000 check to each eligible adult citizen. The period 2020 and 2021 can be seen as one of the most expansive monetary policy periods in history. This quantitative easing (QE) policy is similar at other central banks such as the European Central Bank (ECB), and the Bank of Japan (BoJ). Figure 4 below illustrates this by showing total assets Fed, ECB, and BoJ (upper left corner), effective Fed rates (upper right corner), credit spreads (lower left corner), and yield curve spreads (lower right corner).

The Federal Reserve's quantitative easing program inevitably affects the stock market, though it is difficult to know exactly how and to what extent (Cortes, Gao, Silva, and Song, 2022). There are three central contributions that discuss the monetary policies (lowering interest rates and quantitative easing) and the stock market after the full outbreak of the pandemic (Caballero and Simsek, 2020; Putnins, 2020; Cox et al., 2020). Caballero and Simsek (2020) discuss the theoretical basis for a central bank to use the cutting of interest rates and large asset buy-backs in order to support stock market recovery. During a crisis, risk tolerance goes down, while risk aversion goes up. This leads to falling prices, more leverage and higher risk aversion. In order to break that cycle, a central bank has two solutions. The first is cutting interest rates, which increases risk tolerance and supports leverage. The second involves large asset buy-backs, which shift the risk to the government's balance sheet, and hence increases risk tolerance. However, the solution is not problem-free; the long-term consequence will be a higher level of debt and more financial instability at a macro level. During the period from March to September 2020, the Fed cut interest rates from 1% to 0%, and increased the balance sheet from 4.17 trillion to above 7 trillion dollars, which is the largest increase in history, see figure 4.

Putnins (2020) discusses how this unconventional monetary policy has distorted the equity markets. In response to the Covid-19 pandemic, the US Federal Reserve almost doubled its balance sheet by adding 3$ trillion worth of assets (13% of GDP) in the space of three months, constituting the most aggressive unconventional monetary policy on record. They show that these actions had a substantial effect on stock markets, accounting for one-third of the rebound in the markets since March 2020 and contributing to the apparent disconnect between stock prices and the economy.

Central banks tend to provide expansionary stimulus during periods of deteriorating economic outlook. This action will put upward pressure

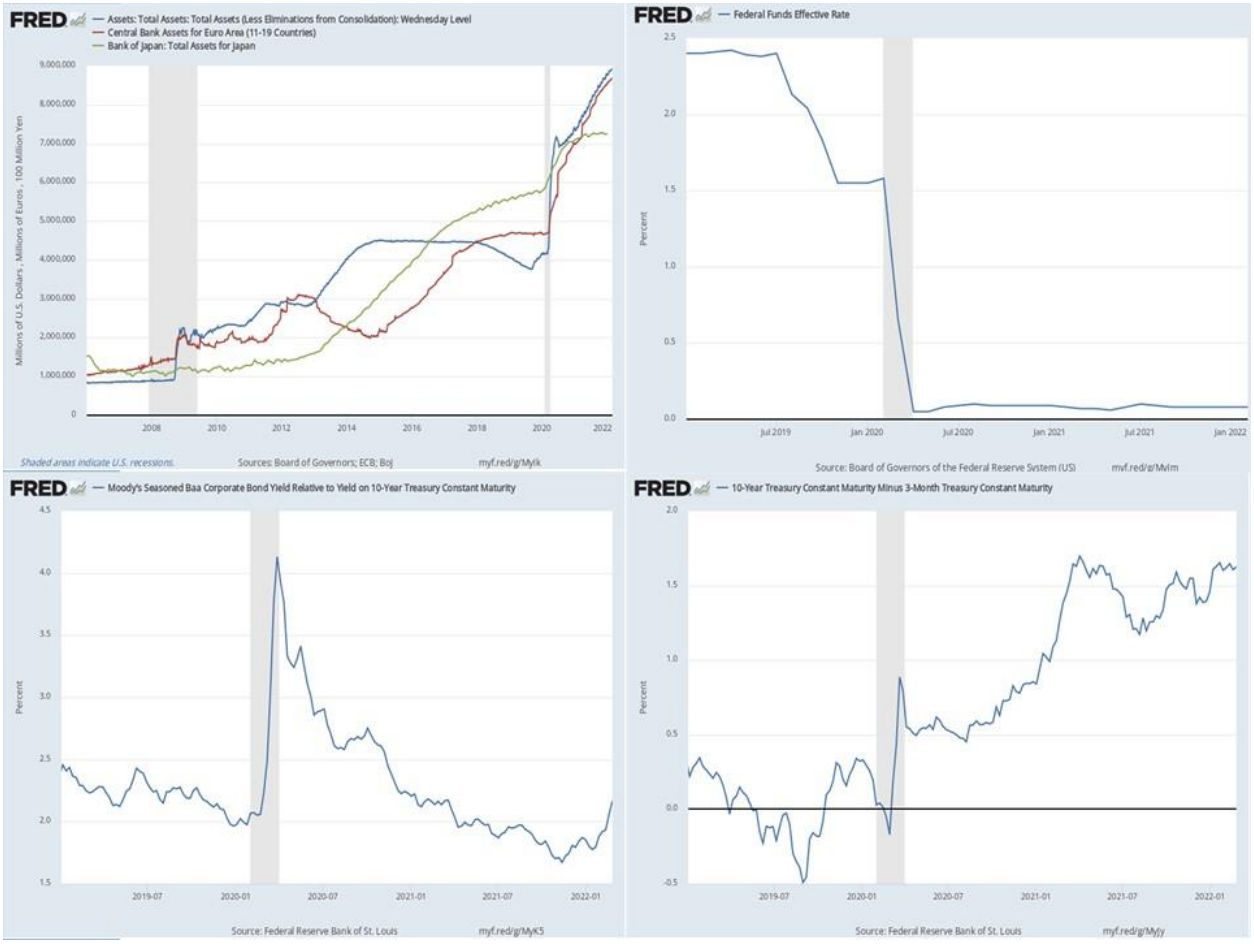

Figure 4. Total assets Fed, ECB, and BoJ (upper left corner), effective Fed rates (upper right corner), credit spreads (lower left corner), and yield curve spreads (lower right corner). Data from the FRED database. Detailed description of data can be found at https://fred.stlouisfed.org/series using WALCL, ECBASSETSW, JPNASSETS, FEDFUNDS, TCINSA, and T10Y3M.

on asset prices, including stock returns, at precisely the time that economic fundamentals are going in the opposite direction. The stronger the central bank intervention, the greater the wedge between stock market returns and economic fundamentals. This is one reason why during the COVID-19 pandemic, when the central bank intervention occurred on an unprecedented scale, the disconnect

between stock markets and the economy has become particularly apparent. The authors label this phenomenon in the title of their paper as "Going from free markets to Fed markets".

Cox et al. (2020) also attempt to explain stock market behavior in the early weeks of the coronavirus pandemic. They found that the most likely candidate for explaining the market's volatility during the early months of the pandemic was the pricing of stock market risk, driven by big fluctuations in risk aversion or sentiment unrelated to economic fundamentals or interest rates. Their conclusions were based on both an estimated asset pricing model and empirical evidence on the role of Federal Reserve communications and actions. Their estimates implied that the decline to near-zero interest rates in mid-March 2020 could explain at most a third of the market rebound. This left the most important causal role for rapidly fluctuating attitudes toward risk or investor sentiment being independent of the aggregate economic state.

In summary, the evidence suggests that there is a positive correlation between a QE policy and a rising stock market. In fact, some of the largest stock market gains in U.S. history have occurred during 2020 and 2021. After all, the purpose of a QE policy is to support or even jump start a nation's economic activity. In practice, QE policy entails buying massive amounts of government bonds or other investments from banks in order to inject more cash into the system. That cash is then loaned by the banks to businesses, which spend it to expand their operations and increase their sales. Stock investors anticipate the increased company revenue and lower discount rates also forced investors into relatively riskier investments to find stronger returns. Many of these investors weight their portfolios towards stocks, pushing up stock market prices. Falling interest rates also influence the decisions made by public companies. Lower rates mean lower borrowing costs. Companies have an incentive to expand their businesses and often borrow money to do so. Fundamental analysis holds that business expansion is a sign of a healthy operation and a positive outlook on future demand. That inspires investors to buy stock, which causes stock prices to rise. More discussion of these mechanisms can be found in Foley et al. (2021) and Cortes et al. (2022)

Figure 5 shows the macroeconomic development during 2020 and 2021. The upper left panel show the development of real GDP, the upper right panel show development of the consumer price index, the lower left panel show unemployment, and lower right panel credit growth. The growth in the economy has been very strong since the outbreak of covid19, and the GDP in real terms have more than recover. The unemployment level is also almost back to 2019 levels. The inflation growth is very strong hitting 7.8% YoY growth from February 2021 to February 2022, the

strongest in 40 years. This combined with the war in Ukraine has slowed the stock markets somewhat in the spring of 2022. The credit growth has come down substantially since the outbreak but is still above 2019 level. Strong economic growth and falling unemployment might have contributed to a very strong stock market in 2020 and 2021.

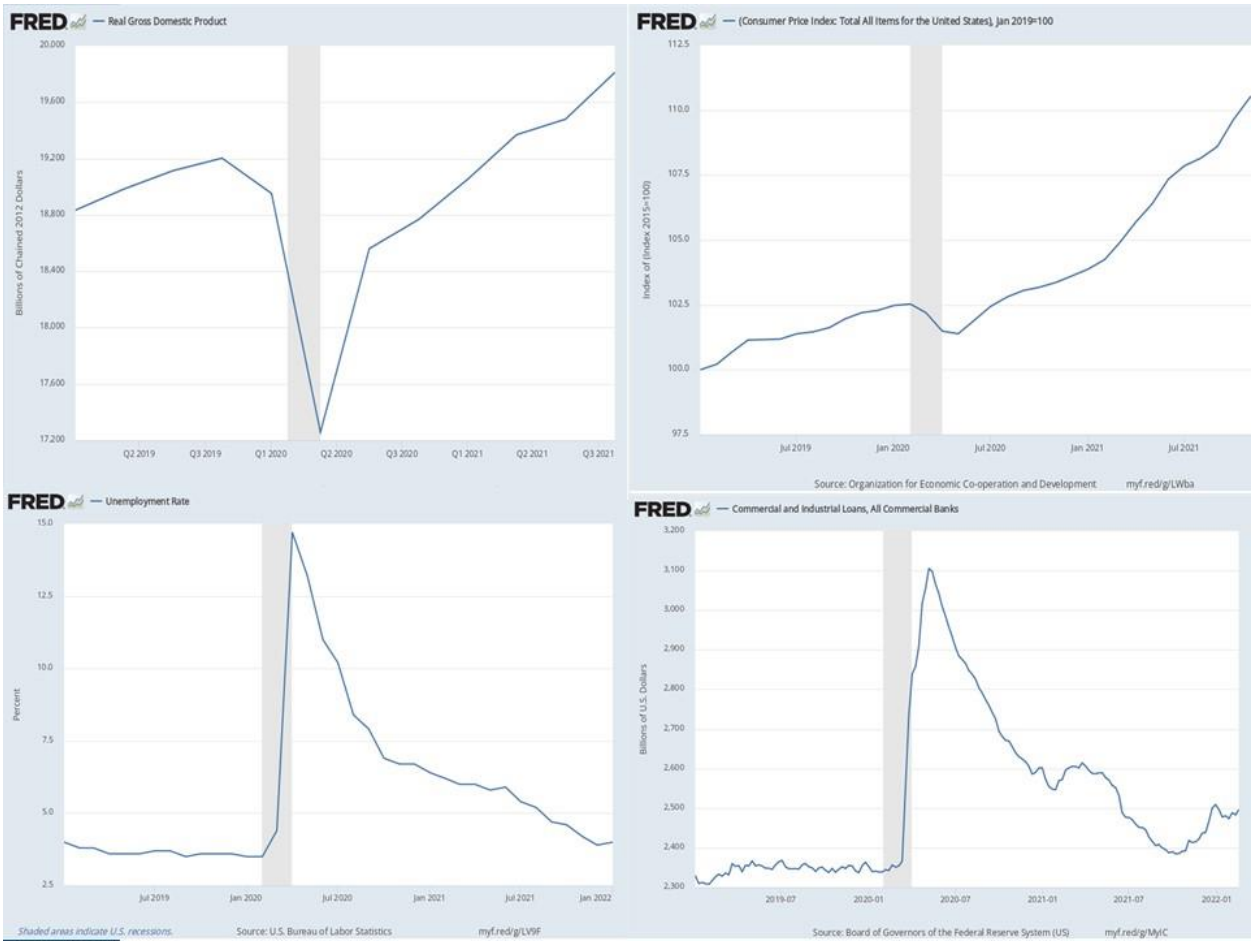

Figure 5. Macroeconomic development during 2020 and 2021. The upper left panel show the development of real GDP, the upper right panel show development of the consumer price index, the lower left panel show unemployment, and lower right panel credit growth. Data from the FRED database. Detailed description of data can be found at https: //fred.stlouisfed.org/series using GDPC1, CPALTT01USM661S#0 , /UNRATE, and TOTCINSA.

4.2. Investors' reaction and fund flow

Investors reactions and flow of funds is also an important factor explaining the "V" shaped recovery in the stock markets. Pástor and Vorsatz (2020) investigated the performance and flows of actively managed U.S. equity mutual funds during the COVID-19 crisis of 2020. They found that most active funds underperformed passive benchmarks during the crisis. Funds with high sustainability ratings performed well, as did funds with high star ratings. Fund outflows surpassed pre-crisis trends, though not dramatically. Investors favored funds that apply exclusion criteria and funds with high sustainability ratings, especially environmental ones. Their analysis indicate that investors remained focused on sustainability during this major crisis, with highly rated ESG funds performing relatively well compared to other funds. This is also confirmed with the discussion and Figure 4 provided in section 5.

Another interesting study is found in Giglio, Maggiori, Stroebel, and Utkus (2020). They looked at retail investor expectations before, during and after the Covid-19 crash. They surveyed retail investors who are clients of Vanguard, one of the largest asset management firms. Following the crash, the average investor turned more pessimistic about the short-run performance of both the stock market and the real economy. Investors also perceived higher probabilities of both further extreme stock market declines, and large declines in short run real economic activity. In contrast, investor expectations about long-run economic and stock market outcomes remained largely unchanged. Disagreement among investors about economic and stock market outcomes also increased substantially following the stock market crash, with the disagreement persisting through the partial market recovery. This is also in line with a discussion by Cheng (2020). Those respondents who were the most optimistic in February 2020 saw the largest decline in expectations and sold the most equity. Those respondents who were the most pessimistic in February 2020 largely left their portfolios unchanged during and after the crash.

V. Who rose, who fell under Covid-19?

5.1. Industry breakdown

Despite the overall devastating effects of the pandemic, it is well documented that some industries were better equipped to handle the Covid-19 shock. This is also reflected in the

heterogeneous financial markets reactions to the Covid-19 shocks across industries. Figure 6 shows the development of stock market returns by sector.

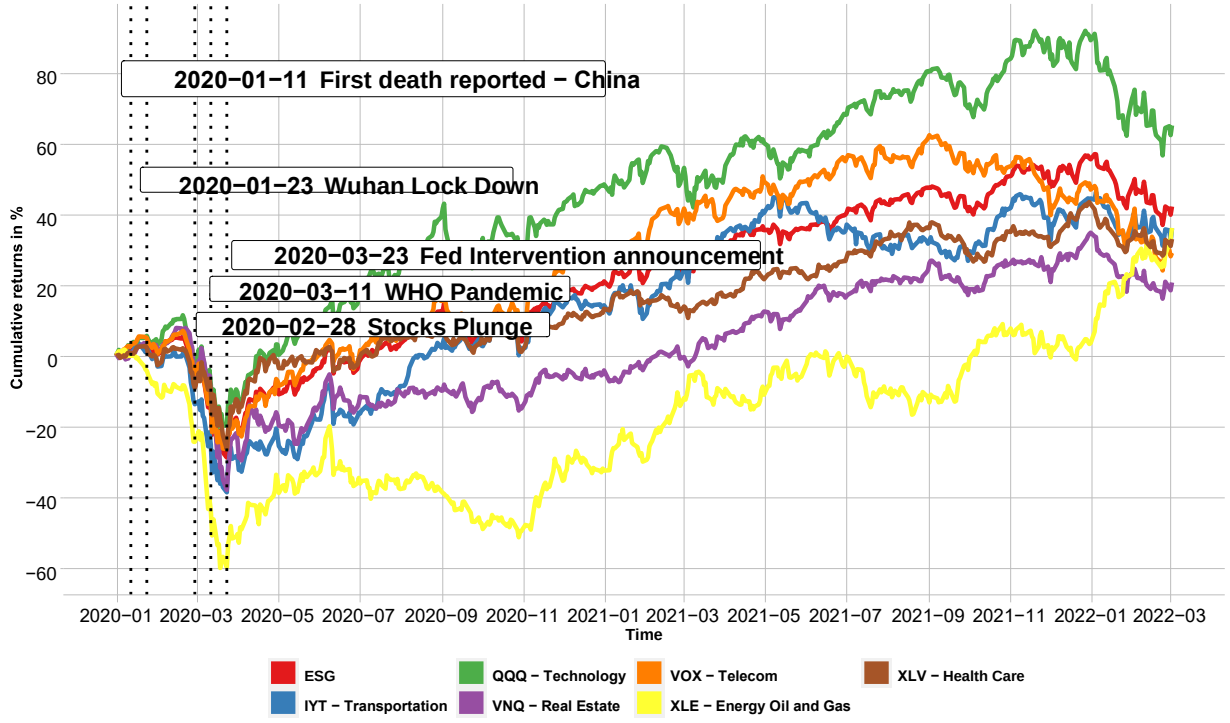

Figure 6. Stock Market Development at Industry Levels; source: Authors' calculation with data from Yahoo Finance.

At the worst moment in late March 2020, energy (oil and gas) were down 60%, whereas other sectors such as Technology, ESG, Telecom and Health care were only down 20%. By September 2020, the cumulative returns of the Energy sector were still down by 40%. On the other hand, those of Technology were up by approximately 30%, while those of Telecom and ESG were up by approximately 10%.

Ramelli and Wagner (2020) study the impact of the Covid-19 shock on CAPM-adjusted cumulative returns of Russell 3000 nonfinancial firms by industry group during the period from January to March 2020. In addition to the overall performance of the stocks in this period, they distinguish among three phases of the pandemic: Incubation (January 2 to January 17), Outbreak (January 20 to February 21) and Fever (February 24 to March 20).

Telecom, Pharma and Biotech, and the Semiconductor industries were found to be among the best performers over the period from January to March 2020. This effect was particularly prominent in the Fever period, though was less pronounced in the earlier stages of the pandemic. This is primarily due to the fact that during the Fever stage, the first lockdown policies and social distancing measures were introduced, which created a surge in demand for services that supported online activities, while at the same negatively affecting the companies that did not have the flexibility to switch to home offices and avoid physical interactions at the workplace. Intuitively, telecommunications and technology companies are more resilient to lockdown measures as they are better equipped to work from home, whereas pharmaceutical firms tend to react positively to disease-related news (Donadelli et al., 2017). On the contrary, Energy, Consumer Services and Real Estate were among the worst performing industries. Interestingly, much of the effect was again attributed to Fever, rather than the Incubation and Outbreak stages, which can be explained by a general decrease in economic activity due to the lockdown measures. In addition, such a late reaction may indicate that the markets did not initially anticipate the depth of the crisis in, i.e. during the Incubation and Outbreak stages.

These findings are supported by the results of Størdal, Dinh, Haugom, and Lien (2020), who study the performance of the Norwegian stock market after the Norwegian government implemented their lockdown policy in March 2020. They find that information technology sector exhibited the best performance in the post-lockdown period (from March 13, 2020 to June 6, 2020), whereas the energy sector was among the worst performers.

On the global scale Szczygielski, Charteris, Bwanya, and Brzeszczyński (2022) share similar results. They study the impact of Covid-19 on both return and volatility of 68 global industries and find that Covid-19 has a negative impact on return while pushing up the volatility. They also conclude that internet, software, health care, and biotech are the most resilient industries during the pandemic. In the meantime, airline, energy, finance, real-estate industries suffered. Zhang, Chen, and Shao (2021) build a model to quantify the spill-over effect between the energy and stock market. At a global scale, they found out that this spill-over effect increased by 19.94% compared to the level before the pandemic.

Landier and Thesmar (2020) also find evidence of heterogeneity in the percent changes of EPS forecasts across industries, and across different time horizons. For example, Real Estate faced the largest downward revision in 2020, with the reduction rapidly declining in subsequent years. Even

so, Energy and Industrials have and will demonstrate more resistance to the pandemic shock between 2020-2023 in a sense that the difference in forecast revisions for these years was and will be predicted to be less prominent. Among the winners here are Utilities, which did not experience substantial revisions in their EPS forecasts.

Carletti et al. (2020) investigate the effects of the first lockdown triggered by COVID-19 in March on the profitability and equity shortfall of Italian firms, the first and the hardest hit country in Europe during the first wave of the pandemic. The study suggests that the most prominent negative effects are found in the Wholesale Trade and Manufacturing industries. However, despite being severely affected by the pandemic, Recreation and Tourism were not subject to any substantial equity shortfall or profit reduction. The authors suggest that the reasons behind this surprising result are support mechanisms in the form of public wage subsidies that covered the labor costs in these industries during the lockdown. Unlike other contributions, Carletti et al. (2020) do not find any significant negative effects on the equity and profitability of companies in Energy and Transportation, as these sectors were exempted from the lockdown in Italy.

5.2. The case of ESG and financial flexibility firms

Among the important factors that contributed to firms' resilience to the negative pandemic effects are corporate social responsibility (CSR), environmental and social (ES) policies and financial flexibility. In particular, firms with a high ES rating and firms with high financial flexibility, e.g., high cash, high profit, low debt and low leverage before the pandemic, have performed better than the others during the Covid-19 outbreak (Albuquerque et al., 2020; Ding et al., 2021; Ramelli and Wagner, 2020; Fahlenbrach, Rageth, and Stulz, 2021; Acharya and Steffen, 2020; Landier and Thesmar, 2020).

In a study of cumulative abnormal returns of US companies, Albuquerque et al. (2020) show that firms with a high ES rating experienced significantly higher stock returns and lower stock return volatility during the first quarter of 2020. Garel and Petit-Romec (2021) show that stocks, which have responsible strategies towards climate change, experience better stock returns in the COVID-19 crisis. Rahman and Al Mamun (2021) also show that good governance stocks in Asia are more resilient to the impact of Covid-19. Bae, El Ghoul, Gong, and Guedhami (2021) have the opposite conclusion with the cited papers above. They show that there is no significant impact of

CSR on stocks' return during the Covid-19 crash period, and after the crash period. The results hold for different industries. However, when CSR aligned with institutional investment, they can observe some positive of CRS on return during the crisis impact albeit being small.

Ding et al. (2021) study the impact of the nexus between the growth rate of Covid19 cases and corporate pre-crises characteristics on the weekly stock of 6,700 firms across 61 economies. They find that the pre-pandemic financial condition shaped the stock price reaction to COVID-19, i.e., the stock returns of companies with more cash, less debt and larger profits experiences smaller declines. In addition, an investment in CSR and better corporate governance policies are also found to alleviate the negative effect of Covid-19 shock on stock returns. Rahman and Al Mamun (2021) share the same conclusion when investigating the Asian stocks. Low leverage, cash-rich companies were less impacted by the Covid-19 crash.

The effect of leverage and cash holdings on stock returns during the pandemic was also addressed by Ramelli and Wagner (2020). These factors were important value drivers for the companies as the pandemic unfolded, with highly leveraged firms and firms with lower cash holdings suffering severely in the Fever stage of the pandemic. Fahlenbrach et al. (2021) support these findings in their study on the value of financial flexibility. More specifically, they show that firms with a high financial flexibility experience a 26% lower stock price drop than those with a low financial flexibility. The financial flexibility in this paper is defined as the ability to fund a cash flow shortfall as a result of the pandemic and, thus, implies larger cash balances and a lower leverage at the end of 2019.

5.3. The case of resilient-to-pandemic firms.

From an asset pricing perspective, the Covid-19 pandemic represents a typical risk to the asset return. If the markets price in this risk, the resilient-to-the-pandemic asset performs better during the time of the pandemic. Analyzing the behavior of resilient and non-resilient to pandemic stocks adds another aspect to the heterogeneous reaction of the stock price to the Covid-19 pandemic. Pagano, Wagner, and Zechner (2021) offer an interesting result on how markets price in the pandemic risk for different stocks.

The authors divide stocks into two categories. One is the resilience to social distancing stocks, while another is the non-resilience to social distancing stocks. Pagano et al. (2021) argue that firms

with operations requiring less physical interaction that can be done from home are more resilient to the pandemic risk. They study the behavior of the return of these two types of stocks before, during and after the Covid-19 period of March 2020. There are three possible scenarios: i) the markets priced in the pandemic risk completely before 2020, ii) the markets did not price in the pandemic risk at all, and iii) the markets had been learning about the pandemic risk before 2020, then priced in this risk completely during the time of Covid-19. These three cases lead to three different patterns of return, as in shown in Table 1.

Table 1. Predicted return differential of resilient vs. non-resilient firms

Theory	Before COVID-19	During COVID-19	After COVID-19
Unpriced disaster risk	Zero	Positive	Zero
Priced disaster risk	Negative	Positive	Negative
Pre-disaster learning	Positive	Positive	Negative

Pagano et al. (2021) find the evidence to support the learning hypothesis. Under this hypothesis, the markets learned about this risk and started to increase the price of resilient to-pandemic stocks before the pandemic. We should see a positive difference in the return between resilient and non-resilient stocks before 2020. Indeed, from 2014 to the end of 2019, after controlling for Fama and French (2015) five factors model (FF5), the author shows that the cumulative adjusted return of resilient stocks is always higher than the one of non-resilient stocks. The difference in the cumulative FF5-adjusted-return has steadily increased from near 0% to approximately 40% from 2014 to 2019.

Under Covid-19, when the pandemic risk materialized, we also expect the resilient stocks to perform better than the non-resilient stocks. Pagano et al. (2021) show that the difference in the cumulative FF5-adjusted-return between resilient and non-resilient one is positive and varies from 10% to 15% from January 2020 to the end of March 2020.

If the markets were fully priced in during the pandemic risk, then after the crisis in March 2020, the expected return of resilient stocks should have been lower than that of the non-resilient ones. This is because right now the resilient ones are relatively more expensive than the non-resilient ones. Pagano et al. (2021) use options price data and Martin and Wagner (2019) methods to derive the implied expected return in the near future of a 30-day horizon to a 730-day horizon. Due to the availability of options price data, they only study a very small sample of three resilient stocks

(Apple, Google, and Microsoft) versus three non-resilient stocks (Marriott, United Airlines, and Royal Caribbean). The results point out that after March 2020, the expected return of non-resilient stocks is higher than that of resilient stocks. This result is robust with respect to various return horizons of the next 30 days, the next 91 days, the next 365 days and the next 730 days. Although based on a very small sample, the results shared some evidence about the materialization of the pandemic risk in the markets.

VI. Conclusion

This paper reviews the financial literature studying the developments in the stock markets during the Covid-19 outbreak. The major conclusions can be summarized as follows. Markets reacted slowly to the pandemic risk before March 2020. When the pandemic got worse, we see a quick crash in the stock market in March 2020. However, markets recovered quickly from April/May 2020. One of the primary reasons for this recovery is due to the intervention of the Fed, which reduced interest rates to 0% and aggressively bought financial assets to support the markets. Firms with financial flexibility (high cash, high profit, low debt) survived well during the crisis. We also see a shift in capital flow toward more ESG friendly firms/funds during this time. The literature on the impact of Covid-19 and financial markets is continuing to grow and expand to directions other than just stock markets, e.g.: retail investor behavior under Covid-19 Ortmann, Pelster, and Wengerek (2020), household spending under Covid-19 Baker, Farrokhnia, Meyer, Pagel, and Yannelis (2020b), transmission rates as a financial risk or not Hong, Wang, and Yang (2021), safe haven assets under Covid-19 Ji, Zhang, and Zhao (2020), financial markets news and Covid-19 Mamaysky (2020), fixed income markets under Covid-19 He et al. (2022); Augustin, Sokolovski, Subrahmanyam, and Tomio (2022); Hao, Sun, and Xie (2022); O'Hara and Zhou (2021), risk perception and politics under Covid-19 Barrios and Hochberg (2021), bank lending under Covid-19 Beck and Keil (2022), sovereign credit risk Augustin et al. (2022); Hao et al. (2022), Norwegian market Zhang, Erland, and Kaiser (2022), and lastly a comparison of the stock market reaction under the Covid-19 period with other previous pandemics Baker, Bloom, Davis, Kost, Sammon, and Viratyosin (2020a).

Finally, we highlight several directions for future research. First, as we saw the impact of cash-flow, discount-rate, and liquidity-injection toward the stocks markets during and after the Covid-

19 crash in March 2020. The remaining question lies on the fact of which channel dominates. The literature does not reach a consensus on the results of this topic nor on the methodological approach to solve it. Further research hopefully can shed light on this.

Second, we observe a slow reaction of the market toward the pandemic risk. Despite the outbreak since January 2020, WHO was hesitant to call it a pandemic. This also created a sense of resistance to recognize the pandemic in the market. That was the reason that markets reacted quickly after the WHO pandemic's announcement. If the markets included the pandemic information from Jan 2020, we would see a continuous but small decline overtime and we should not expect any major change in the markets after the WHO's announcement. The recovery after can be related to liquidity support from the Fed following their announcement. This raises the question if the market could be more efficient to recognize the pandemic risk in its early phrase and which preventive measures investors can take to mitigate the markets' risk in a similar crisis in the future.

Another interesting question is what will happen when QE policy ends. It is uncertain what will happen to the stock market, for good or ill, when the flow of easy money from central banks stops. For instance, if the Fed lets the bonds mature and does not replace them, it is equally unclear what impact this could have on the bond market and then on the stock market. Some believe the low-interest rate policy of the Federal Reserve after the dot-com-crash in the late 1990s helped to inflate the early 21st-century housing bubble. Similar issues will be faced by other central banks that have adopted QE policies during economic lockdowns. It is theoretically possible stock market prices could crash like those housing prices in 2008-09 if the same phenomenon results from QE. Future research in this direction would be of interest.

REFERENCES

Acharya, Viral V., and Sascha Steffen, 2020, The risk of being a fallen angel and the corporate dash for cash in the midst of COVID, *Review of Corporate Finance Studies* 9, 430–471.

Albuquerque, Rui, Yrjo Koskinen, Shuai Yang, and Chendi Zhang, 2020, Resiliency of Environmental and Social Stocks: An Analysis of the Exogenous COVID-19 Market Crash, *The Review of Corporate Finance Studies.*

Alfaro, Laura, Anusha Chari, Andrew Greenland, and Peter Schott, 2020, Aggregate and Firm-Level Stock Returns During Pandemics, in Real Time, Technical report, National Bureau of Economic Research, Cambridge, MA.

Altig, Dave, Scott Baker, Jose Maria Barrero, Nicholas Bloom, Philip Bunn, Scarlet Chen, Steven J Davis, Julia Leather, Brent Meyer, Emil Mihaylov, Paul Mizen, Nicholas Parker, Thomas Renault, Pawel Smietanka, and Gregory Thwaites, 2020, Economic uncertainty before and during the COVID-19 pandemic, *Journal of Public Economics* 191, 104274.

Augustin, Patrick, Valeri Sokolovski, Marti G. Subrahmanyam, and Davide Tomio, 2022, In sickness and in debt: The COVID-19 impact on sovereign credit risk, *Journal of Financial Economics* 143, 1251–1274.

Bae, Kee Hong, Sadok El Ghoul, Zhaoran (Jason) Gong, and Omrane Guedhami, 2021, Does CSR matter in times of crisis? Evidence from the COVID-19 pandemic, *Journal of Corporate Finance* 67, 101876.

Baker, Scott R, Nicholas Bloom, Steven J Davis, Kyle Kost, Marco Sammon, and Tasaneeya Viratyosin, 2020a, The unprecedented stock market reaction to COVID-19.

Baker, Scott R, Robert A Farrokhnia, Steffen Meyer, Michaela Pagel, and Constantine Yannelis, 2020b, How does household spending respond to an epidemic? consumption during the 2020 COVID-19 pandemic.

Barrios, John M., and Yael V. Hochberg, 2021, Risk perceptions and politics: Evidence from the COVID-19 pandemic, *Journal of Financial Economics* 142, 862–879.

Barro, Robert J., 2006, Rare Disasters and Asset Markets in the Twentieth Century, *The Quarterly Journal of Economics* 121, 823–866.

Barro, Robert J., José F. Ursúa, and Joanna Weng, 2022, Macroeconomics of the Great Influenza Pandemic, 1918–1920, *Research in Economics.*

Beck, Thorsten, and Jan Keil, 2022, Have banks caught corona? Effects of COVID on lending in the U.S., *Journal of Corporate Finance* 72, 102160.

Bollerslev, Tim, and Viktor Todorov, 2011, Tails, Fears, and Risk Premia, *The Journal of Finance* 66, 2165–2211.

Böni, Pascal, and Heinz Zimmermann, 2020, The COVID-19 Stock Market Downturn: Expected Growth or Discount Rate? *SSRN Electronic Journal*.

Brounen, Dirk, and Jeroen Derwall, 2010, The Impact of Terrorist Attacks on International Stock Markets, *European Financial Management* 16, 585–598.

Burdekin, Richard C.K., 2020, Death and the stock market: international evidence from the Spanish Flu, *https://doi.org/10.1080/13504851.2020.1828802* 28, 1512–1520.

Caballero, Ricardo, and Alp Simsek, 2020, Asset Prices and Aggregate Demand in a "Covid19" Shock: A Model of Endogenous Risk Intolerance and LSAPs, Technical report, National Bureau of Economic Research, Cambridge, MA.

Campbell, John Y, and Robert J Shiller, 1988, The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors, *Review of Financial Studies* 1, 195–228.

Carletti, Elena, Tommaso Oliviero, Marco Pagano, Loriana Pelizzon, and Marti G Subrahmanyam, 2020, The COVID-19 shock and equity shortfall: Firm-level evidence from Italy, *Review of Corporate Finance Studies* 9, 534–568.

Cheng, Ing-Haw, 2020, Volatility Markets Underreacted to the Early Stages of the COVID-19 Pandemic, *The Review of Asset Pricing Studies* 10, 635–668.

Contessi, Silvio, and Pierangelo De Pace, 2021, The international spread of COVID-19 stock market collapses, *Finance Research Letters* 42, 101894.

Cortes, Gustavo S., George P. Gao, Felipe B.G. Silva, and Zhaogang Song, 2022, Unconventional monetary policy and disaster risk: Evidence from the subprime and COVID–19 crises, *Journal of International Money and Finance* 122, 102543.

Cox, Josue, Daniel Greenwald, and Sydney Ludvigson, 2020, What Explains the COVID19 Stock Market? Technical report, National Bureau of Economic Research, Cambridge, MA.

Ding, Wenzhi, Ross Levine, Chen Lin, and Wensi Xie, 2021, Corporate immunity to the COVID-19 pandemic, *Journal of Financial Economics* 141, 802–830.

Donadelli, Michael, Renatas Kizys, and Max Riedel, 2017, Dangerous infectious diseases: Bad news for Main Street, good news for Wall Street? *Journal of Financial Markets* 35, 84–103.

Fahlenbrach, Rudiger, Kevin Rageth, and René M. Stulz, 2021, How Valuable Is Financial Flexibility when Revenue Stops? Evidence from the COVID-19 Crisis, *The Review of Financial Studies* 34, 5474–5521.

Fama, Eugene F, and Kenneth R French, 2015, A five-factor asset pricing model, *Journal of Financial Economics* 116, 1–22.

Foley, Sean, Amy Kwan, Richard Philip, and Bernt Arne Ødegaard, 2021, Contagious margin calls: How COVID-19 threatened global stock market liquidity, *Journal of Financial Markets* 100689.

Garel, Alexandre, and Arthur Petit-Romec, 2021, Investor rewards to environmental responsibility: Evidence from the COVID-19 crisis, *Journal of Corporate Finance* 68, 101948.

Giglio, Stefano, Matteo Maggiori, Johannes Stroebel, and Stephen Utkus, 2020, Inside the Mind of a Stock Market Crash.

Gordon, M. J., 1959, Dividends, Earnings, and Stock Prices, *The Review of Economics and Statistics.*

Gormsen, Niels Joachim, and Ralph S.J. Koijen, 2020, Coronavirus: Impact on stock prices and growth expectations, *Review of Asset Pricing Studies* 10, 574–597.

Grossman, Sandford J., and Merton H. Miller, 1988, Liquidity and Market Structure, *The Journal of Finance* 43, 617–633.

Hao, Xiangchao, Qinru Sun, and Fang Xie, 2022, The COVID-19 pandemic, consumption and sovereign credit risk: Cross-country evidence, *Economic Modelling* 109.

He, Zhiguo, and Arvind Krishnamurthy, 2013, Intermediary Asset Pricing, *American Economic Review* 103, 732–70.

He, Zhiguo, Stefan Nagel, and Zhaogang Song, 2022, Treasury inconvenience yields during the COVID-19 crisis, *Journal of Financial Economics* 143, 57–79.

Hong, Harrison G., Neng Wang, and Jinqiang Yang, 2021, Mitigating Disaster Risks in the Age of Climate Change, *SSRN Electronic Journal*.

Jackwerth, Jens, 2020, What do index options teach us about COVID-19? *Review of Asset Pricing Studies* 10, 618–634.

Ji, Qiang, Dayong Zhang, and Yuqian Zhao, 2020, Searching for safe-haven assets during the COVID-19 pandemic, *International Review of Financial Analysis* 71, 101526.

Landier, Augustin, and David Thesmar, 2020, Earnings expectations during the COVID-19 crisis, *Review of Asset Pricing Studies* 10, 598–617.

Liu, Jun, Jun Pan, and Tan Wang, 2005, An Equilibrium Model of Rare-Event Premia and Its Implication for Option Smirks, *The Review of Financial Studies* 18, 131–164.

Loughran, Tim, and Bill McDonald, 2020, Management Disclosure of Risk Factors and COVID-19, *SSRN Electronic Journal*.

Mamaysky, Harry, 2020, Financial Markets and News about the Coronavirus, *SSRN Electronic Journal*.

Martin, Ian W.R., and Christian Wagner, 2019, What Is the Expected Return on a Stock? *Journal of Finance* 74, 1887–1929.

Niederhoffer, Victor, 1971, The Analysis of World Events and Stock Prices, *The Journal of Business* 44, 193.

O'Hara, Maureen, and Xing (Alex) Zhou, 2021, Anatomy of a liquidity crisis: Corporate bonds in the COVID-19 crisis, *Journal of Financial Economics* 142, 46–68.

Ortmann, Regina, Matthias Pelster, and Sascha Tobias Wengerek, 2020, COVID-19 and investor behavior, *Finance Research Letters* 101717.

Pagano, Marco, Christian Wagner, and Josef Zechner, 2021, Disaster Resilience and Asset Prices, *SSRN Electronic Journal*.

Pástor, Lubos, and M. Blair Vorsatz, 2020, Mutual fund performance and flows during the COVID-19 crisis, *Review of Asset Pricing Studies* 10, 791–833.

Putnins, Talis J., 2020, From Free Markets to Fed Markets: How Unconventional Monetary Policy Distorts Equity Markets, *SSRN Electronic Journal*.

Rahman, Md Lutfur, and Mohammed Abdullah Al Mamun, 2021, How resilient are the Asia Pacific financial markets against a global pandemic? *Pacific-Basin Finance Journal* 69, 101656.

Ramelli, Stefano, and Alexander F Wagner, 2020, Feverish stock price reactions to COVID19, *Review of Corporate Finance Studies* 9, 622–655.

Rietz, Thomas A., 1988, The equity risk premium a solution, *Journal of Monetary Economics* 22, 117–131.

Samitas, Aristeidis, Elias Kampouris, and Stathis Polyzos, 2022, Covid-19 pandemic and spillover effects in stock markets: A financial network approach, *International Review of Financial Analysis* 80, 102005.

Shelor, Roger M, Dwight C Anderson, and Mark L Cross, 1990, The Impact of the California Earthquake on Real Estate Firms' Stock Value, *Journal of Real Estate Research* 5, 335– 340.

Størdal, Ståle, Minh Thi Hong Dinh, Erik Haugom, and Gudbrand Lien, 2020, Norwegian stock market behaviour duringthe initial phase of the COVID-19 pandemic, *Beta* 34, 207– 221.

Szczygielski, Jan Jakub, Ailie Charteris, Princess Rutendo Bwanya, and Janusz Brzeszczyński, 2022, The impact and role of COVID-19 uncertainty: A global industry analysis, *International Review of Financial Analysis* 80, 101837.

Wachter, Jessica A, Robert Barro, John Campbell, Mikhail Chernov, Gregory Duffee, Xavier Gabaix, Paul Glasserman, Francois Gourio, Campbell Harvey, Dana Kiku, Bruce Lehmann,

Christian Juillard, Monika Piazzesi, Nikolai Roussanov, Jerry Tsai, and Pietro Veronesi, 2013, Can Time-Varying Risk of Rare Disasters Explain Aggregate Stock Market Volatility?, *The Journal of Finance* 68, 987–1035.

Worthington, Andrew, and Abbas Valadkhani, 2004, Measuring the impact of natural disasters on capital markets: an empirical application using intervention analysis, *Applied Economics* 36, 2177–2186.

Zhang, Dan, Marie Erland, and Maria Holm Kaiser, 2022, The Impact of COVID-19 on the Norwegian Stock Market, *Beta* 36, 1–19.

Zhang, Hua, Jinyu Chen, and Liuguo Shao, 2021, Dynamic spillovers between energy and stock markets and their implications in the context of COVID-19, *International Review of Financial Analysis* 77, 101828.