Supplementary Material to Dietrich, Kuester, Müller and Schoenle *"News and uncertainty about COVID-19: Survey evidence and short-run economic impact"*

Supplementary Material A. Survey details

This section collects further information about the survey.

Supplementary Material A.1. Survey Overview

The survey was administered on the Qualtrics Research Core Platform, and Qualtrics Research Services recruited participants to provide responses. Survey data used in this paper spans the time from March 10, 2020 to June 11, 2021. Participants were asked for their expectations and behavior regarding COVID-19. While the survey also contains other blocks with various questions, these are not reported here, since they are asked after the questions on COVID-19 and thus do not affect the answers.

Supplementary Material A.2. Sample and Respondent Characteristics

Invitations went out to residents of the U.S. Respondents were pre-screened for residence-status, English language fluency, and age. All respondents who failed to meet the screening criteria were discontinued from the survey. Only respondents who confirmed residence in the U.S., who professed English language fluency, and who reported to be of ages above or 18, were brought on to the survey proper. Upon meetings these criteria, we screened responses by removing any participants who took less than five minutes to complete the survey or had at least one gibberish response (e.g., "$sd - \$rt2$"). Table 1 provides a detailed breakdown of our sample. It shows that our sample was roughly representative of the U.S. population to start with, according to the sampling criteria. In addition, our analysis uses a raking scheme to compute respondent weights in a way that ensures that our sample is representative of the U.S. population by gender, age, income, education, ethnicity, and Census region.

Supplementary Material A.3. Survey Questions on Income, GDP, and Inflation

Questions Q1 to Q3 in Supplementary Material A.6 summarize the type of point-estimate questions we ask about GDP, household income and inflation, for 12-month horizons. Questions Q4 to Q6 in Supplementary Material A.6 summarize the types of distributional questions we ask about GDP, household income and inflation.

In formulating these questions, we follow the approach in the SCE: First, we elicit point estimates. Second, we elicit the probability that respondents assign to a particular outcome given a range of outcomes. When we ask for point estimates, we first ask whether respondents expect inflation or deflation (or output increases or decreases). Then, we ask what their point estimates are.We choose to ask on point estimates in this twofold manner in order to avoid issues about the correct sign of the numerical answer, i.e. that respondents intend to answer -3% but just give 3 into the answer field. In the case of eliciting the distribution, we bin the support like the SCE into bins of decreases less than -12, -12 to -8, -8 to -4, -4 to -2, -2 to 0 and symmetrically for increases.

Supplementary Material A.4. Complementary Survey Questions

Our survey included a series of complementary questions. These questions do not elicit expectations. However, they cover a wide range of behavioral topics, usually with yes/no answers. These questions include savings and purchasing behavior and plans in response to COVID-19, the expected duration of the pandemic, and whether respondents have hoarded food, and medical supplies in response to COVID-19. Supplementary Material A.6 summarizes these complementary questions B1 to B8.

Supplementary Material A.5. Sampling Frequency

We run the survey in real time with a daily sample of at least 100 respondents. This high-frequency approach generates novel insights into the pros and cons of high-frequency data in the face of large economic shocks. We illustrate the consequences of choosing different sampling frequencies in Figure A.1. The figure's left panel shows the cross-sectional mean of GDP expectations sampled at a daily frequency. The right panel shows various lower-frequency counterpartts: an 11-day moving average (red solid line), a monthly mean (blue dashed line), and means based on sampling every 30 days at the 1st of each month (black dotted line) or the 15th of each month (green dashed line).

As one can see, daily observations of GDP expectations are subject to high volatility (left panel), as we also discuss in detail in the following results section. On the other hand, each way of of low-frequency sampling as practiced by conventional survey approaches may capture different information. The details of the low-frequency implementation matter. If one samples throughout the month but then averages, one does not only capture the

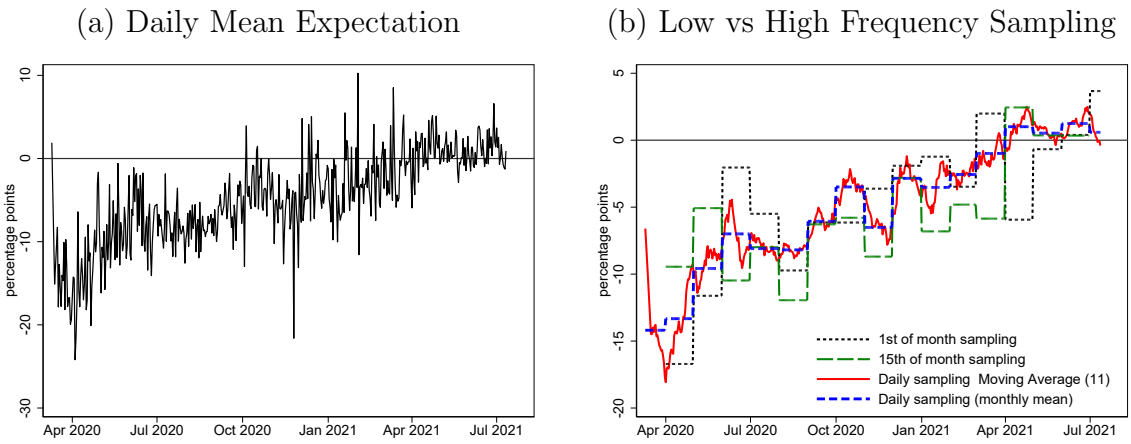


Figure A.1: Sampling Frequency. *Notes:* Solid black line in left panel (a) shows the daily daily mean of survey responses (weighted using survey weights and Huber-robust weights). Red line in panel (b) shows an 11 day moving average representation of daily mean. Dashed blue line shows monthly averages. Back and green line give survey GDP expectations if we reduce the sampling frequency to once a month (1st or 15th of month).

volatile movement of the daily means, but filters out some of the noise attached to the daily sampling frequency. If one samples on specific dates, one may capture an incomplete and possibly misleading picture of the evolution of expectations. As the once-a-month samples show, such low frequency-approaches would have missed out the drastic decline and recovery of expectations in the early crisis period. Or, one might have exaggerated the impact of COVID-19 on expectations if sampling had coincided with the day of the most extreme low. The ultimate choice of sampling frequency depends on the economic circumstances and, of course, the presence or absence of a real-time need for information.

Supplementary Material A.6. List of Survey Questions

Survey participants are shown the following introductory text:

"Since January 2020 the coronavirus (COVID19) is spreading with human infections around the world. Besides causing human suffering, this might also affect economic activity. We now want to know your personal expectations on this topic. Of course, no one can know the future. These questions have no right or wrong answers - we are interested in your views and opinions."

We then start with questions on the GDP change due to COVID-19 for the 12 months horizon:

Q1a: *In your view, within 12 months from today, will the overall economic impact of the coronavirus be positive or negative? This would include direct effects and indirect effects.*

O Positive

O Negative

Dependent on the answer given on the previous question, the participant is shown the next question:

Q1b:*What do you expect the overall economic impact of the coronavirus to be over the next 12 months? Please give your best guess.*

I expect the overall economic impact of the coronavirus to be ***positive/ negative*** _____ *percent of GDP.*

Q2a: *Over the next 12 months, do you think that the coronavirus will cause the total income of all members of your household (including you), after taxes and deductions to be higher or lower?*

O Higher

O Lower

Q2b: *How much higher do you expect total income of all members of your household to be over the next 12 months because of coronavirus? Please give your best guess.*

I expect total income of all members of my household to be _____ *percent* ***higher/ lower*** *because of coronavirus.*

Q3b: *The next few questions are about inflation. Over the next 12 months do you think that the coronavirus will cause inflation to be higher or lower?*

O Higher

O Lower

Q3b: *How much higher do you expect the rate of inflation to be over the next 12 months because of coronavirus? Please give your best guess.*
I expect the rate of inflation to be _____ percentage points ***higher/ lower*** *because of coronavirus.*

We the proceed by asking about the individaul distribution of expectations:

Q4: *In your view, within 12 months from today, what will be the overall economic impact of the coronavirus?*
What would you say is the percent chance that, over the next 12 months, the overall economic impact in percent of GDP will be . . . [1] [2]

Negative, by 25 percent or more _____
Negative, by 12 to 25 percent _____
Negative, by 8 to 12 percent _____
Negative, by 4 to 8 percent _____
Negative, by 2 to 4 percent _____
Negative, by 0 to 2 percent _____
Positive, by 0 to 2 percent _____
Positive, by 2 to 4 percent _____
Positive, by 4 to 8 percent _____
Positive, by 8 to 12 percent _____
Positive, by 12 to 25 percent _____
Positive, by 25 percent or more _____

Q5: *In your view, what would you say is the percent chance that over the next 12 months,*

[1] On March 10, 2020 , the answer bins have been sorted inversely, staring with "Positive, by 12 percent or more" to "Negative, by 12 percent or more".

[2] Before April 7, 2020, the number of bins was 10, without both extreme alternatives. Instead, the second bin was "Negative, by 12 percent or more" and a similar formulation for the positive impact bin. While the ultimate bins read "20% or more/less" from April 07, 2020 until April 30, 2020, we adjusted this to 25% more or less on May 1, 2020.

the coronavirus will cause total income of all members of your household (including you), after taxes and deductions, to be . . .

Lower, by 12 percent or more _____
Lower, by 8 to 12 percent _____
Lower, by 4 to 8 percent _____
Lower, by 2 to 4 percent _____
Lower, by 0 to 2 percent _____
Higher, by 0 to 2 percent _____
Higher, by 2 to 4 percent _____
Higher, by 4 to 8 percent _____
Higher, by 8 to 12 percent _____
Higher, by 12 percent or more _____

Q6: *In your view, what would you say is the percent chance that, over the next 12 months, the coronavirus will cause the rate of inflation to be . . .*

lower by 12 percentage points or more _____
lower by between 8 percentage points and 12 percentage points _____
lower by between 4 percentage points and 8 percentage points _____
lower by between 2 percentage points and 4 percentage points _____
lower by between 0 percentage points and 2 percentage points _____
higher by between 0 percentage points and 2 percentage points _____
higher by between 2 percentage points and 4 percentage points _____
higher by between 4 percentage points and 8 percentage points _____
higher by between 8 percentage points and 12 percentage points _____
higher by 12 percentage points or more _____

B1: *Have you increased your personal savings due to the outbreak of the coronavirus?*

O Yes
O No

B2: *Has your financial planning changed due to the outbreak of the coronavirus?*

O Yes

O No

B3: *Have you refrained from planned larger purchases due to the outbreak of the coronavirus?*

O Yes

O No

B4: *Do you spend a larger fraction of your income due to the outbreak of the coronavirus?*

O Yes

O No

B5: *Due to the economic consequences of the coronavirus, do you fear you may lose your job?*

O Yes

O No

B6: *Since the outbreak of coronavirus, do you try to avoid products from China?*

O Yes

O No

B7: *Since the outbreak of the coronavirus, have you started to store larger quantities of food supplies at home than before?*

O Yes

O No

B8: *Since the outbreak of the coronavirus, have you started to store larger quantities of medical supplies at home than before?*

O Yes

O No

In addition, we ask all respondents the following demographic questions:

D1: *Please enter your age.*

D2: *Please indicate your gender.*

O Male
O Female
O Other

D3: *How would you identify your ethnicity? Please select all that apply.*

O Asian/Asian American
O Black/African American
O White/Caucasian
O Other
O Prefer not to say

D4: *Do you consider yourself of Hispanic, Latino or Spanish origin?*

O Yes
O No

D5: *Please indicate the range of your yearly net disposable income.*

O Less than $10,000
O $10,000 - $19,999
O $20,000 - $34,999
O $35,000 - $49,999
O $50,000 - $99,999
O $100,000 - $199,999
O More than $200,000

D6: *In which state do you currently reside?*

D7: *What is the highest level of school you have completed, or the highest degree you have achieved?*

O Less than high school
O High school diploma or equivalent
O Some college, but no degree
O Bachelor's degree
O Master's degree
O Doctorate or Professional Degree

Supplementary Material B. Data

Supplementary Material B.1. Blue Chip Forecasts

In order to compare the household expected COVID-19 impact over the next 12 months to a measure of professional forecasters, we use both GDP and inflation (CPI) expectations from the Blue Chip panel of forecasters[3]. To match the question format asked in our survey - the impact of COVID-19 on a variable - most closely, we contrast expected outcomes by professional forecasters to a constant growth scenario.

Specifically, we use GDP level nowcasts from the Philadelphia Fed's Real-Time Data Set for Macroeconomists , available each month for the prior quarter (in case of GDP) or the prior month (for CPI indices)[4]. These level nowcasts are then used to compute expected levels over the next 12 months utilizing the Blue Chip forecast data. For GDP, we look at the expected level in 3, 6, 9 and 12 months time. For the CPI, we compute expected price levels for the current and the next 11 months. Since the Blue Chip data contains expected growth rates in each month only for quarterly horizons, we break these down to monthly growth rates, assuming constant growth within the quarter. Equation (B.1) describes expected levels:

$$E_t^{BC} x_{t+k|t} = x_{t-1|t}^{NC} \prod_{k=0} (1 + E_t^{BC} g_{t+k|t}) \tag{B.1}$$

Here, $x_{t-1|t}^{NC}$ gives the nowcast for the variable in the preceding month. $E_t^{BC} g_{t+k|t}$ gives Blue Chip expected growth in month $t+k$. Consequently, $E_t^{BC} x_{t+k|t}$ is the expected level by Blue Chip forecasters in $t+k$. Subsequently, expected levels are contrasted against a

[3]Blue Chip forecasts are obtained from Walters Kluwer N.V. See Aguinaldo, J., Stone, C., Batten, S., and Moeller, T. J. (2021). *Blue chip economic indicators.* Wolters Kluwer N.V.

[4]For the GDP time series, the previous quarter nowcast is unavailable for the first month of each quarter. Here, we thus use the data provided in the second month of the quarter. (That is, the 2019Q4 nowcast from Feb 2020 is also used in Jan 2020.)

constant growth scenario. This scenario assumes constant growth starting from the nowcast for January 2020 (CPI) or 2019Q4 (GDP). Underlying annual growth rates are 2% in the case of CPI and 1.91% for GDP, the average 2019 growth rate. x^C_{t+k} denotes the level of variable x under the constant growth scenario in $t+k$.

$$E_t^{BC} X_{t+12|t}^{COVID} = \frac{1}{12} \sum_{k=0}^{11} \left[\ln(E_t^{BC} x_{t+k|t}) - \ln(x^C_{t+k}) \right] \tag{B.2}$$

$E_t^{BC} X_{t+12|t}^{COVID}$ denotes the average impact of COVID-19 on variable x over the next 12 months.

Supplementary Material B.2. Realized Levels for GDP and Inflation

In order to compare survey expectations to realized levels of the respective variable, we also display respective statistics. Here, our approach is close to the one outlined in the last section. Real GDP as well as CPI inflation are compared to the constant growth scenario over the next 12 months. Then, we compute the average log deviation between the actual and constant growth value for the next 12 months from any point in time. This measure is meant to match our survey questions most closely.

Supplementary Material B.3. Data Sources

Within our study, we use several external data sources. Figure 1 panel (c) uses COVID-19 infection data for the US form the Johns Hopkins University database.Panel (d) of the same figure shows weekly unemployment claims in percent of workforce (obtained via FRED, data series [iursa]).

Panel (b) of figure 3 shows the 5 xear break-even inflation rate. Data is obtained via FRED, data series [t5yie].

In Figure C.5 panel (a) uses personal household expenditure data (FRED data series [pce].Panel (b) shows household disposable income, both with and without transfers (FRED data series [dspic96] and [w875rx1]).

Supplementary Material C. Additional Figures

Supplementary Material C.1. Demographic Heterogeneity in Expectations

We find that survey responses co-vary with socio-economic characteristics in an economically meaningful way. Figure C.2 breaks down the expected impact of COVID-19 on GDP by socio-economic demographics. The left panel of row (a) looks at education, distinguishing between respondents with and without college education. Respondents in the low-education group expect a larger and more persistent GDP impact throughout our sample period, rendering the adjustment of expectations of the highly educated more similar to that of the Blue Chip survey. To the extent that education correlates with IQ, the pattern in panel (a) also squares with recent evidence by D'Acunto et al. (2021). In a sample of men, they find that higher-IQ respondents display considerably smaller forecast errors.

Next, the left panel of row (b) of Figure C.2 presents rather stark differences by gender: for much of the year 2020 women expect a GDP impact of COVID-19 that is about 3 times larger and much more persistent. That expectation formation differs systematically across gender has recently been documented by **?**. The authors stress that traditional gender roles rather than innate characteristics account for this observation. Indeed, women seem to have been most exposed to job loss or changes in labor-market participation in the pandemic, see Alon et al. (2021).

The left panel of row (c) shows that older respondents (55 and above) expect the economic fallout of COVID-19 to be more negative than younger respondents. Note that older respondents, in other circumstances, are not generally more pessimistic than the young. From October 2020 to July 2021, we also asked respondents about climate change and, specifically, its expected impact on GDP and GDP growth. It turns out that in this regard the older cohorts are considerably more optimistic than the young (Dietrich et al., 2021). Generally, cohort effects may be important for expectation formation and economic behavior (e.g. Malmendier and Nagel, 2011). Clearly, in addition, older respondents will have been more susceptible to facing hospitalization or death following an infection.

Last, the left panel of row (d) shows responses for different income levels. We define low income as below 35k$ per year. High income respondents have a minimum annual income of 100k$. The remainder are middle-income households. Expectations of low and middle

income respondents adjust much more strongly and persistently to COVID-19. Bear in mind that while we group respondents by household income, in all cases above the survey question asks for the effect of COVID-19 in terms of *aggregate* income (GDP), not personal household income.

In addition, figures on the right side of each panel in Figure C.2 show that also the extent of uncertainty differs systematically across groups of the population. In general, uncertainty is higher for those groups for which the expected impact is larger, with the exception of age: in the group of respondents aged 54 or more, uncertainty about the impact of COVID-19 is smaller than in the other groups. Similar demographic effects are prevalent for other variables as well, and again for the mean as much as for uncertainty, see the figures C.3 to C.4 for the corresponding time series.

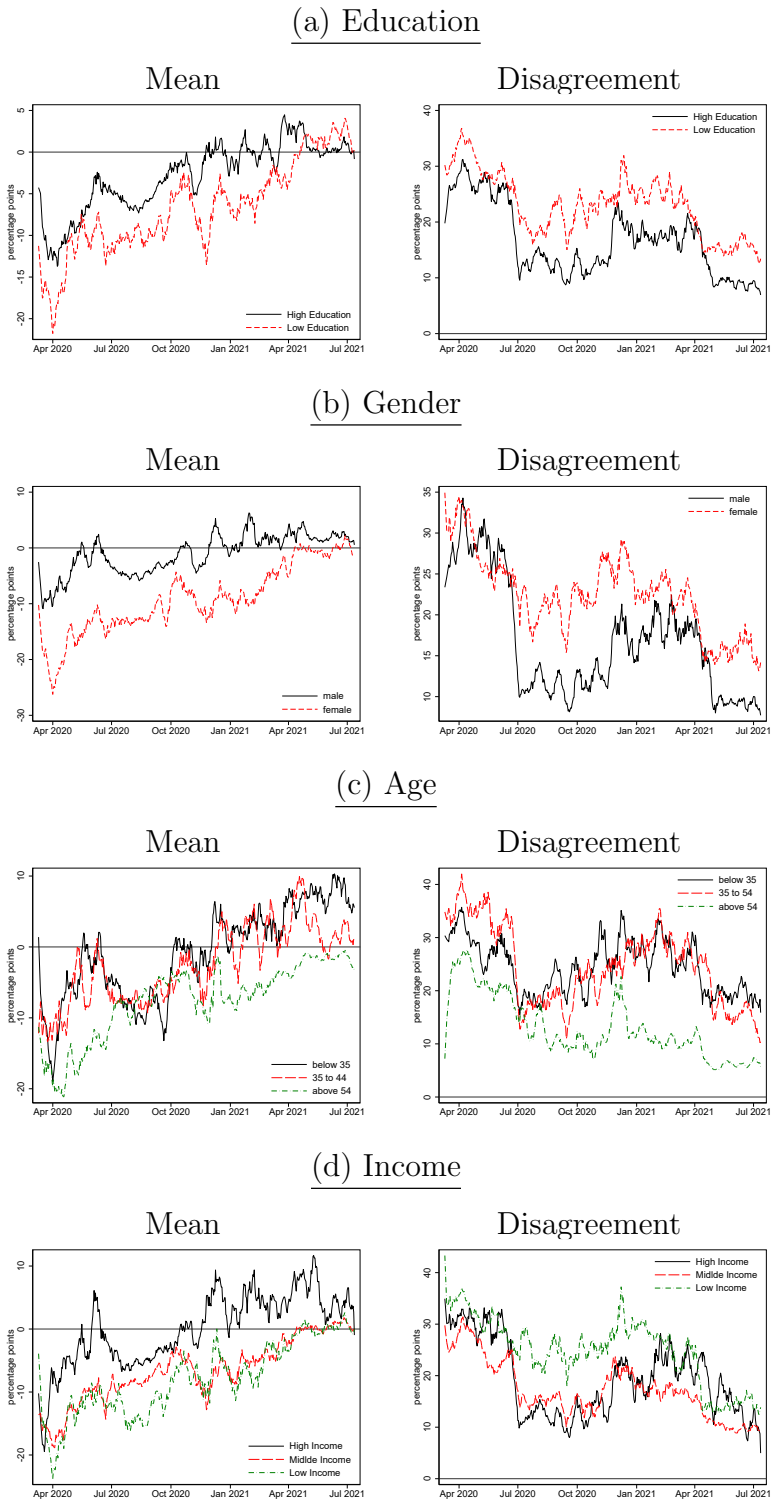


Figure C.2: Heterogeneous Expectations: COVID-19 Impact on GDP. *Notes:* Consumers' 12-months ahead daily expected COVID-19 impact on GDP (left panel, "mean") and cross-sectional standard deviation of the expected impact (right panel, "disagreement"). Lines represent an eleven-day balanced moving average.

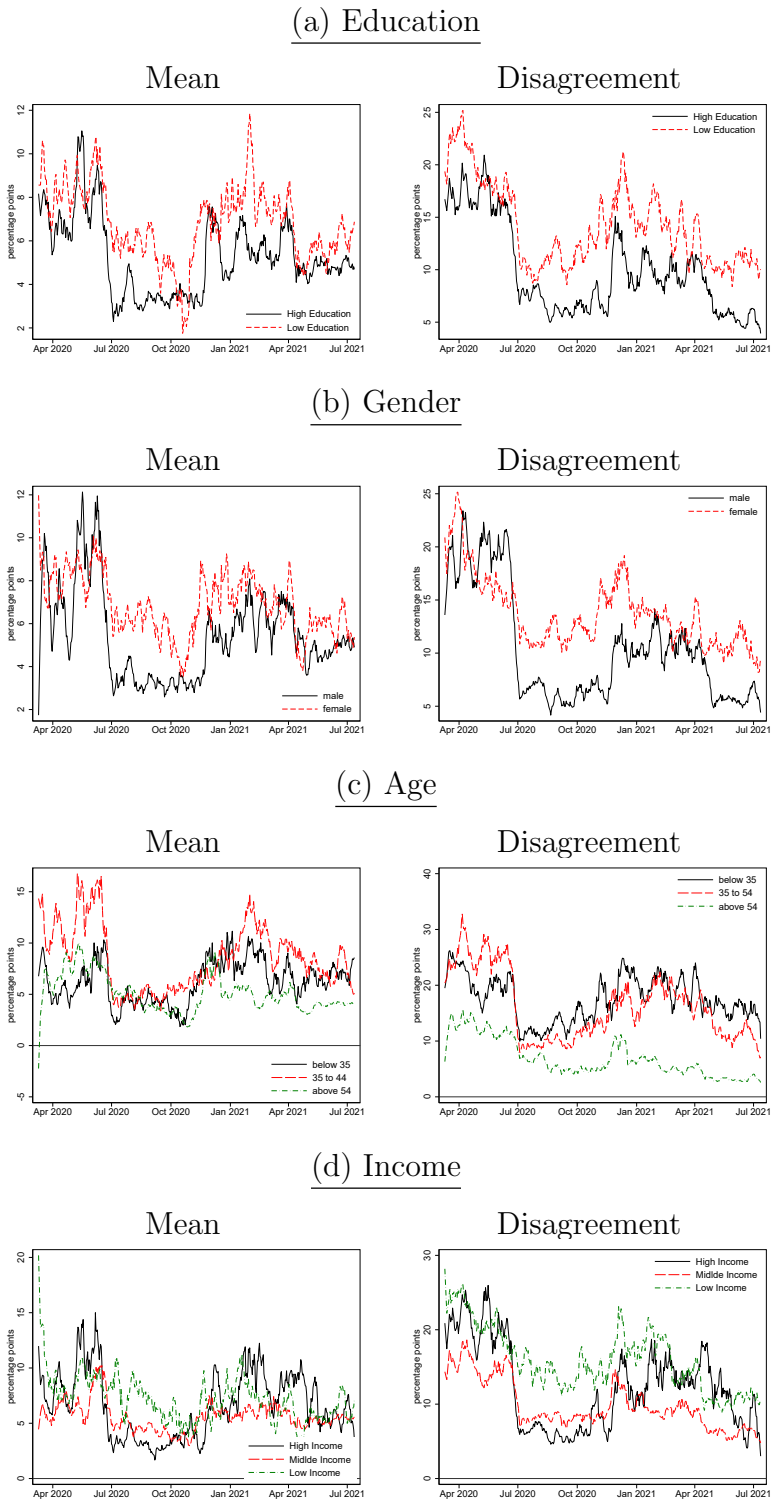


Figure C.3: Heterogeneous Expectations: COVID-19 Impact on Inflation. *Notes:* Consumers' 12-months ahead daily expected COVID-19 impact on inflation (left panel, "mean") and cross-sectional standard deviation of the expected impact (right panel, "disagreement"). Lines represent an eleven-day balanced moving average.

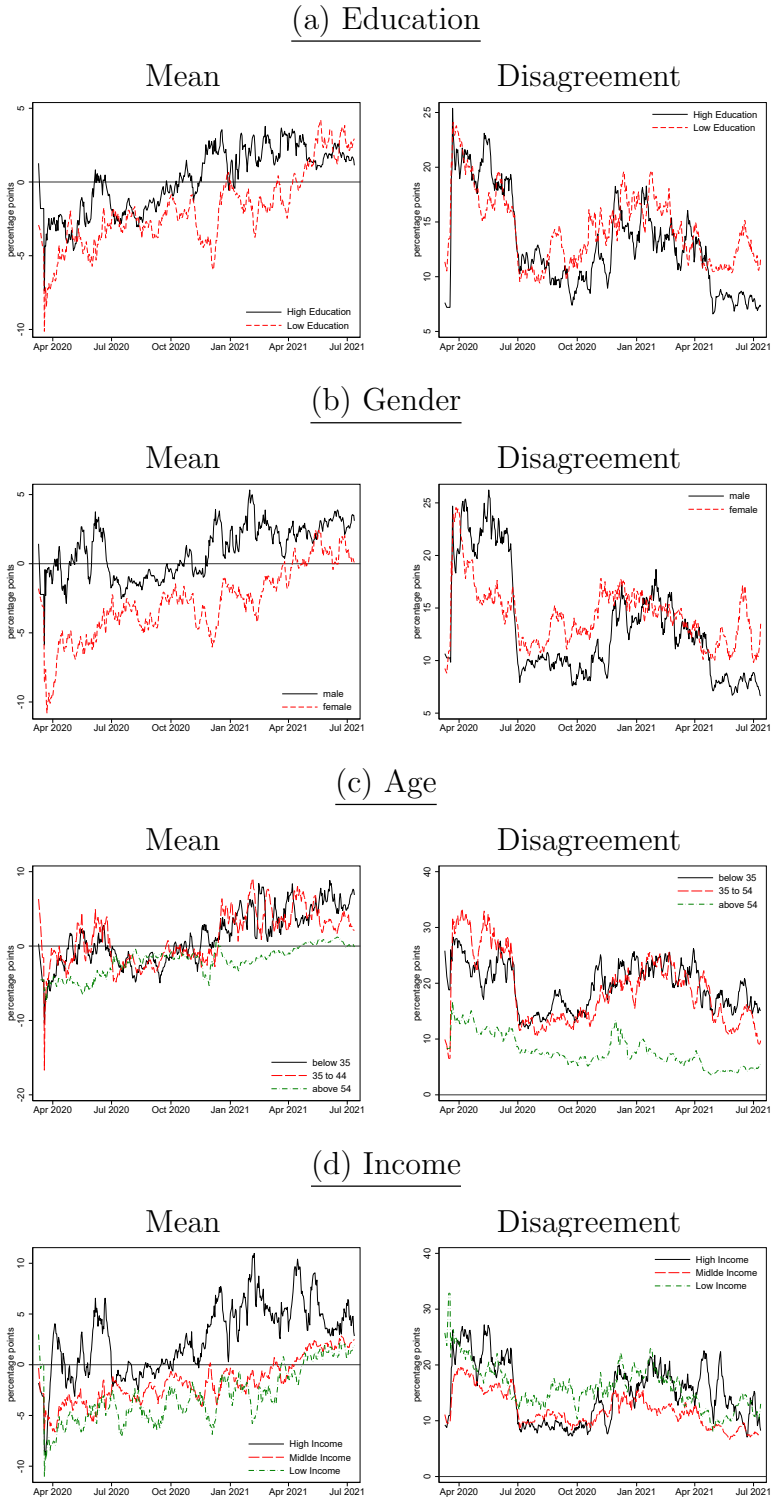


Figure C.4: Heterogeneous Expectations: COVID-19 Impact on Personal Household Income. *Notes:* Consumers' 12-months ahead daily expected COVID-19 impact on personal household income (left panel, "mean") and cross-sectional standard deviation of the expected impact (right panel, "disagreement"). Lines represent an eleven-day balanced moving average.

Supplementary Material C.2. COVID-19 Expectations and Behavioral Adjustments

We also find that behavioral adjustments—self-reported by respondents—and the change in household expectations in response to the pandemic shock co-vary in an economically meaningful way. Figure C.5 illustrates this. In panel (a) we show an index of personal consumption expenditures (dotted blue line), as provided by the Bureau of Labor Statistics, next to the survey expectations about the impact of COVID-19 on personal household income. Here we focus on the average response across respondents and use the solid line to display the 11-day moving average (reproduced from panel (b) of Figure 1). Expectations are measured against the left axis, the index of consumption expenditure is measured against the right axis and normalized to 100 in February 2020. The two series show a high degree of co-movement: both drop sharply in March/April 2020 and then recover gradually and in lockstep over our sample period—consistent with the notion that households respond to an adverse outlook by lowering current expenditures.

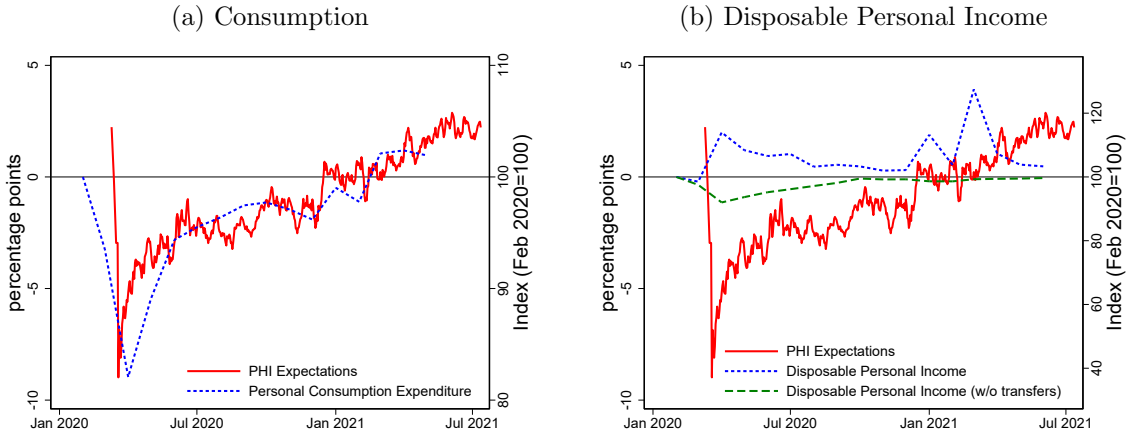


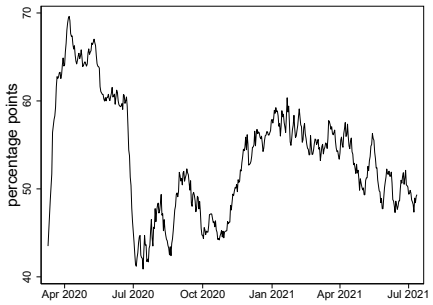
Figure C.5: Expectations and Behavioral Adjustment. *Notes:* Panel (a) shows mean household income expectation (11 day moving average) and realized monthly personal consumption expenditures (PCE), while panel (b) compares expectations to actual disposable income. For data sources, refer to Supplementary Material B.3. Both, PCE and real disposable income are indices measured against the right axis and normalized to 100 in Feb 2020.

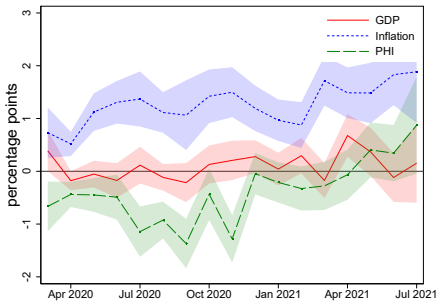
This finding is particularly noteworthy because, *ex post*, disposable income was holding up well during our sample period. This fact is widely credited to the exceptional policy responses to the COVID-19 shock (Higgins and Klitgaard, 2021; **?**). To illustrate this in the context of our analysis, we plot in panel (b) disposable personal income (measured in

real terms against the right axis, for better visibility) jointly with households' expectations regarding the impact of COVID-19 on household income. We observe that actual average disposable income rose even as expectations declined. The latter pertain to a 12-month horizon. Hence, it is interesting to observe that even towards the end of our sample period disposable income is still higher than early in the pandemic (blue dotted line). To be sure, as panel (b) also shows, disposable income fell if one factors out transfers (green dashed line).

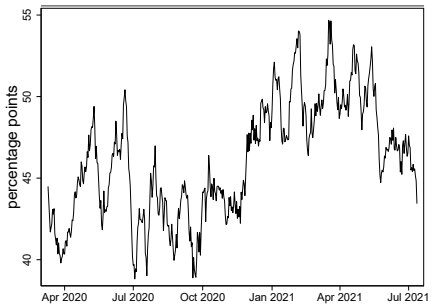
In the top row of Figure C.6 we visualize the survey response to the question "Has your financial planning changed due to the outbreak of the coronavirus?" The left panel displays the fraction of respondents which answer this question positively. We observe that the fraction of positive responses fluctuates consistently at about 55 percent, throughout our sample period. We also estimate a probit model which relates the answer to the financial planning question to consumer expectations. For this purpose, we pool observations in each month and show results in the right panel of row (A) in Figure C.6. The lines represent the estimate of the marginal impact that expectations regarding the expected impact of COVID-19 on GDP, on inflation, and on personal household income have on the probability to respond with "yes" to the question on changed financial planning. Shaded areas indicate the 95% confidence bound. Figures C.6 and C.7 in repeat this exercise for several other behavioral questions. In all cases, we find that expectations regarding the inflationary impact of COVID-19 seem to impact reported survey participant behavior.

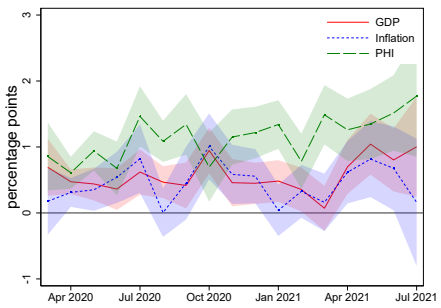
(a) "Has your financial planning changed due to the outbreak of the coronavirus?"



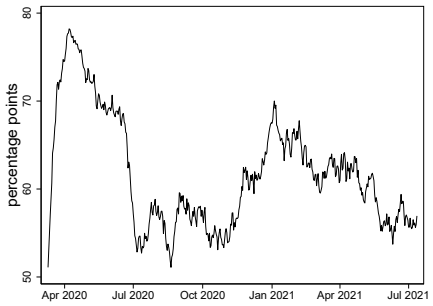


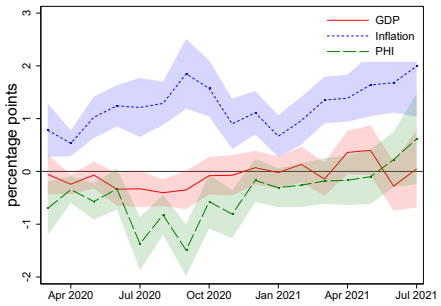
(b) "Have you increased your personal savings due to the outbreak of the coronavirus?"



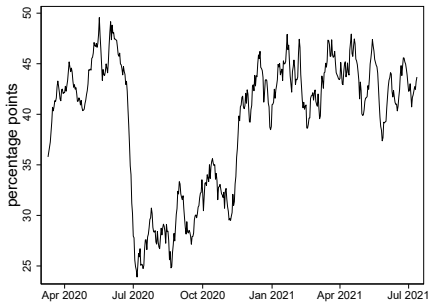


(c) "Have you refrained from planned larger purchases due to the outbreak of the coronavirus?"





(d) "Do you spend a larger fraction of your income due to the outbreak of the coronavirus?"



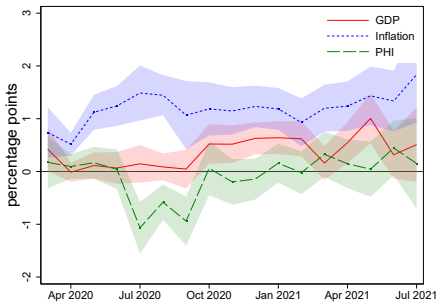
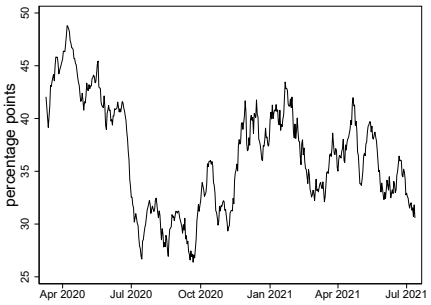
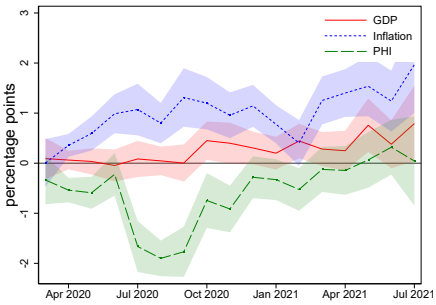


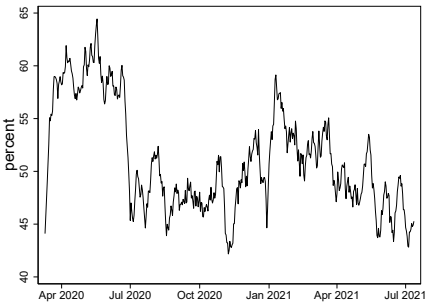
Figure C.6: Behavioral Adjustments. *Notes:* Left hand side gives daily mean response as a black line. Figures on the right side give the monthly probit regression coefficient towards GDP, inflation and personal household income expectations as well as 95% confidence bounds.

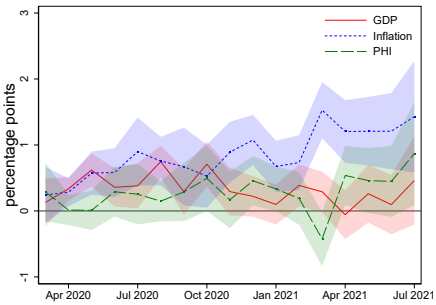
(a) "Due to the economic consequences of the coronavirus, do you fear you may lose your job?"



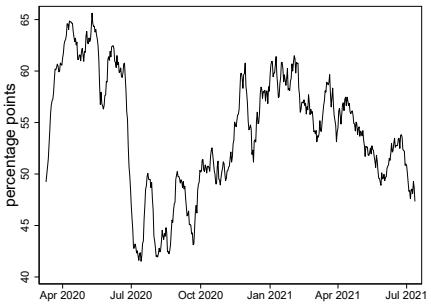


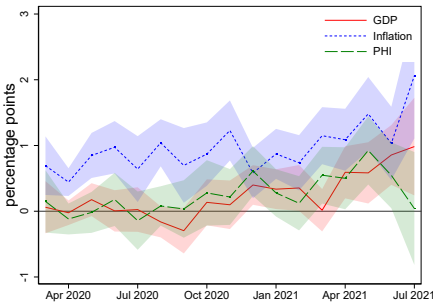
(b) "[...] do you try to avoid products from China?"



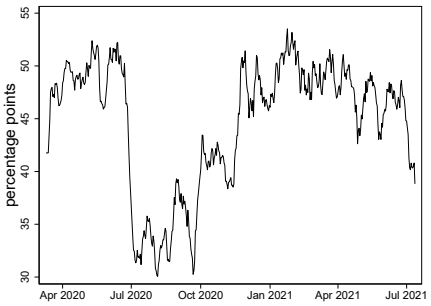


(c) "[...] have you started to store larger quantities of food supplies at home than before?"





(d) "[...] have you started to store larger quantities of medical supplies at home than before?"



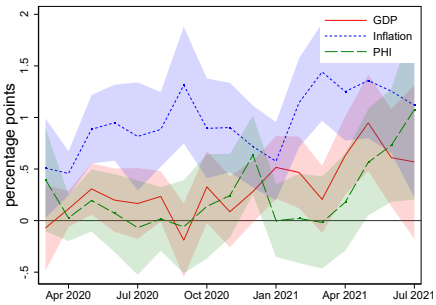
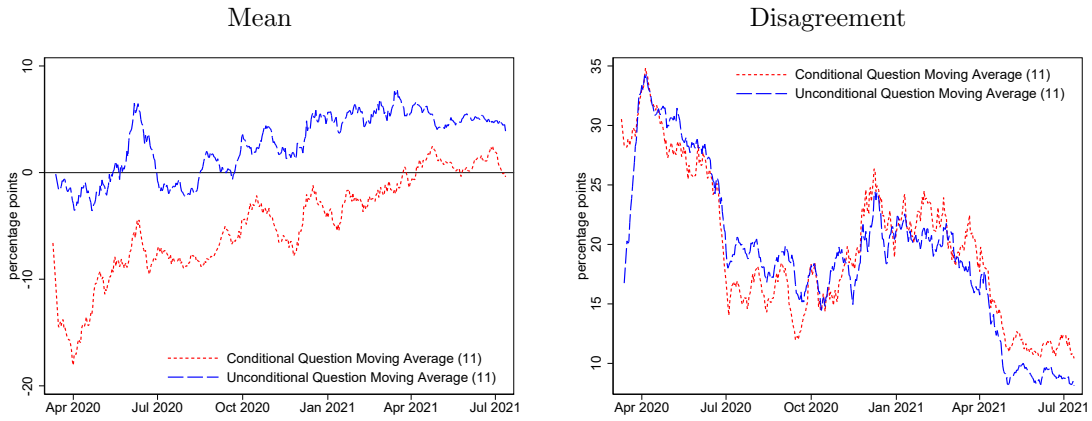


Figure C.7: Behavioral Adjustments c'td. *Notes:* Left hand side gives daily mean response as a black line. Figures on the right side give the monthly probit regression coefficient towards GDP, inflation and personal household income expectations as well as 95% confidence bounds.

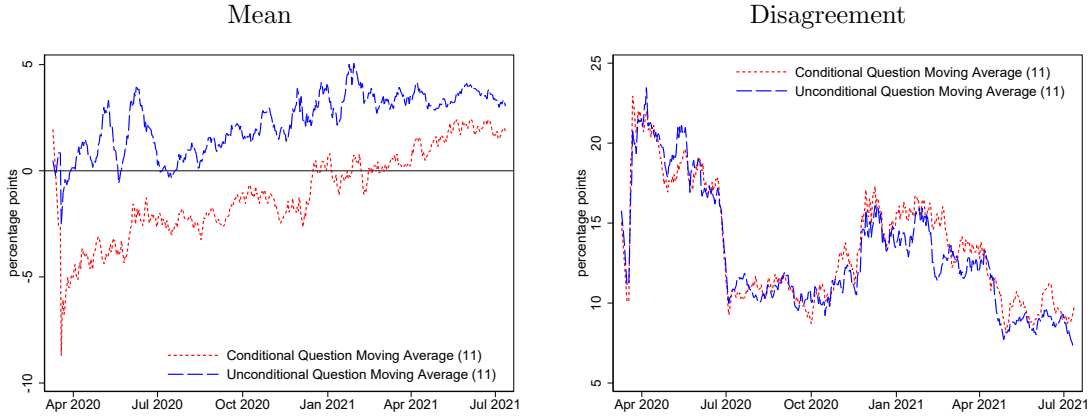
Supplementary Material C.3. Conditional vs. Unconditional Expectations

Supplementary Material C.4. GDP and Personal Household Income Disagreement

(a) GDP



(b) Personal Household Income



(c) Inflation

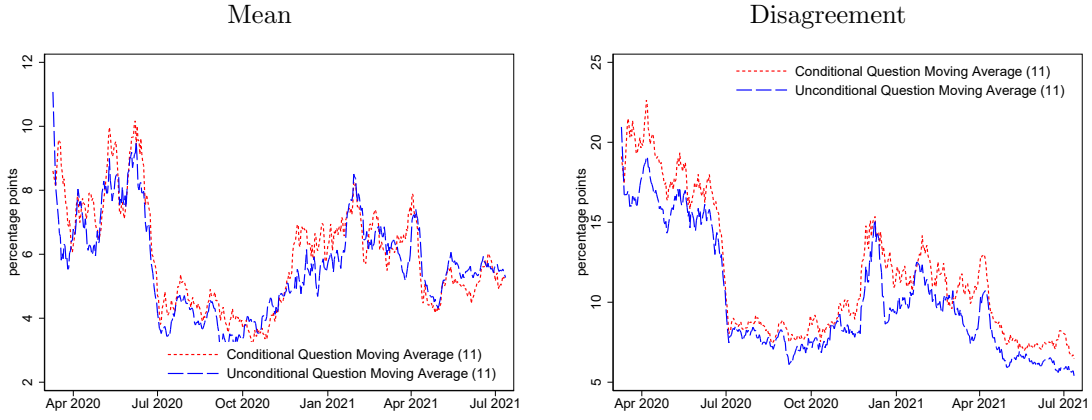


Figure C.8: Conditional vs Unconditional Survey Questions. *Notes:* Figure displays 11-day moving average for time series on household expectations from survey: red line gives expectations conditional on COVID-19, as shown in 1 and 3; blue line shows unconditional expectations for the same time horizon. Left: mean expectations; Right: disagreement among respondents (moving average of daily standard deviation).

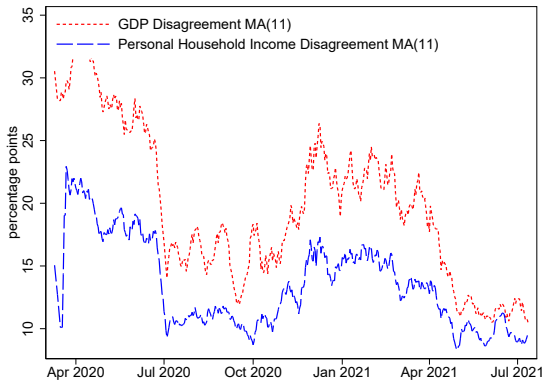


Figure C.9: Disagreement COVID-19 impact on GDP and Personal Household Income *Notes:* Figure displays 11- moving average for time series on disagreement about COVID-19 impact on GDP and personal household income from our survey: red line gives disagreement for GDP, as also shown in Figure 2, panel (a) in the paper; blue line shows respective time series for disagreement about personal household income.

Supplementary Material D. Model

Supplementary Material D.1. Business Cycle Moments

Table D.1 displays the business cycle statistics of the model as well as empirical counterparts.

	Data			Model		
	SD	AR(1)	Cor$(\cdot, Y_t)$	SD	AR(1)	Cor$(\cdot, Y_t)$
Y_t	1.19	0.84	1	0.92	0.91	1
N_t	1.36	0.92	0.82	0.57	0.83	0.19
R_t	1.19	0.90	0.61	0.60	0.92	0.22
Π_t	0.96	0.14	0.20	0.32	0.93	-0.04
R_t^e	23.57	-0.15	0.10	18.53	-0.02	0.04

Table D.1: Business-Cycle Moments, Data and Model. *Notes:* Business cycle moments of the model and moments in the data. We use quarterly data between 1984Q1 and 2008Q2 taken from the St. Louis Fed's FRED database (OUTNFB for real GDP, PCECTPI for consumer price inflation, HOANBS for hours worked and FEDFUNDS for the federal funds rate). To measure real returns on equity, we use the S&P 500 Total Return index normalized by the consumer price level. The source for the S&P 500 Total Return index is the St. Louis Fed's FRED database (SP500). Output and hours worked are in log percentages. Returns, interest rates, and inflation are in annualized percentage points. Model moments are unconditional. Data are hp-filtered with filter weight 1,600.

Supplementary Material D.2. Computation of Solutions with the Effective Lower Bound

Perturbation methods compute solutions as the sum of a first-order component and higher-order components (Andreasen et al., 2017). The algorithm employed here replaces the first-order component by the solution to a perfect-foresight simulation, the "foresight component." That simulation relies on a linearized version of the model with the effective-lower-bound constraint added (Holden, 2019). Our solution (an approximation), then, is given by the sum of the foresight component and the higher-order perturbation components. This mixing of perfect-foresight simulations with higher-order perturbation is similar in spirit to Andreasen and Kronborg (2020). If the lower bound does not bind, the algorithm gives solutions identical to standard third-order perturbation.

More in detail, we simulate time series of the endogenous variables by iteratively drawing new innovations and then updating. In each period, for the current state, we first compute the third-order perturbation solution. We store the higher-order components. We also store the

higher-order components of the conditional mean dynamics (over a longer forecast horizon).[5] Approximate conditional mean dynamics with lower bound then are given by the path of the foresight component and the higher-order mean dynamics. The perfect-foresight part of the solution makes sure that, for the nominal interest rate, these approximate conditional mean dynamics respect the effective lower bound in the current and in future periods. Solving with this constraint on the perfect foresight solution, we have the foresight component of the solution.

The answers in the consumer survey are best thought of as impulse responses of the economy to the pandemic. To compute these impulse responses we compare a "no-COVID" to a "COVID-19" economy. For the no-COVID economy, we compute solutions for 5000 different draws of sequences of innovations drawn from the calibrated distribution of shocks. The COVID-19 economy is subject to the same sequences of shocks, with one difference. Namely, in the initial period, there is a large, unexpected, one-time "COVID-19" shock, a convolute of one-time innovations that is discussed in the main tes. In both cases, the simulations start at the stochastic steady state of the economy. The difference, draw by draw, of the no-COVID and the COVID-19 solutions gives the impulse response to the COVID-19 shock.

Supplementary Material D.3. Further information on the model-based COVID scenarios

In what follows we provide additional results on the transmission of the shocks underlying the COVID-19 scenarios. First, Figure 4 in the main text has shown how the COVID scenario affects output and inflation, and the uncertainty about both. Here, we report the responses of other variables to the COVID-19 shock. In Figure D.10, a solid line is the mean. Dashed lines with squares mark $\pm$ 2-standard deviation bands.

The baseline features several exceptionally large shocks. A negative 15 standard deviation shock to demand preferences (a_t), a 17.5 standard deviation shock to uncertainty about demand preferences (σ_t^a), a negative 5 standard deviation shock to the persistent component of productivity (A_t) and a negative 15 standard deviation shock to the temporary news component of productivity (Z_t). Figure D.11 illustrates the role that each of these shocks

[5] We rely on the codes by Levintal (2017) for the perturbation and the codes by Andreasen et al. (2017) for computing conditional moments.

play individually. It should be clear that the model is non-linear, so the effects are not additive.

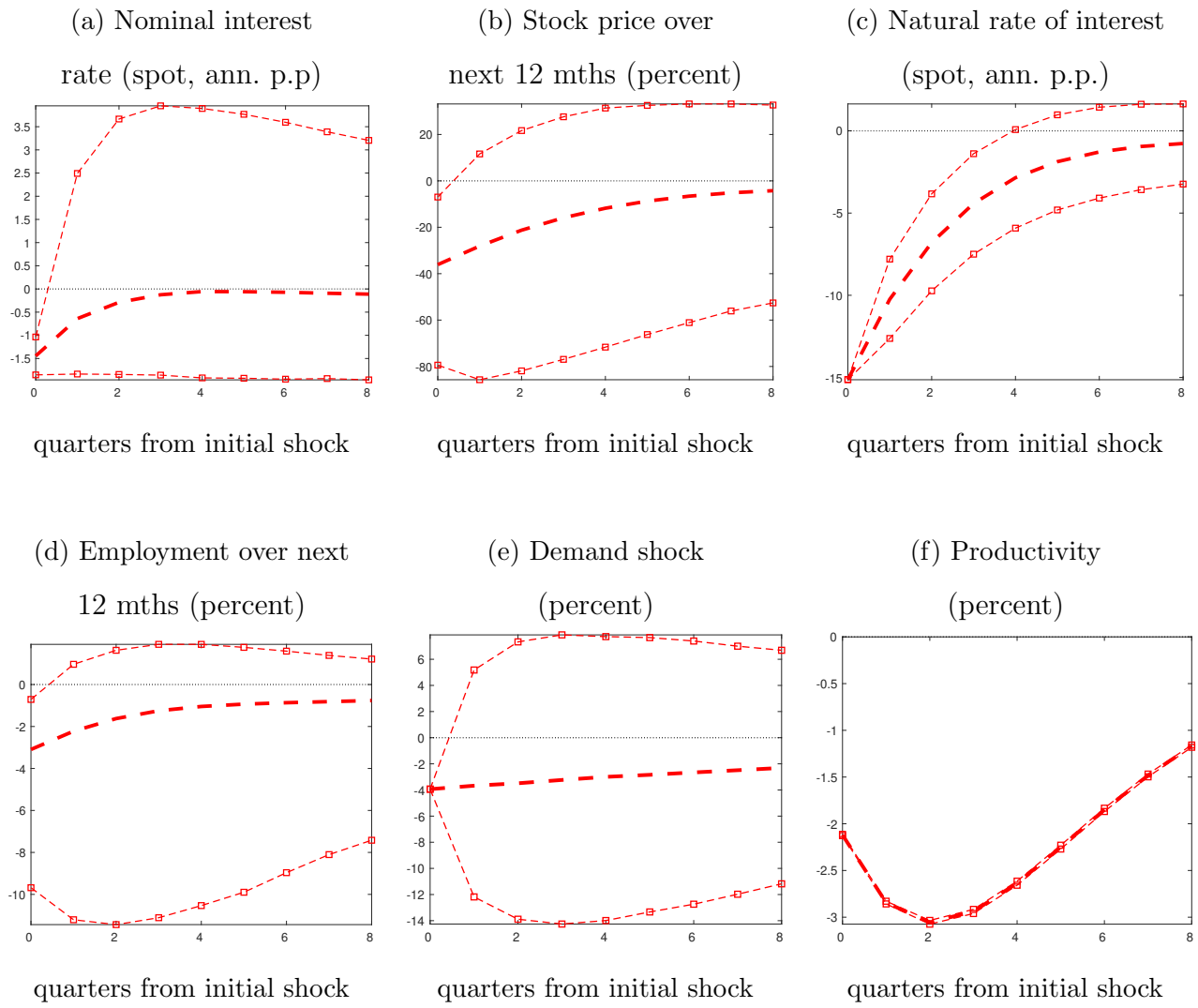


Figure D.10: The COVID-19 Baseline, further Economic Outcomes. *Notes:* Effect of the COVID-19 scenario on the distribution of future output and inflation. Expectations as of the time of impact of the shock. Same as first row of Figure 4 in the main text, but showing the effect on additional variables.

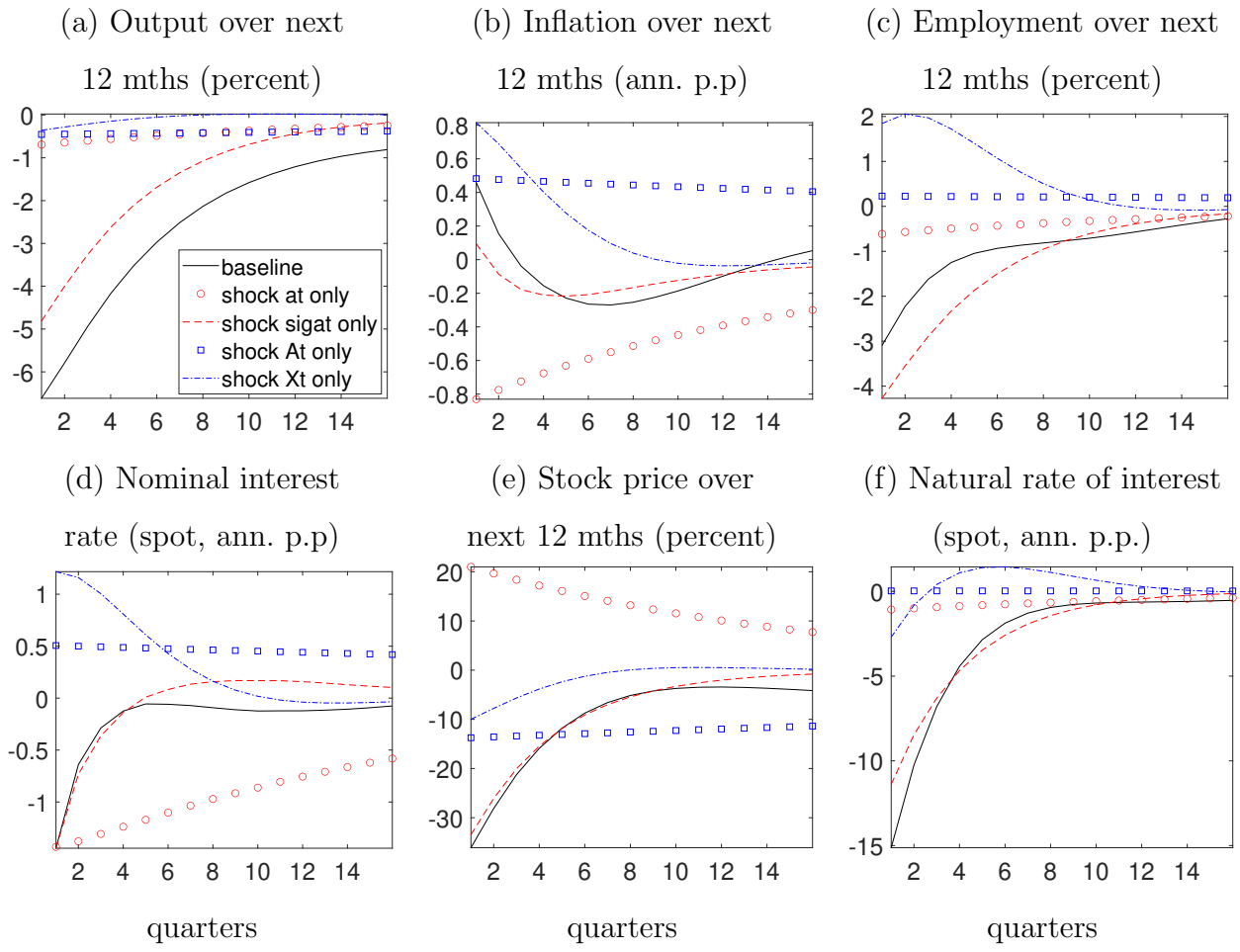


Figure D.11: The COVID-19 Effect, by Shock. *Notes:* Same as Figure 4 in the main text and Figure D.10 in the Supplementary Material, but contrasting the baseline COVID effect (black line) with a scenario in which only one of the shocks hits in period 1. Shown are the mean responses only.

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