Inside the Mind of a Stock Market Crash

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Abstract: We provide a data-driven analysis of how investor expectations about economic growth and stock market returns changed during the February-March 2020 stock market crash induced by the COVID-19 pandemic. We surveyed wealthy retail investors who are clients of Vanguard in mid-February 2020, around the all-time stock market high, and then again on March 11 and 12, after the stock market had collapsed by over 20%. The average investor turned more pessimistic about the short-run performance of both stock markets and the economy. Investors also perceived higher probability of both further extreme stock market declines and large declines in short-run real economic activity. In contrast, investors' expectations about the long run remained largely unchanged, and if anything improved. Disagreement among investors about economic and stock market outcomes also increased substantially. Our analysis is an input in both the design of the ongoing economic policy response and in further advancing economic theories.

One Sentence Summary: Our study of investors' beliefs before and during the COVID-19 crisis in February-March 2020 shows a sharp increase in pessimism about short run, but not long run, economic performance, and increased disagreement about the future of the economy.

We elicit investor beliefs using a survey about future economic growth and stock market returns before and during the stock market crash of March 2020, which was triggered by increasing concerns about the economic effects of the global COVID-19 pandemic. Beliefs and their dynamics play a central role in macroeconomics and finance, both in academic research and policy. Understanding how beliefs vary with changes in the economic environment is central to understanding asset markets and real economic outcomes. This paper offers a unique picture of the dynamics of beliefs during times of market distress, for an important set of market participants: retail investors who are clients of Vanguard, one of the U.S. largest asset management firms.

We find that beliefs about the stock market returns over the next year turned pessimistic following the stock market crash; expectations of GDP growth over the short-term (the next 3 years) also declined, although somewhat moderately. Expectations of short-run disaster probabilities in returns and GDP growth, defined respectively as a stock market drop of 30% or more in the next year and negative GDP growth over the next 3 years, both spiked during this episode. Surprisingly, however, long-term expectations of GDP growth and stocks over the next 10 years remained stable, if anything improving.

In addition to documenting these aggregate patterns, we show that the dispersion of views across investors, typically referred to as *disagreement*, increased substantially during the crash. We also study how the beliefs of previous optimists and pessimists react differentially to the crash. The vast majority of investors became more pessimistic about the short-run outlook of stock markets. Interestingly, however, among those investors who were very pessimistic before the crash, i.e. those who ex-ante were expecting negative 1-year stock market returns, about half actually become

more optimistic following the crash, showing that as the market actually crashed they revised their expectations for the future upwards.

The aim of this paper is to document these rich patterns in the data. We take no stand on whether the expectations measured by our survey are rational or include behavioral elements. The dynamics of individual and aggregate expectations after large shocks are among the most informative moments for workhorse models of macroeconomics and finance. For example, our data is informative about models of rare aggregate disasters (Barro (2006); Gabaix (2012), Wachter (2013)), models of disagreement between economic agents (Scheinkman and Xiong (2003), Fostel and Geanakoplos (2008), Simsek (2013), Morris and Yildiz (2019)), and more generally for behavioral finance (Thaler). Our results also provide timely insights into the mindset of retail investors that are a valuable input for the ongoing policy response to the crisis.

The paper builds on a project that we launched in 2017 in collaboration with Vanguard, with the aim of deepening our understanding of expectations in macroeconomics and finance (see Giglio et al. (2019) for details). We designed a novel survey, the GMSU-Vanguard survey, that elicits beliefs central to macro-finance, such as expected stock returns and expected GDP growth in both the short run and the long run. We also elicited respondents' perceived probability of economic disasters. The survey has been administered to retail clients of Vanguard every two months since February 2017. When we started the project, we had anticipated that one of the most interesting questions was how beliefs would change during an economic crisis or large stock market crash. We had therefore designed the administration of the survey to be able to launch additional surveys at short notice following such a potential stock market crash. This paper is the outcome of this pre-planned contingent survey administration.

After one of the longest and most-pronounced stock market booms on record during 2009-2019, the U.S. stock market experienced a sudden crash starting on Monday February 24th 2020. By March 11th 2020, the S&P 500 index had dropped 19.2% from its previous high. On that day, the financial press announced that U.S. stock markets had entered "bear territory", commonly defined as a drop in value of 20% or more from the high point (see Wall Street Journal). Following these dramatic market events, we fielded an unscheduled survey on March 11th 2020 at 6pm eastern daylight time, after the market close. The sample selection rules are described in Giglio et al. (2019), and we encourage the reader to refer to that paper for more background information on the survey.[1]

Our regular survey obtains approximately 2,000 responses per wave, with the majority of responses coming from people who have responded to multiple waves. The February wave obtained 2,390 responses. The March wave of the survey obtained 1,502 responses in the 24 hours after it was sent out to investors; 325 of those responses came from individuals who had also responded to the February wave.[2] The surveyed population is one that is relevant for understanding financial markets: retail investors with substantial investments in both equity and fixed income products. The median respondent has 225 thousand dollars invested with Vanguard, 70% in equity instruments and 15% in fixed income, and is approximately 60 years of age. At the 90th percentile,

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[1] The only difference compared to regular scheduled surveys is that we did not add newly selected clients that had never been contacted before by our study. This is consistent with the focus in this article on *changes* in beliefs of respondents over time.

[2] Response rates vary on average between 4% for newly contacted people to above 10% for those who have already responded once. Giglio et al. (2019) discuss selection bias in who answers the survey.

respondents have over 1 million dollars invested at Vanguard. Giglio et al. (2019) provides more detailed summary statistics on the investor population sampled by this survey.

As part of our ongoing project, a regular survey had been administered on February 11th 2020, which turned out to be almost exactly the all-time high in the U.S. stock market, offering us a clean measure of beliefs before the recent crash.[3] At this time, the Coronavirus (COVID-19) outbreak in China had already occurred, but its global spread had not yet been widely reported or commonly understood. The timing of the two surveys offers an extraordinarily clean comparison of beliefs starting from an all-time market high and going into one of the most dramatic and sudden stock market crashes in the last century.

We begin by documenting patterns in *average beliefs* in the data. Figure 1 shows the time-series of average beliefs across all our respondents for the entire period covered by our survey, including the last wave that was launched on March 11th 2020. Fig. 1A shows the 1-year expected stock market return, Fig. 1B the 10-year expected stock market return, Fig. 1C the expected real GDP growth per year over the next 3 years, Fig. 1D the expected real GDP growth per year over the next 10 years, Fig. 1E the probability of stock market disaster defined as a loss of more than 30% within the next year, and Fig. 1F the probability of a GDP disaster defined as negative average GDP growth over 3 years. For the last wave, we report not only the average belief of all respondents, but also split the responses between those that were received on March 11th and on March 12th. We report the split because on March 12th the S&P 500 fell an additional 9.5%.

Many of the panels in Figure 1 show large changes in beliefs following the market crash, of a magnitude not observed in the previous two years. In the two years before the crash, expectations about 1-year stock market returns had ranged between 3 and 6% and were at the high end of that range in February 2020. The crash brought them down to 1%. Investors who responded on March 12th, after a further stock market drop, had on average lowered their expectation by a further 1% compared to those who responded on March 11th. This pessimism about short-run market returns is not accompanied by pessimism about the long run. Fig. 1B shows that 10-year expected stock market returns actually increased modestly after the crash, from 6.9% per year to 7.2% per year.

Fig. 1C shows that average expectations about real GDP growth over the next 3 years moved from 2.8 to 2.4%, implying a cumulative loss of GDP over the next three years of just over 1.2%. Long term 10-year growth expectations were largely unchanged, if anything increasing from 3.1% to 3.2% per year. To provide a sense of the order of magnitude of expected GDP losses, it is illustrative to compare to what actually happened during the global financial crisis. Starting at the end of June 2008, real GDP growth in the U.S. over the next three years was -0.3%, with a pronounced v-shaped pattern of growth over that period. At least for now, the investors surveyed here are not expecting on average that the COVID-19 shock will lead to a repeat of the GDP losses anywhere near those experienced during the financial crisis.

Finally, Fig. 1E and 1F display large increases in the perceived probability of disaster in the short term in the stock market and GDP growth. The probabilities increase from 4.5% to 8% for the stock market, and from 17% to 23% for GDP growth. It is these extreme outcomes that the ongoing economic policy response is trying to minimize, but our respondents still find their probability to have increased substantially.

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[3] The survey was emailed to Vanguard clients on February 11th and the link remains open for the following fifteen days. Most surveyed people, if they respond, do so within the first two to three days. The S&P 500 index reached its all-time high on February 19th closing at 3386.15.
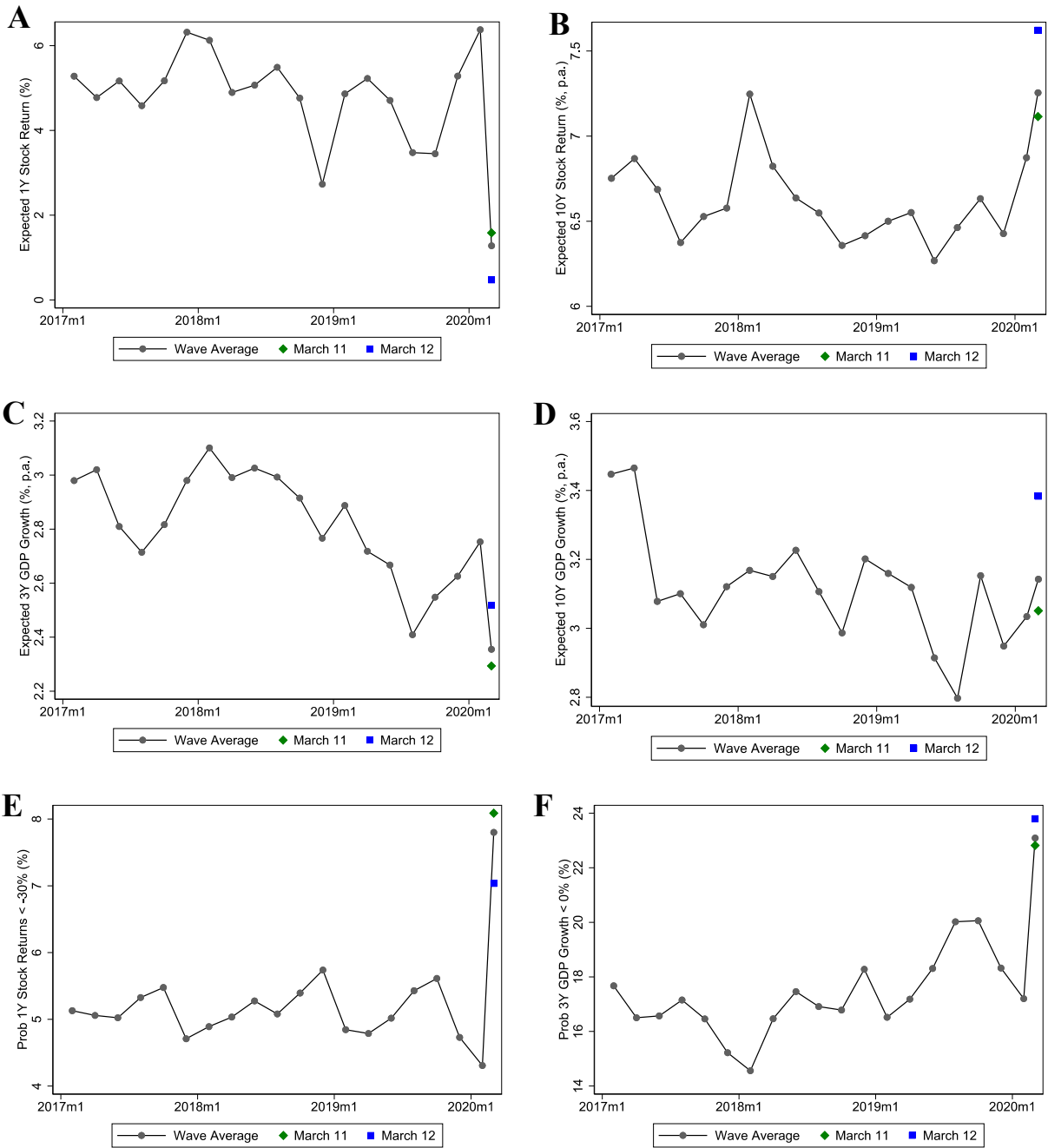
Fig. 1. Figure shows average beliefs across all respondents in each survey wave. Panel A shows the 1-year expected stock market return, Pane B the 10-year expected stock market return, Panel C the expected real GDP growth per year over the next 3 years, Panel D the expected real GDP growth per year over the next 10 years, Panel E the probability of stock market returns being lower than -30% within the next year, and Panel F the probability of GDP growth being less than zero on average over the next 3 years.

Beyond studying the behavior of *average* beliefs across investors, our data also allow us to understand the evolution of *disagreement* among investors. Figure 2 shows the smoothed kernel density of the cross-section of beliefs, for the 1-year expected return (Fig. 2A) and for the probability of a stock market disaster (Fig. 2B). The dashed and solid lines plot the distributions of beliefs before and after the crash, respectively.
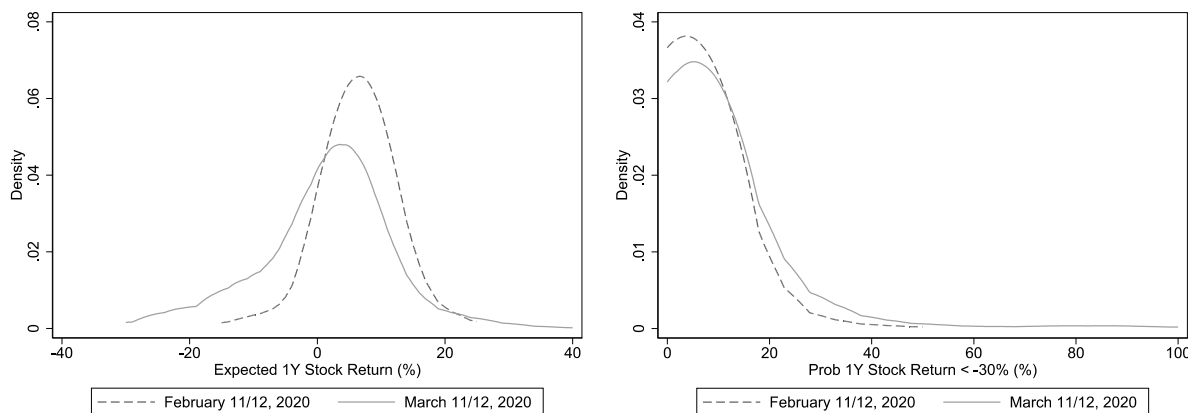

Fig. 2. Figure shows kernel density distributions over responses on February 11-12, 2020 and the March 11-12, 2020 waves of the GMSU-Vanguard survey. The left panel shows the distribution of beliefs about 1-year expected stock returns, the right panel shows the distribution of beliefs about the probability of a stock market decline of more than 30 percent over the coming 12 months.

The dispersion in beliefs across individuals, i.e., the level of disagreement, increased substantially after the market crash, as visible from the widening of both densities. The cross-sectional standard deviation (across respondents) of reported 1-year expected stock returns almost doubled from 5.3% to 9.9% between the two waves. The response of disagreement is asymmetric, with pessimism --- the left tail of Fig. 2A --- becoming substantially more pronounced in the investor population: the cross-sectional skewness of beliefs almost doubles from -0.32 to -0.5; the 10th percentile moves from 2% to -15%, whereas the 90th percentile remains essentially stable, falling to 10% from 12%. Finally, the 90th percentile of the distribution of perceived probabilities of disaster, captured by the right tail of Fig. 2B, doubles from 10% to 20%.

After stock market crashes, on average, stock prices over dividends tend to be low and risk premia tend to be high (Campbell Shiller (1988)). This is the crucial pattern referred to in macro-finance research as time variation in risk premia. Economic models rationalize this time variation using different mechanism. Our data supports the models of Gabaix (2012) and Wachter (2013) that after a disaster the (perceived) probability of further disasters increases, thus generating high risk premia to compensate investors for bearing this market risk. Our data also supports, at least qualitatively, the heterogenous beliefs models of Fostel and Geanakoplos (2008) and Simsek (2013) since we showed in our previous work (Giglio et al. (2019)) that optimists in our data take more risk and therefore, much like in the models, suffer greater losses if the stock market falls. The wealth redistribution from optimists to pessimists following a market crash is precisely what generates higher risk premia in this class of models. In addition, our data shows that the beliefs of optimists and pessimists are not static, to the contrary, they have reach dynamics. These dynamics are largely absent from the current generation of models, in part we believe because of a lack of reliable

empirical evidence, and our work offers novel empirical facts as an opportunity for further advancements of these theories.

We can further refine our understanding of belief dynamics by digging deeper into the nature of disagreement. We seek to understand *which* people changed their beliefs, and how: did pessimists become more pessimistic, or was the change in disagreement driven largely by investors who were previously optimistic? Our survey is particularly well suited to answering these questions, because we observe a significant number of investors who respond to multiple waves of the survey.

In Table 1 we study the subset of investors that responded to *both* the February 2020 and March 2020 survey (325 people). Table 1A focuses on the 1-year expected return, and Table 1B focuses on the probability of stock market disaster. In each panel, we group respondents in four buckets based on their beliefs about 1-year stock returns *before* the crash in the February wave; each row of the table corresponds to a different group. Those investors that, in the February 2020 wave, were most pessimistic are shown in the top row. This group expected negative returns going forward. The bottom row, instead, includes the most optimistic investors, those that in February 2020 expected 1-year returns above 10%. The columns of the table report the *change in beliefs* (equally weighted) in percentage points between February 2020 and March 2020. Each entry of the table reports the fraction of investors within each row that experienced a changed in belief in the range expressed in the corresponding column. For example, the first row of Fig. 3A shows that of those investors that in February 2020 expected negative returns: 4% lowered their expectations by 10 to 20 percentage points, and 13% lowered their expectations by 5-10 percentage points.

The table shows a widespread transition toward more negative beliefs. Looking at 1-year expected returns (Table 1A), we see that for every group except those who were already the most pessimistic in February, at least 72% of the respondents become more pessimistic after the crash; 85% of the previously-most-optimistic group become more pessimistic. Even among investors who already expected *negative* returns before the crash (top row), almost half become more pessimistic. One interpretation of these results is that in February, after the spread of the Coronavirus had already started, a set of individuals (the pessimists) thought a stock market crash was likely to occur over the next year. As this scenario actually unfolded, about half of these individuals thought that the correction had gone far enough and increased their expected returns, and half expected further stock market declines. On the other hand, the vast majority of optimists revised their expectations downwards dramatically in light of the market crash.

Panel A.			Change in Expected Returns After the Crash (percentage points)			
Boom Expected 1 y Returns	Less than -20	Between -20 and -10	Between -10 and -5	Between -5 and 0	Between 0 and 5	Greater than 5
Less than 0	0.00	0.04	0.13	0.30	0.17	0.35
Between 0 and 5	0.08	0.18	0.10	0.36	0.19	0.08
Between 5 and 10	0.09	0.13	0.12	0.42	0.16	0.08
Greater than 10	0.06	0.23	0.28	0.28	0.04	0.11

Panel B.			Change in Probability of Crash After the Crash (percentage points)			
Boom Probability of Crash	Less than -5	Between -5 and 0	Between 0 and 5	Between 5 and 10	Between 10 and 20	Gretaer than 20
Between 0 and 2.5	0.00	0.04	0.66	0.16	0.08	0.06
Between 2.5 and 5	0.00	0.50	0.20	0.10	0.20	0.00
Between 5 and 10	0.01	0.25	0.44	0.21	0.06	0.03
Greater than 10	0.37	0.19	0.18	0.03	0.13	0.09

Table 1. Panel A shows the transition density between the level of ex-ante expectations about 1-year stock market returns (rows) and ex-post changes in these expectations (columns). Panel B shows an analogous analysis for the perceived probability of the stock market return being lower than -30%. The interior buckets in both rows and columns are closed on the left and open on the right.

This view is also supported by Table 1B, that presents an analogous analysis for the perceived probability of a stock market disaster (in this panel, previous pessimists are in the last row). Those who ex-ante reported the highest probabilities of a large stock market decline are also those who decreased their perceived probability the most following such a decline; again, about half the pessimists become more optimistic, and half become even more pessimistic.

Our final analysis uses our panel data to investigate the joint dynamics of changes in expectations about economic growth and stock market returns across individuals. A long literature in finance has explored the relation between these two objects, but the use of survey data to analyze their joint dynamics in a crash is novel. Indeed, while market prices depend on expectations of future real economic performance (the firms' dividends, which are, in turn, related to GDP growth), they also reflect investor sentiment and risk tolerance, which can vary significantly over time. Table 2 reports the correlation table of individual-level changes in beliefs between the February and March waves of the survey. For example, the table shows (row 6, column 3) that investors who increased their perceived probability of a stock market disaster also increased the perceived probability of GDP growth disaster.

Correlations	(1)	(2)	(3)	(4)	(5)	(6)
(1) Δ Expected 1Y Stock Return (%)	1					
(2) Δ Expected 10Y Stock Return (% p.a.)	0.032	1				
(3) Δ Prob 1Y Stock Return < -30% (%)	-0.351	0.120	1			
(4) Δ Expected 3Y GDP Growth (% p.a.)	0.198	0.108	-0.051	1		
(5) Δ Expected 10Y GDP Growth (% p.a.)	-0.014	0.251	-0.028	0.431	1	
(6) Δ Prob 3Y GDP Growth < 0% p.a. (%)	-0.190	-0.021	0.148	-0.330	-0.122	1

Table 2. Cross-sectional correlation of changes in individual beliefs between the February 11-12, 2020 and the March 11-12, 2020 waves of the GMSU-Vanguard survey.

The first column also highlights that, on average, those investors who became more pessimistic about average stock returns also became more pessimistic about the probability of a stock market crash and a GDP disaster (rows 3 and 6), as well as about the short-run outlook for GDP growth (row 4). However, changes in beliefs about long-run GDP growth and long-run stock market returns (rows 2 and 5) are essentially uncorrelated with changes in short-run beliefs, highlighting the perceived short-lived nature of the crisis.

Before concluding, we point out to the reader a number of possible limitations of the current study. First, like all survey-based studies, the presence of measurement error is a potential concern, especially for the quantitative interpretation of the results. Second, the population of investors we survey is selected both in terms of being Vanguard clients and in terms of choosing to answer the survey. Both of these concerns are extensively discussed in our previous work (Giglio et al., 2019) and here we limit our answer to pointing out that (i) Vanguard is one of the world's largest asset managers with assets of $6 trillion and serves over 10 million individua investors, thus making it per-se an interesting population to study, and (ii) while measurement error and selection are present, we have found our surveys to reveal beliefs that are reflected in investors trading decisions. A final concern, more specific to this paper, is that the COVID-19 crisis is but one

shock, with its own idiosyncratic components, so that not all patterns documented might be general to other economic shocks. It suffices to say that shocks of this magnitude are so rare that much advancement in economics is achieved by their study even given the idiosyncratic limitations.

To conclude, our study provides a unique real-time look inside the mind of market participants during the COVID-19 crisis. It shows that while investors turned more pessimistic and increased their perceived probability of a catastrophic event both in terms of real economic outcomes and further stock market declines, they also formed a nuanced view of the world. Short-term pessimism has so far been matched with unchanged to improved long-run expectations. Our results offer a data-driven analysis of relevance for policy makers trying to shape the economic policy response to the COVID-19 shock, and an initial step in much of the scientific study of this crisis that both economists and scientists will perform for years to come.

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