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Wishful Thinking in Macroeconomic Expectations

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Abstract

We conduct an online survey experiment to investigate determinants of macroeconomic expectations. We investigate the effect of probability overweighting, religiosity, ambiguity aversion, and time preference. We find that subjects exhibiting probability overweighting, having higher degree of religiosity, having lower discount factor are more optimistic on economic growth and income, while ambiguity averse subjects are more pessimistic about the impact of Covid-19 outbreak on the economic growth rate. We compute the forecast errors and estimate the proportion of forecasts with rounding and implausible values. We find that significant proportion of subjects have rather poor understanding on macroeconomic variables. Subjects with higher degree of religiosity, living in small towns and villages, and with higher subjective socioeconomic status have higher forecast errors, while subjects with better education have lower forecast errors. Overall, we find that subjects form optimistic expectations, supporting the implication of belief-based utility (Brunnermeier and Parker, 2005) and wishful thinking (Seybert and Bloomfield, 2009) on macroeconomic expectations.

Keywords: Macroeconomic Expectations; Belief-based Utility; Probability Overweighting; Ambiguity Aversion; Time Preference; Religiosity; Experiment

JEL codes: C93; D84; E21; E31; E71

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1 Introduction

This paper experimentally investigate determinants of people's expectation about the macroeconomy, such as the economic growth rate, inflation rate, and individual decisions in consumption, savings, and investment. We conduct an incentivized online survey experiment across provinces in the mainland China to elicit the subject's macroeconomic expectations, as well as a set of behavioral measures including *ambiguity attitudes, probability overweighting, time preference, religiosity,* and demographics. Our focus is on whether and how the elicited preferences and demographics correlate with expectations on the macroeconomy and consumption, savings, and investment decisions.

We conducted the online survey experiment across provinces in China in early March 2020. Subjects were asked to make forecasts on the macroeconomy, such as the economic growth rate and inflation rate in 2020. The forecasts on macroeconomy were incentivized using the quadratic scoring rule (Brier, 1950). Note that macroeconomic forecasts differs from other types of forecasts because the subjects have a personal stakes in the event. Although this mechanism gives rise to the possibility that the subjects might be overly optimistic about the macroeconomy, a feature that we identify in the data, it nonetheless serves as a way to understand how people form expectation about the macroeconomy when they have a personal stakes.

We contribute to the nascent field of using survey experiment to measure macroeconomic beliefs.[1] To the best of our knowledge, this study is among the first to experimentally investigate the correlation between macroeconomic expectations with ambiguity aversion (Ellsberg, 1961), time preference (Laibson, 1997; Meier and Sprenger, 2010), probability overweighting (Kahneman and Tversky,

[1] We also contribute to the experimental macroeconomics literature, in which most existing studies are conducted in laboratory with student subjects, see e.g., Amano, Kryvtsov, and Petersen (2014) and Assenza et al. (2014), and Hommes (2021) for extensive reviews.

1979), and religiosity (Iannaccone, 1998; Barro, and McCleary, 2003). Our study differs from previous studies (e.g., Coibion, Gorodnichenko, and Kumar, 2018; Coibion, Gorodnichenko, and Ropele, 2020) as we elicit the individual preference's in terms of ambiguity aversion and time preference, and test the determinants of the expectations in relation to ambiguity aversion (Gilboa and Schmeidler, 1989; Ghirardato, Maccheroni and Marinacci, 2004; Klibanoff, Marinacci, and Mukerji, 2005) and belief-based utility (Caplin and Leahy, 2001; Brunnermeier and Parker, 2005).

The identification of an individual's preferences can possibly provide an explanation for the observed dispersion of macroeconomic beliefs identified by studies such as Coibion, Gorodnichenko, and Kumar (2018). Our study is also among the first to investigate the effect of the Covid-19 outbreak on individual macroeconomic expectations in China.

The reasoning for the effect of ambiguity aversion is as follows.[2] The Covid-19 outbreak can be considered an uncertainty shock (e.g., Bloom, 2009; Hansen and Sargent, 2012; Angeletos, Collard, Dellas, 2018; Bloom et. al., 2018), and its effect depends on how people deal with it. In the classical Ellsberg paradox (Ellsberg, 1961), a decision-maker who prefers to bet on the urn in which the chance of winning is known over the ambiguous urn (in which the chance of winning is unknown) is said to exhibit ambiguity aversion. We hypothesize that ambiguity averse subjects are more pessimistic about the effects of the shock of Covid-19 on the economy. Furthermore, an ambiguous subject is more likely to reduce consumption and increase savings based on a precautionary saving motivation (Kimball, 1990; Berger, 2014).

The reasoning for the effect of *belief-based utility* (Brunnermeier and Parker, 2005) is as follows. A decision-maker has an incentive to distort her belief and be overly optimistic in the presence of an uncertainty shock. When forming expectations, the decision-makers face a trade-offs between accuracy, which is good

[2]See the online appendix for the theoretical framework.

for future planning, and optimism, which allows hope and lessens anxiety induced by an uncertainty shock. For example, when forming beliefs about the economic growth rate, an optimistic belief lessens worry (hence no action, such as increasing savings, is taken) about possible recession, but it comes with the cost that the decision-maker might be ill-prepared (if she don't increase her savings) if there is an economic downturn. We hypothesize that a decision-maker with a low discount factor (that is, she cares less about the future) is more optimistic because she cares more about current utility. The idea can also be understood as *wishful thinking* (Seybert and Bloomfield, 2009) that individuals overestimate the likelihood of desirable events which can be linked to *probability overweighting* (Kahneman and Tversky, 1979) .

In a survey of New Zealand firms on their macroeconomic beliefs, Coibion, Gorodnichenko, and Kumar (2018) find that there is widespread dispersion in beliefs about past and future macroeconomic conditions and that this dispersion is consistent with the firms' incentives to collect and process information. Coibion, Gorodnichenko, and Ropele (2020) conduct a survey of Italian firms to study the effect of inflation expectations on their economic decisions, and find that firms that are treated with information about recent inflation form higher inflation expectations, which subsequently affect their decisions in terms of pricing, demand for credit, employment and capital.

Although our study was conducted following the Covid-19 outbreak, a large part of our study is about the determinants of macroeconomics expectation rather than specifically to the effect of Covid-19 which can be interpreted broadly as about how an uncertainty shock (e.g., Bloom, 2009; Hansen and Sargent, 2012; Angeletos, Collard, and Dellas, 2018; Bloom et al., 2018) on the economy affects macroeconomy expectations.

We investigate the effects of the social distancing policy and the prevalence rate (Covid-19 contraction) on macroeconomic expectations. We use two large datasets drawn from anonymized mobile phone records and examine the effect

of the change in the number of social contacts before and after the outbreak on provincial level macroeconomic expectation. To test the effect of the prevalence rate, we investigate the correlation between the prevalence rate at the provincial level and macroeconomic expectations. In addition to the behavioral measures, we collect a rich set of demographic information including gender, income, education, occupations, subjective socioeconomic status, location, and religiosity and examine how demographics correlate with macroeconomic expectations.

Our study is among the first to examine macroeconomic expectations in China following the Covid-19 outbreak. Coibion, Gorodnichenko, and Weber (2020) study the effect of Covid-19 on U.S households spending and macroeconomic expectations. In a survey, Binder (2020) finds that most consumers in the United States are concerned about effects of Covid-19 on the economy, and that greater concern is associated with higher inflation expectations and more pessimistic unemployment expectations.[3] For China, Chen et al. (2020) investigates the effect of Covid-19 on consumption by using high frequency transaction data in China. They find that daily offline consumption fell by 32% or 18.57 million RMB per city. In Bu et al. (2020) investigate risk taking behavior subjects from Wuhan before and after the Covid-19 outbreak.[4] In their survey (non-incentivized), they ask subjects (students in Hubei province) on whether China's economy will become better in the next 12 months and find that Wuhan subjects are more pessimistic. However, they do not measure subject's ambiguity attitude and time preference. Using transaction-level customer data from Denmark, Anderson et al. (2020) find that aggregate spending was 27% below the counterfactual level without the pandemic.

Our study differs from these studies in two ways. First, using the methodology of Experimental Economics, we elicit a much wider set of macroeconomic expectations, as well as measures on ambiguity attitude, time preference, and probability

[3]See also Hanspal et al. (2020) on how does the exposure to the COVID-19 stock market crash affect expectations and planned behavior.

[4]For studies using experimental economics investigating impact of Covid-19 on economic preferences, see also e.g., Li et al. (2020), Shachat et al. (2020).

overweighting.[5] Second, our study is the first to study macroeconomic expectations in China using the methdology of experimental economics with elicitation of ambiguity aversion, time preference, and religiosity.

Our main findings can be summarized as follows. We find that subjects exhibiting probability overweighting, having higher degree of religiosity, lower discount factor are more optimistic on economic growth and income, while ambiguity averse subjects are more pessimistic about the impact of Covid-19 outbreak on the economic growth rate. We find that subjects form optimistic expectations, supporting the implication of belief-based utility (Brunnermeier and Parker, 2005) and wishful thinking (Seybert and Bloomfield, 2009). Subjects exhibiting probability overweighting (Kahneman and Tversky, 1979) are more optimistic on economic growth and income.

There are widespread variations on macroeconomic expectations, and some households hold macroeconomic expectations that differ significantly from "reasonable" levels. We measure the forecast errors of economic growth, inflation rate 2020, and unemployment rate in 2020, and find that subjects with higher degree of religiosity, living in small towns and villages, and with higher SES are more likely to have higher forecast error on economic growth rate, inflation rate, and unemployment rate, while subjects with better education have lower forecast errors.

A significant proportion of the subjects plan to reduce their consumption and increase saving because of the Covid-19 outbreak, which supports the theory of precautionary saving (Kimball, 1990; Berger, 2014). Expected inflation rate is positively correlated with expected money supply growth. The percentage of subjects whose beliefs is compatible with the quantity theory of money (Friedman, 1956b; 1989) or neutrality of monetary policy (Wallace, 1981) is quite low.

We find that the reduction in social contacts because of social distancing leads to expectations of higher inflation, lower income, and the decision to reduce investment for 2020 but not over the longer term (2021–2025). A higher prevalence

[5]We see the current study as an experimental study since the preferences are elicited using experimental tasks.

rate induces expectations of higher unemployment rate in 2020 and lower expected consumption for 2021–2025.

The rest of this paper is organized as follows. Section 2 presents the experimental design. Section 3 reports the experimental results. Section 4 concludes the paper.

2 Experimental Design

We conducted an online experiment across 32 provinces in China in early March 2020, using an online platform. We elicited the subjects' expectations about the macroeconomy, in particular about the economic growth rate, the inflation rate, the unemployment rate, for 2020, and for 2021–2025. The forecasts on macroeconomic expectations (economic growth rate, inflation rate, and unemployment rate) were incentivized using the quadratic scoring rule.[6] The forecast's payoff is determined by the following formula:

$$\text{Payoff} = 10\text{-}0.5(\text{forecast value - actual value})^2$$

Note that the actual value is realized in the future.[7] This naturally creates an incentive for the subject to be optimistic about the forecast and thus fits well in the framework of optimal expectation (Brunnermeier and Parker, 2005). By forecasting a higher value, the decision-maker relishes the hope of a positive outcome in the current period, but it comes with the potential cost that the forecast might

[6] We choose this method rather than other methods, e.g., Hossain and Ryo (2013), for its simplicity for subjects to understand, which is especially important for online experiment. We explain to the subjects that the more accurate is their forecast, the higher payoff they will receive. As acknowledged by Hossain and Ryo (2013), one limitation of their mechanism (and other mechanisms (Karni and Safra, 1995)) is that it does not work when the agent has a personal stake on the event.

[7] Actual value refers to the official statistic announced by the Chinese government. See, e.g., Chow (2006), and Chen et al. (2019) for discussion on reliability of Chinese official statistics.

be less accurate, which leads to not only loss in the future payoff but also sub-optimal decisions (e.g., less saving). Hence, there is a trade-off between optimism and accuracy. Thus, the subject's optimism depends on the weights she places on current utility and future utility, which we measure using the discount factor. A subject who has a lower discount factor is more likely to be optimistic.

Note that in contrast to the more conventional forecast tasks of laboratory studies, subjects in our context have a stake in the outcome in addition to the payoff from the forecast task, as the economy's growth rate affects their payoff in real life.

The subjects also indicated their expectations (unincentivized) for the same set of macroeconomic measures in a scenario in which there was no Covid-19 shock. We also elicited the subjects' expectations (unincentivized) on how Covid-19 would affect their personal decisions in consumption, income, savings, and investment.[8] We also elicited a set of behavioral measures including risk attitudes, ambiguity attitudes, and time preference, as shown below in the elicitation procedure.

We collected a rich set of demographic information: gender, income, education, occupations, subjective socioeconomic status (SES), location, and religiosity. A total of 1,176 subjects participated in the experiment. The subjects received a participation fee of RMB10, plus the payoff from one randomly drawn choice task (for 10% of randomly drawn participants).[9] The subjects were told that their choices would be anonymous and strictly confidential. On average, the subjects has an education at the college or undergraduate level, and 55% percent of subjects were male. The average individual monthly income was RMB 6,520.

[8]Previous research have founded mixed evidence on the link between macroeconomic expectations and behavior. Using survey data from the Michigan Survey of Consumers, Bachmann et al. (2015) find no significant correlation between inflation expectations and willingness to purchase larger ticket items. D'Acunto et al. (2020) find significant correlation between household's inflation expectation and consumption.

[9] For forecast on 2021–2025, we will implement the payment in the future if the task and the subject is drawn for payment.

Risk Attitudes

We use the Holt and Laury (2002) design to elicit the subject's degree of risk aversion. In each of the following, the subjects indicate their choice between option A or B. We estimate the degree of risk aversion assuming utility with constant relative risk aversion. For subjects who switched their choices more than once, we use the last switch point to determine the degree of risk aversion.

	A	B
1	1/10 of RMB20, 9/10 of RMB16	1/10 of RMB38.5, 9/10 of RMB1
2	2/10 of RMB20, 8/10 of RMB16	2/10 of RMB38.5, 8/10 of RMB1
3	3/10 of RMB20, 7/10 of RMB16	3/10 of RMB38.5, 7/10 of RMB1
4	4/10 of RMB20, 6/10 of RMB16	4/10 of RMB38.5, 6/10 of RMB1
5	5/10 of RMB20, 5/10 of RMB16	5/10 of RMB38.5, 5/10 of RMB1
6	6/10 of RMB20, 4/10 of RMB16	6/10 of RMB38.5, 4/10 of RMB1
7	7/10 of RMB20, 3/10 of RMB16	7/10 of RMB38.5, 3/10 of RMB1
8	8/10 of RMB20, 2/10 of RMB16	8/10 of RMB38.5, 2/10 of RMB1
9	9/10 of RMB20, 1/10 of RMB16	9/10 of RMB38.5, 1/10 of RMB1
10	10/10 of RMB20, 0/10 of RMB16	10/10 of RMB38.5, 0/10 of RMB1

Ambiguity Attitudes

We elicit the subjects' valuation of a risky gamble, and an ambiguous gamble. In the risky gamble, a card is drawn from a bag that contains 25 R cards and 25 G cards. The subject wins RMB30 if R is drawn and 0 otherwise. The subject chooses between taking the gamble or receiving a sure amount as shown below. We use the highest switch point to determine the valuation of the risky gamble.

	A	B
1	Draw a card	Receive RMB3 for sure
2	Draw a card	Receive RMB6 for sure
3	Draw a card	Receive RMB9 for sure
4	Draw a card	Receive RMB12 for sure
5	Draw a card	Receive RMB15 for sure
6	Draw a card	Receive RMB18 for sure
7	Draw a card	Receive RMB21 for sure
8	Draw a card	Receive RMB24 for sure
9	Draw a card	Receive RMB27 for sure

The elicitation for the subjects' valuation of the ambiguous gamble is done in the same fashion. In the ambiguous gamble, a card is drawn from a bag that contains 50 cards and each card is marked either R or G. However, the number of R cards and the number of G cards are unknown. A subject is said to exhibit ambiguity aversion (neutral, seeking) if her valuation of the risky gamble is higher (equal, lower) than that of the ambiguous gamble.

Probability Overweighting

We estimate the decision weight (Kahneman and Tversky, 1979) of the subject in the risky gamble using the degree of risk aversion estimated from the Holt and Laury task and assuming a constant relative risk aversion. More speicifically, the decision weight w is easimated using the following such that the subject is indifferent between taking the risky gamble and receiving the sure amount which is her valuation of the risky gamble:

$$u(value) = wu(30)$$

A subject exhibits probability overweighting if the decision weight is higher

than the objective probability.

Time Preference

We used two sets of choice tasks to elicit the subjects' time preference. In the first set, subjects choose between receiving RMBx (ranging from RMB10 to RMB35) today or a higher amount RMB40 in 1 month. In the second set, subjects choose between receiving RMBx (ranging from RMB10 to RMB35) in 6 months or a higher amount RMB40 in 7 months, as shown below. We estimate the implied discount rate from the choices. A subject is said to exhibit present bias if her discount rate for the first set is higher than that for the second set.

	A	B
1	Receive RMB35 in 6 months	Receive RMB40 in 7 months
2	Receive RMB30 in 6 months	Receive RMB40 in 7 months
3	Receive RMB25 in 6 months	Receive RMB40 in 7 months
4	Receive RMB20 in 6 months	Receive RMB40 in 7 months
5	Receive RMB15 in 6 months	Receive RMB40 in 7 months
6	Receive RMB10 in 6 months	Receive RMB40 in 7 months

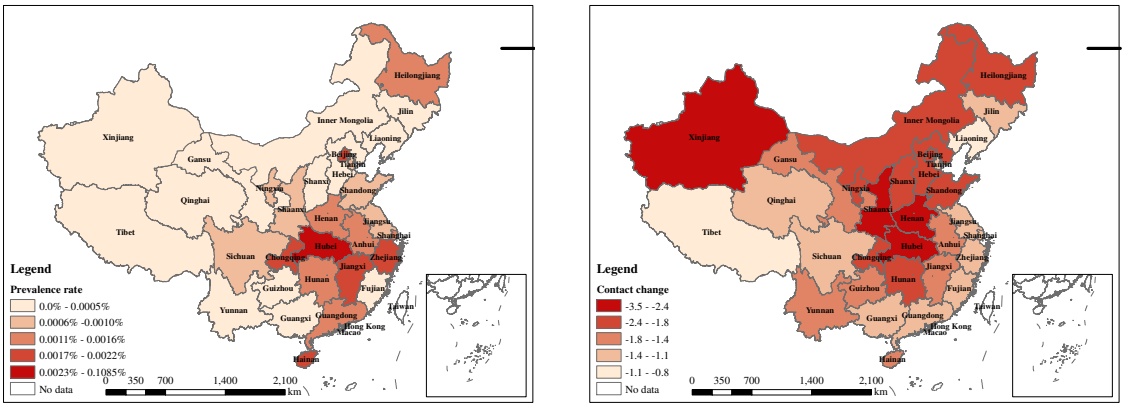
Forecast Error

For forecasts on economic growth rate, inflation rate, and unemployment rate in 2020, we compute the forecast error which is the difference between forecast value and realized value. We use the official statistics announced by the Chinese government as the realized value. Absolute value of the forecast is also computed.

Prevalence Rate

We use the prevalence rate (as of February 23, 2020) at the provincial level. The province of Hubei had the highest prevalence rate of 0.11%, see also Figure 1a, which shows the prevalence rate for the provinces.

Figure 1: Prevalence Rates and Change in Social Contacts



(a) Prevalence Rates (February 23, 2020)

(b) Change in Social Contacts (February 2020)

Social Distancing

We obtain the numbers of social contacts (people physically met up) before (December 2019) and after (February 2020) the Covid-19 outbreak from two large datasets derived from anonymized mobile phone records. The first dataset consists of the daily average number of social contacts over a regular week in all provinces in China before the Covid-19 outbreak, and the second dataset consists of the daily average after the outbreak. We use the difference in the number of social contracts before and after the outbreak, in natural logarithmic form, as a measure of Covid-19's effect on social distancing. The average number of social contacts decline from 18.77 before the outbreak to 17.08 after the outbreak (p-value=0.00, two-sample t-test).[10] Figure 1b plots the change in social contacts. Note that Hubei province had the largest decline in social contacts.

[10] The average change in social contact is -1.69 (std. dev. 0.56) with the range of -0.92 and -3.54. The average prevalence rate is 0.0000519 (std. dev. .0002091) with the range of 3.00e-07 and .0010847.

3 Experimental Results

Table 1 reports the summary statistics of the subjects' expectations about the macroeconomy, consumption, income, savings, investment, and their attitudes and preferences including ambiguity attitudes, risk attitudes, and time preference. It is obvious that the Covid-19 outbreak has a substantial effect on the macroeconomic expectations.

3.1 Economic Growth Rate

Most of the subjects are rather optimistic about the economic outlook. They believe that the economy will continue to grow. The average expected annual economic growth rate is 8.37% (2020; median: 6.00%, std. dev.: 7.41) and 8.91% (2021–2025; median: 5.49%, std. dev.: 9.05).[11]

Fewer than 0.5% of the subjects believe the economy will enter a recession. Although the average beliefs appears to be higher than last year's economic growth rate —about 6.2% according to World Bank estimates— this is consistent with the findings in the literature that there is widespread variation (e.g., Coibion, Gorodnichenko, and Ropele, 2020) in macroeconomic beliefs, which can differ significantly from publicly available figures. This also suggests that some households have rather poor understanding on economic growth rate. A similiar pattern is observed for the expectations on inflation rate and unemployment rate. In a recent study by Andre et al. (2019), they find that households and experts have different expectations and expert predictions are quantitatively close to standard DSGE (Dynamic Stochastic General Equilibrium) models and VAR (Vector Autoregres-

[11] In removing outliers with unreasonable values, we consider the average expected annual economic growth rate in 2020 based on the subsample (92.3% of the whole sample) in which the subjects' expected growth rate is less than 40%. The average annual economic growth rate in 2021–2025 is based on the subsample (91.2% of the whole sample) in which the subjects' expected growth rate is less than 40%.

Table 1: Summary Statistics

	Mean (Std. Dev.)
Macroeconomic Expectations	
Economic Growth Rate 2020	8.37% (7.41)
Annual Economic Growth Rate 2021–2025	8.91% (9.05)
Inflation Rate 2020	8.51% (7.89)
Annual Inflation Rate 2021–2025	8.91% (9.05)
Unemployment Rate 2020	10.29% (10.60)
Unemployment Rate 2021–2025	9.68 (10.28)
Effect of the Covid-19 Outbreak on Macroeconomy Expectations	
Lower Economic Growth Rate 2020	61.99%
Higher Economic Growth Rate 2020	22.62%
Lower Annual Economic Growth Rate 2021–2025	27.55%
Higher Annual Economic Growth Rate 2021–2025	53.15%
Higher Inflation Rate 2020	42.86%
Higher Annual Inflation Rate 2021–2025	39.63%
Lower Income 2020	32.74%
Higher Income 2020	62.41%
Lower Consumption 2020	31.12%
Higher Consumption 2020	66.33%
Increase Saving 2020	68.37%
Lower Investment 2020	28.34%
Higher Investment 2020	66.38%
Preferences	
Probability Overweighting	66.19%
Present Bias	36.05%
Discount factor 1	0.41 (0.31)
Discount factor 2	0.37 (0.34)
Ambiguity Averse, Ambiguity Seeking, Ambiguity Neutral	29.76%, 25.68%, 44.56%
Risk Averse, Risk Seeking, Risk Neutral	60.63%, 26.96%, 12.41%

sions) evidence.

Result 1: *There are widespread variations on macroeconmic expectations.*

Most of the subjects think that the Covid-19 will reduce the economic growth rate, specifically 61.99% (for 2020) and 53.15% (for 2021–2025).[12] The majority of the subjects think that Covid-19 will negatively affect economic growth. This finding also suggests that the subjects expect the effect to be lower in the long term, as the difference in the proportion is significant at the 1% level.

Column 1 of Table 2 reports the marginal effect estimates of the probit regression in which the dependent variable is the belief that the 2020 economic growth rate will be lower because of Covid-19.[13] It shows that subjects with higher degree of religiosity are less likely to hold the belief, while ambiguity averse subjects are more likely to hold this belief. In particular, ambiguity averse subjects are 8% more likely to believe that there is a negative effect. In fact, 67% of ambiguity averse subjects hold the belief which is significantly higher than the 60% observed with the non-ambiguity-averse subjects. The regression result suggests that the belief is not correlated with risk aversion and present bias. Column 2 reports the same regression for year 2021-25. The coefficient on religiosity is significantly

[12] Subjects who live in provinces directly adjacent to Hubei (the province where Wuhan is located) hold a more pessimistic view on the outbreak's impact on the economic growth rate in 2021-2025: 59% of the subjects believe that the economic growth rate will be lower, whereas 51% of the subjects in provinces not adjacent to Hubei hold this pessimistic belief.

[13] One concern is the possible measurement error when eliciting economic growth rate, inflation rate, and unemployment rate, because the average person might be unsure about these questions and thus their answers might be noisy. To control such measurement errors, we exclude outliers with unreasonable values from the regressions. Our primary focus is on the effect of ambiguity aversion and time preference on expectations rather than the level of expectations. Note that the estimation on the coefficients of ambiguity aversion and time preference are not affected by the potential measurement errors on expectations, as long as the measurement errors are not correlated with ambiguity aversion and time preference.

negative. The coefficient on the discount factor 1 is significantly positive, suggesting that subjects who put higher weight on future utility are more likely to believe that the 2021–2025 economic growth rate will be lower. In other words, subjects with a lower discount factor are less likely to believe that the 2021–2025 economic growth rate will be lower, a result consistent with the theory of optimal expectation (Brunnermeier and Parker, 2005). The coefficient on ambiguity aversion is weakly significant with a p-value of 0.07, which suggests that the effect of ambiguity aversion is weaker for long term expectations.

Result 2: *Subjects with higher degree of religiosity and those with lower discount factor are more optimistic about the impact of Covid-19 on the economic growth rate, whereas ambiguity averse subjects are more pessimistic.*

Column 3 (4) reports the the marginal effect estimates of the probit regressions where the dependent variables are expecting higher economic growth in 2020 (2021-25) because of Covid-19. It can be seen that the coefficients on overweight are weakly significant, suggesting those with probability overweighting are more optimistic. Interestingly, the coefficient on overweight are not significant in both regressions in columns 1 and 2, suggesting that probability overweighting affects beliefs on positive prospect of economic growth rather the negative prospect.

Column 1 (2) of Table 3 reports the OLS regression on expected annual economic growth in 2020 (2021-25). The coefficient on religiosity and decision weight are significantly positive in both regressions,[14] while the coefficient present bias is significant for 2021-25.[15] This suggests that those with higher degree of religiosity, higher decision weight, and being present bias are more optimistic.

The coefficients on the social contact change and the prevalence rate are both insignificant (see Columns 1–2 of Table 3). That is, the social distancing policy and the prevalence rate do not have a significant effect on the subjects' expectations about the economic growth rate over short-run (2020) or the long-run (2021–2025).

[14]The correlation between religiosity and probability overweighting is significantly positive.

[15]A subject is classified as exhibiting present bias if her discount factor 1 is lower than her discount factor 2.

Effect of Probability Overweighting

Table 4 reports the comparison of macroeconomic expectations conditional whether the subject exhibits probability overweighting. It can be seen that subjects exhibiting probability overweighting have different macroeconomic expectations compared to those do not exhibit probability overweighting. In particular, they are more optimistic on economic growth and income.

Result 3: *Subjects exhibiting probability overweighting are more optimistic on economic growth and income.*

Short-run vs. Long-run

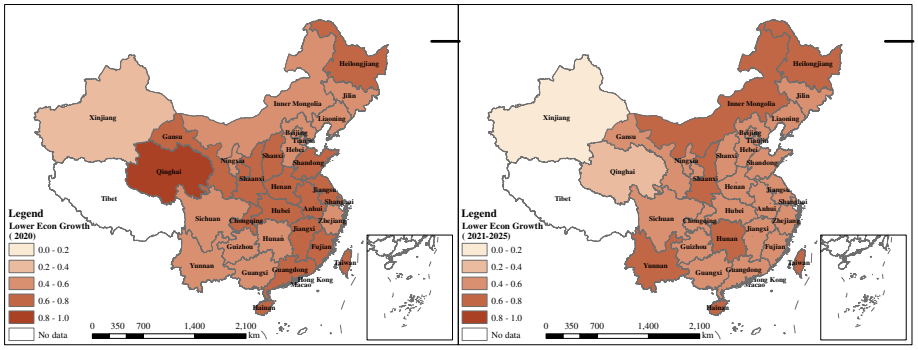
Panel A of Figure 2 shows maps of the expectations of lower economic growth because of Covid-19 for 2020 and 2021–2025. Comparing these maps, we see that the subjects are less likely to expect that the Covid-19 outbreak will lower economic growth rate in the long run than in the short-run. That is, they expect the impact of Covid-19 will be lower in the long-run.

3.2 Forecast Errors

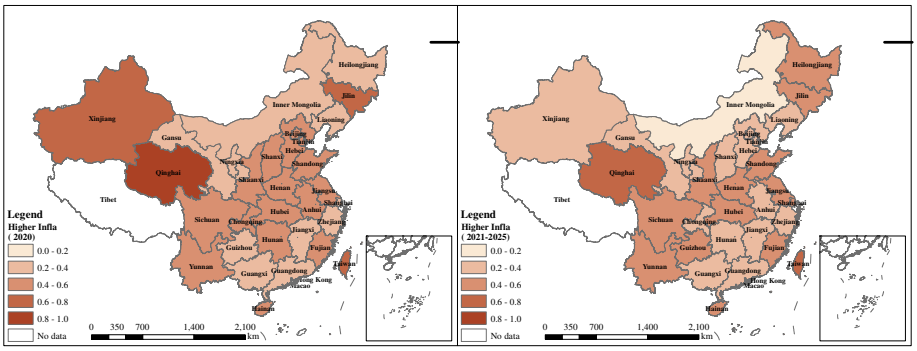
Column 1 of Table 5 reports the OLS regression on determinants forecast error on economic growth rate in 2020. The subjects are on average very optimistic as the realized value is less than actual value, as indicated by the significantly positive constant term. The regression shows that subjects with higher degree of religiosity, living in small towns and villages, have higher decision weight, and with higher SES have higher forecast error, see also Figure 3. The coefficient on education is negative and weakly significant, suggesting that subjects with better education tend to have lower forecast error. A similar pattern was observed for forecast error on inflation rate 2020, and unemployment rate 2020, see also Figure 4 and 5. We do not find significant effect of family income, gender, age, social contact change,

Figure 2: Expectations of Economic Growth Rate, Inflation Rate, and Income

(a) Lower Economic Growth Rate



(b) Higher Inflation Rate



(c) Lower Income

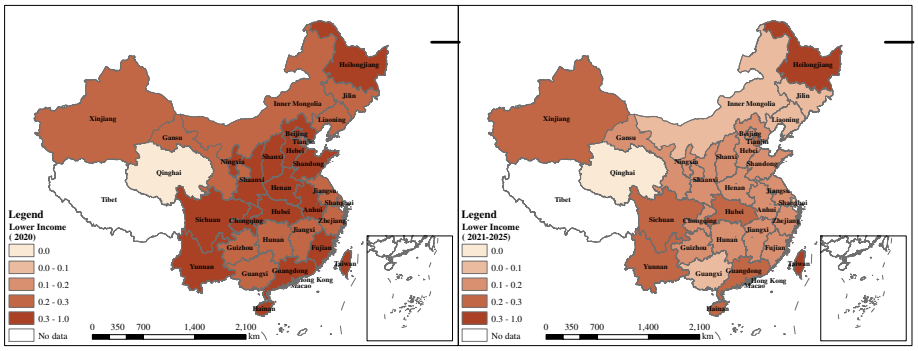


Table 2: Determinants of Economic Growth Expectations

	Dependent variables:			
	(1) Lower Econ Growth 2020	(2) Lower Econ Growth 2021–25	(3) Higher Econ Growth 2020	(4) Higher Econ Growth 2021–25
Overweight	-0.02	-0.03	0.06*	0.06*
	(0.04)	(0.04)	(0.03)	(0.04)
Religiosity	-0.03**	-0.05***	0.01	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Ambiguity Averse	0.08**	0.06*	-0.04	-0.04
	(0.03)	(0.03)	(0.03)	(0.03)
Discount Factor1	0.08	0.12**	0.00	0.00
	(0.05)	(0.05)	(0.05)	(0.05)
Discount Factor2	0.05	0.01	-0.05	-0.03
	(0.05)	(0.05)	(0.04)	(0.04)
Social Contact Change	0.01	-0.04	-0.00	0.02
	(0.03)	(0.04)	(0.03)	(0.03)
Prevalence Rate	37.87	-57.25	21.84	66.55
	(93.40)	(95.64)	(78.56)	(84.07)
Female	0.05*	0.10***	-0.05**	-0.05*
	(0.03)	(0.03)	(0.03)	(0.03)
Control	Yes	Yes	Yes	Yes
Observations	1,169	1,169	1,169	1,169
Pseudo R-squared/R-squared	0.03	0.03	0.02	0.02

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is the belief that the 2020 economic growth rate will be lower because of the Covid-19 outbreak. Column 3 (4) reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is the belief that the 2020 (2021-25) economic growth rate will be higher because of the Covid-19 outbreak. Overweight is a dummy that equals 1 if the subject exhibits probability overweighting. Religiosity is the frequency that the subject participates in religious activities on a scale of 1 (never) to 6 (very frequently). Ambiguity averse is a dummy that equals 1 if the subject is ambiguity averse, and 0 otherwise. Present bias is a dummy that equals 1 if the subject exhibits present bias, that is, discount factor 1 is lower than discount factor 2. Discount factor 1 is elicited using the task in which the subjects choose between receiving RMB x (ranging from RMB10 to RMB35) today or a higher amount (RMB40) in 1 month. Discount factor 2 is elicited using the task in which the subjects choose between receiving RMB x (ranging from RMB10 to RMB35) in 6 months or a higher amount (RMB40) in 7 months. Social contact change is the difference, presented in its natural logarithmic form, between the number of social contacts before and after the outbreak. The prevalence rate is the prevalence rate (as of February 23, 2020) at the provincial level. Control has the following independent variables: Risk aversion denotes the degree of risk aversion; edu is the subject's level of education on a scale of 1 (secondary school or below) to 6 (Ph.D) and; location is the subject's location on a scale of 1 (4 big cities Beijing, Shanghai, Guangzhou, Shenzhen) to 6 (Villages). Control also has the following measures: monthly family income; SES, which is the subject's subjective socioeconomic level on a scale of 1 (the lowest) to 10 (the highest); gov job, which is a dummy that equals 1 if the subject is a civil servant; SOE job is a dummy that equals 1 if the subject works in an state-owned enterprise; private job, which is a dummy that equals 1 if the subject works in a private company; and no job, which is a dummy that equals 1 if the subject is not in the job market. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Determinants of Expectations on Level of Economic Growth Rate

	(5) Expected Econ Growth 2020	(6) Expected Econ Growth 2021—-25
Decision Weight	1.59*	2.13***
	(0.82)	(0.82)
Religiosity	0.92***	1.06***
	(0.24)	(0.24)
Ambiguity Averse	0.21	0.12
	(0.51)	(0.52)
Present Bias	0.36	1.47***
	(0.49)	(0.49)
Social Contact Change	0.12	0.06
	(0.57)	(0.59)
Prevalence Rate	371.73	-459.34
	(1,490.65)	(1,509.56)
Female	-0.43	-0.79
	(0.49)	(0.49)
Constant	7.88***	5.00**
	(2.21)	(2.25)
Control	Yes	Yes
Observations	1,000	988
Pseudo	0.03	0.05
R-squared/R-squared		

Notes: Column 1 reports the OLS regression in which the dependent variable is the 2020 economic growth rate for the sub-sample (92.3% of the whole sample) in which the subjects' expected growth rate is less than 40%. Column 2 reports the OLS regression in which the dependent variable is the 2021–2025 annual economic growth rate for the sub-sample (91.2% of the whole sample) in which the subjects' expected growth rate is less than 40%. Decision Weight is the decision weight estimated. The other variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Probability Overweighting

Mean	Overweight	No Overweight	p-value
Economic Growth Rate 2020	8.64	7.86	0.10*
Lower Economic Growth Rate 2020	0.62	0.62	0.97
Higher Economic Growth Rate 2020	0.25	0.19	0.02**
Economic Growth Rate 2021-25	9.32	8.40	0.06*
Inflation Rate 2020	8.89	7.77	0.03**
Inflation Rate 2021–2025	10.68	8.30	0.04**
Unemployment Rate 2020	10.91	8.94	0.00***
Unemployment Rate 2021–2025	10.16	8.69	0.02**
Lower Income 2020	0.30	0.37	0.02**

Notes: *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

and prevalence rate on forecast errors.

We compare the forecast errors conditional on whether the subject exhibit probability overweighting. We find that subjects exhibiting probability overweighting have significantly higher forecast errors than thos who donot.

Our result of no correlation between income and forecast errors is consistent with the finding of D'Acunto et al. (2019) on forecast error on inflation, while our finding on negative correlation between education and forecast error is in contrast to the no result finding of D'Acunto et al. (2019).

We find that the job type of subejcts is an important determinant of forecast error. In particular, subjects who are farmer, student, housewife, retired have lower forecast errors, with p-values equal to 0.05, 0.00, and 0.01, for economic growth 2020, inflation rate 2020, and unemployment rate 2020, respectively. They are also more likely to make implausible forecasts on economic growth and unemployment rate, while the difference on inflation rate is not significant. Our result is consistent with the finding of Andre et al. (2019) that households and experts have different expectations.

Result 4: *Subjects with higher degree of religiosity, exhibiting probability overweighting, living in small towns and villages, and with higher SES have higher forecast error on economic growth rate, inflation rate, and unemployment rate, while subjects with better education have lower forecast errors.*

3.3 Rounding

The proportion of forecasts using rounding (multiples of 5) are 37.8%, 43.0%, and 42.9%, for forecasts on economic growth rate 2020, inflation rate 2020, and unemployment rate 2020, respectively. Binder (2017) reports evidence of rounding and proposes it as a measure of uncertainty about the underlying survey responses. Consistent with Binder (2017), we find that forecasts with rounding have higher forrcast errors, as shown in Table 6 . Further, we find that subjects with higher degree of religiosity are significantly more likely to use rounding forecast for economic

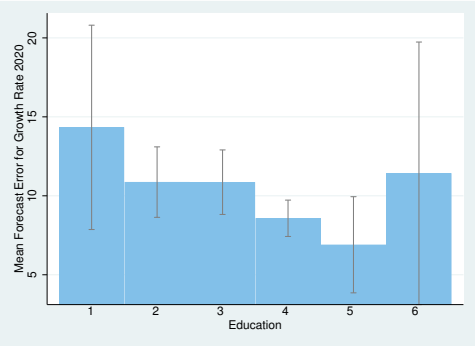
Table 5: Forecast Error

	Dependent variables:		
	(1) Forecast Error Econ Growth 2020	(2) Forecast Error Inflation 2020	(3) Forecast Error Unemployment 2020
Religiosity	1.83***	1.95***	0.91*
	(0.45)	(0.49)	(0.49)
Decision Weight	2.04**	3.44***	1.83*
	(0.95)	(1.02)	(1.03)
Education	-0.88*	-1.33**	-1.69***
	(0.51)	(0.55)	(0.55)
Fam Income	-0.07	-0.42*	0.07
	(0.21)	(0.23)	(0.23)
SES	0.47*	0.64**	0.58**
	(0.27)	(0.29)	(0.29)
Town Village	4.45***	4.46***	4.24***
	(1.03)	(1.11)	(1.11)
Female	1.33	0.66	1.47
	(0.94)	(1.00)	(1.01)
Age	-0.03	-0.03	-0.11*
	(0.05)	(0.06)	(0.06)
Social Contact Change	1.14	0.93	1.63
	(1.11)	(1.19)	(1.20)
Prevalence Rate	-396.69	158.87	2,866.77
	(2,952.39)	(3,161.82)	(3,170.06)
Constant	6.82*	7.88**	11.29***
	(3.54)	(3.78)	(3.80)
Observations	1,074	1,074	1,074
R-squared	0.06	0.08	0.05

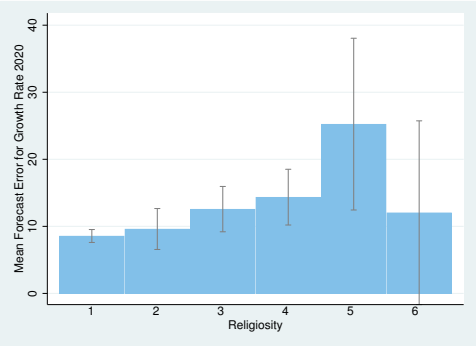
Notes: This table reports OLS regression on determinants of forecast errors using observations with forecast error at most equal to 100. Town Village is a dummy that equals 1 if the subject lives in small town or village, zero otherwise. The other independent variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Figure 3: Forecast Errors on Economic Growth 2020

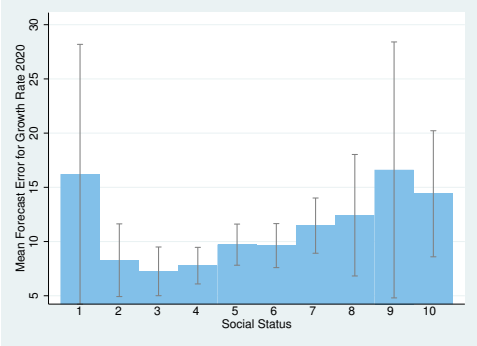
(a) Education



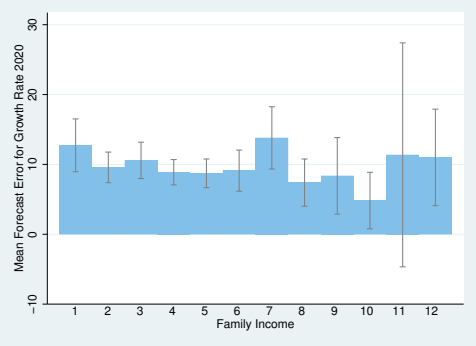
(b) Religiosity



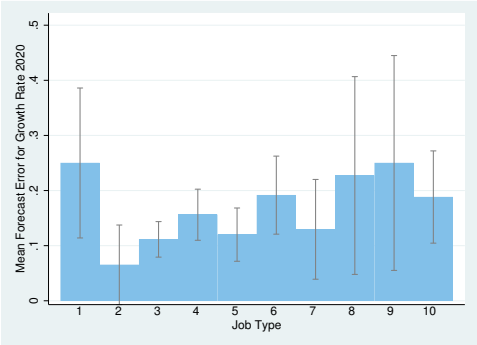
(c) SES



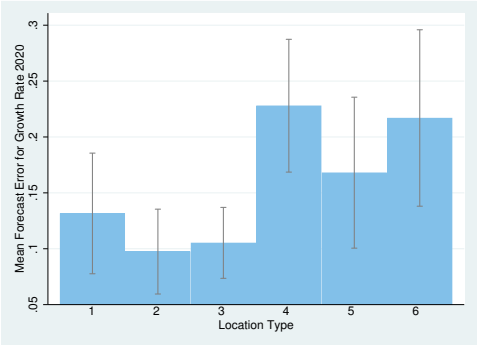
(d) Family Income



(e) Job Type



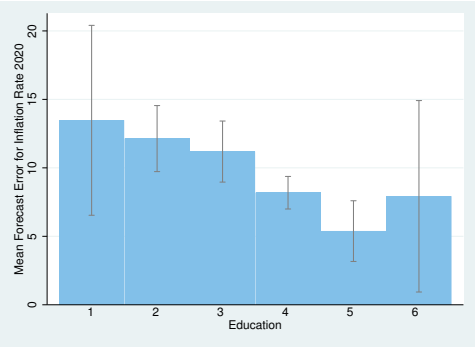
(f) Location Type



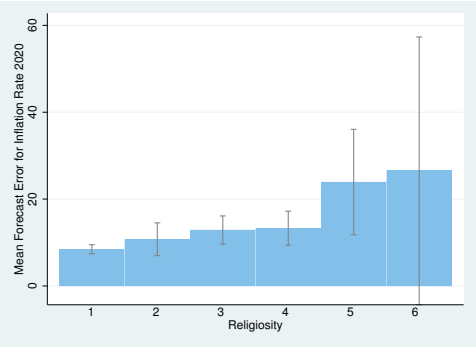
Notes: Education is on a scale of 1 (secondary school or below) to 6 (Ph.D). Religiosity is the frequency that the subject participates in religious activities on a scale of 1 (never) to 6 (very frequently). SES is subjective socioeconomic level on a scale of 1 (the lowest) to 10 (the highest). Family income is family's monthly income on a scale of 1 (less than 5000 RMB) to 12 (20000 RMB and above). Job type denotes farmer (1), civil servants (2), professional and technical personnel (3), business service personnel (4), worker (5), students (6), leaders government (7), enterprises, and institutions (8), housewife (9), retired (10), and other (11). Location type refers to Beijing, Shanghai, Guangzhou, Shenzhen (1), Tianjin, Chongqing, provincial capital cities (2), prefecture-level city (3), county-level city (4), town (5), and rural area (6).

Figure 4: Forecast Errors on Infation Rate 2020

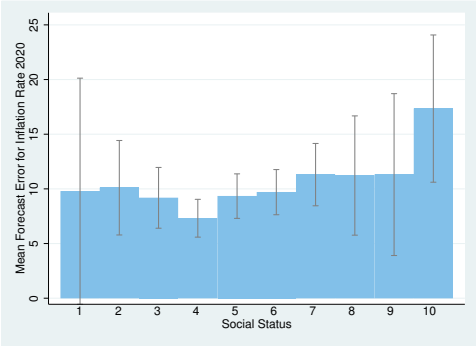
(a) Education



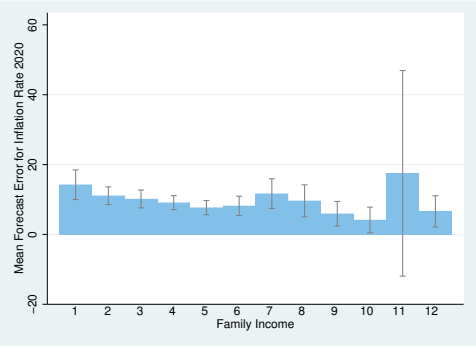
(b) Religiosity



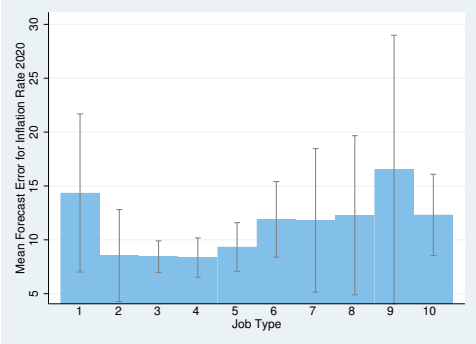
(c) SES



(d) Family Income



(e) Job Type



(f) Location Type

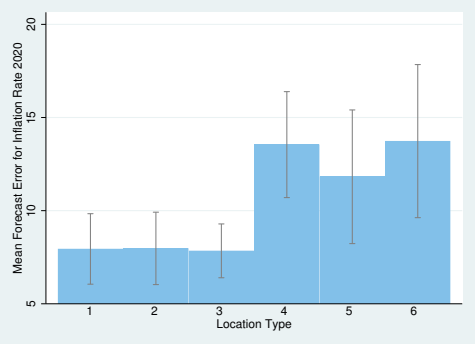
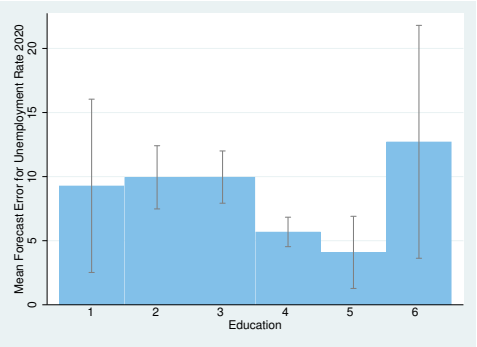
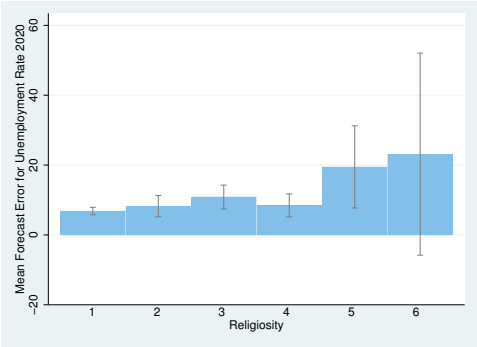


Figure 5: Forecast Errors on Unemployment Rate 2020

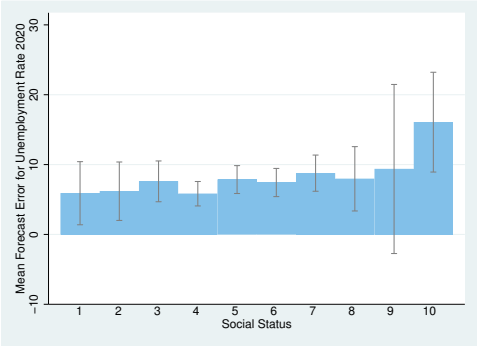
(a) Education



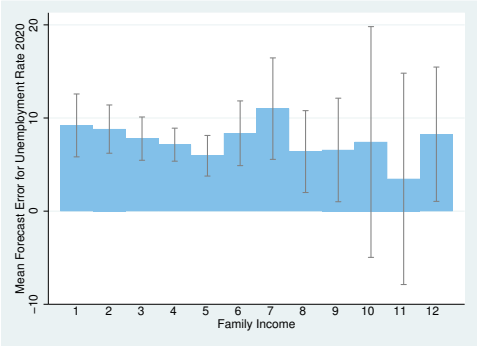
(b) Religiosity



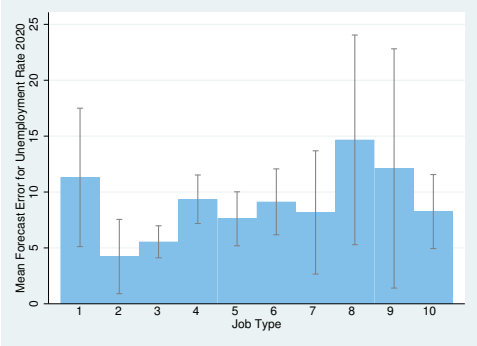
(c) SES



(d) Family Income



(e) Job Type



(f) Location Type

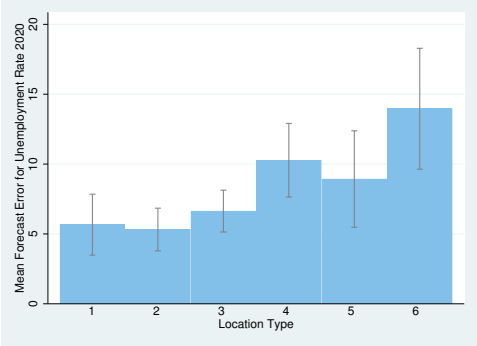


Table 6: Forecast Errors for Round and Non-round Forecasts

Mean Absoulte Forecast Error	Non-round	Round	p-value
Economic Growth Rate 2020	6.17	23.91	0.00***
Inflation Rate 2020	5.03	23.67	0.00***
Unemployment Rate 2020	5.19	19.33	0.00***

growth 2020 and inflation 2020.

3.4 Implausible Forecasts

We compute the proportion of forecasts with implausible values for economics growth 2020, inflation rate 2020, and unemployment rate 2020. We define a forecast as implausible if the forecast value is higher (or lower) than 3 times of the official statistics in 2019. We are interested in the relationship between demographics and forecasting implausible values (which may serve as a measure of understanding of macroeconomic variables) rather than the proportion of subjects making implausible forecasts which is a subjective measure that is sensitive to how we define it. Table 7 reports the marginal effect estimations of probit regression on making implausible forecasts. We observe that subjects with higher degree of religiosity, those living in small towns and villages are more likely to make implausible forecasts, while those with better education are less likely to make implausible forecasts.[16]

We conduct the survey with households who may have different understanding on macroeconomic expectations as compared to experts. A recent study by Andre et al. (2019) find that households and experts have different expectations, while expert predictions are quantitatively close to standard DSGE models and VAR evidence. We, indeed, find some households have expectations on economic growth rate and inflation rate that is beyond reasonable level. This illustrates, indeed, some households do not have good understanding on macroeconomic variables.

[16]The proportion of implausible forecasts for economics growth 2020, inflation rate 2020, and unemployment rate 2020 are 15.12%, 26.08%, and 23.11%, respectively.

Table 7: Implausible Forecast

	Dependent variables: Implausible Forecast		
	(1) Economic Growth 2020	(2) Inflation 2020	(3) Unemployment 2020
Religiosity	0.04***	0.07***	0.03***
	(0.01)	(0.01)	(0.01)
Education	-0.02**	-0.02	-0.03**
	(0.01)	(0.01)	(0.01)
Family Income	-0.00	-0.01*	-0.00
	(0.00)	(0.01)	(0.01)
SES	0.01**	0.01	0.01
	(0.01)	(0.01)	(0.01)
Town Village	0.08***	0.10***	0.08***
	(0.02)	(0.03)	(0.03)
Female	0.02	0.03	0.05**
	(0.02)	(0.03)	(0.03)
Age	-0.00	-0.00	-0.00***
	(0.00)	(0.00)	(0.00)
Social Contact Change	0.03	-0.01	0.02
	(0.02)	(0.03)	(0.03)
Prevalence Rate	6.41	-60.59	46.10
	(68.80)	(85.51)	(78.78)
Pseudo R-squared	0.07	0.05	0.04
Observations	1,169	1,169	1,169

Notes: This table reports marginal effect of probit regressions on determinants of making an implausible forecast. Town Village is a dummy that equals 1 if the subject lives in small town or village, zero otherwise. The other independent variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Result 5: *Significant proportion of implausible forecasts are observed. Subjects with higher degree of religiosity, those living in small towns and villages are more likely to make implausible forecasts, while those with better education are less likely to make implausible forecasts.*

3.5 Reasonable Forecasts and Optimistic Macroeconomic Expectations

Table 8 reports the forecast error of the observations which have no rounding and implausible values. We find that, for these observations, the forecast error for economics growth 2020 is significantly positive and different from zero, while

Table 8: Forecast Errors

	Whole Sample	No Rounding &No Implausible value
Economic Growth Rate 2020	12.61	3.06
Inflation Rate 2020	12.78	1.79
Unemployment Rate 2020	9.62	-0.36

the forecast error of unemployment rate 2020 is significantly negative. The result shows that for subjects who make reasonable forecast, they are still on average optimistic for the forecasts on economic growth rate and unemployment rate.

3.6 Inflation Rate

The average expected inflation rate is 8.51% for 2020 (median:5.2%, std. dev.:7.89), 8.91% (annual; median: 5.49%, std. dev.:9.05) for 2021–2025, while the average money supply growth rate is 9.09% (median:10%, std. dev.:18.76).[17,18,19]

Column 2 of Table 9 reports the marginal effect estimates of the regression in which the dependent variable is the belief that the 2021–2025 inflation rate will be higher because of the Covid-19 outbreak. The coefficient of discount factor 2 is significantly positive, which suggests that subjects who put a lower weight for future utility are less likely to expect a higher inflation rate because of Covid-19. This result is confirmed in the regressions reported in Column 3 and 4 in which

[17] To remove outliers, we consider the 2020 average expected annual inflation rate based on the subsample (92.9% of the whole sample) in which the subjects' expected inflation rate is less than 50%, and the 2021–2025 average expected annual inflation rate based on the subsample (93.2% of the whole sample) in which the subjects' expected inflation rate is less than 50%. We do not find evidence of tendency to round inflation forecasts to multiples of five as in Binder (2017).

[18] About 33.08% of the subjects believe that the Covid-19 outbreak will lead to a reduction in the money supply in 2020; 35.71% believe that there will be no change; and 31.21% believe that there will be an increase in the money supply.

[19] D'Acunto et al. (2019) find that inflation expectations is correlated with IQ.

we find that subjects with a higher discount factor expect higher annual inflation rates for 2020 and 2021–2025. If we consider a higher inflation rate as a negative shock, then our result implies that subjects with a lower discount factor are more optimistic about the annual inflation rate for 2021–2025.

Column 1 of Table 9 reports the marginal effect estimates of the regression in which the dependent variable is the belief that the 2020 inflation rate will be higher due to the Covid-19 outbreak. We find that the coefficient of social contact change is negative and weakly significant, which suggests that a stronger magnitude of social distancing induces subjects to expect a higher inflation rate. This finding is confirmed in the regression reported in column 3 where the coefficient is significantly negative. However, the coefficient is not significant for year 2021–2025 as shown in Columns 2 and 4, which suggests that subjects may believe that the effect of social distancing on the inflation rate will only last over short-run. This finding is supported by Panel B of Figure 2, which is the map of the expectations of proportion of subjects who hold the belief that the inflation rate will be higher because of the Covid-19 outbreak. Comparing the map of 2020 and 2021–2025, we see that subjects expect the effect to be lower in the longer term.

Result 6: *Subjects with lower discount factor are more optimistic about the annual inflation rate. Social distancing induces a higher expected inflation rate for 2020.*

The regression reported in column 3 and 4 of Table 9 shows that expected inflation rate in 2020, and 2021-25 are both positively correlated with expected money supply growth in 2020, while the coefficients are much lower than 1. To investigate if subjects believe in price rigidity, we can compare the values of expected money supply growth with the expected inflation rate, if the latter is smaller, it implies that the subject believes that price is rigid. We find that 46.85% of subjects hold the belief that price is rigid, 10.46% believe that the inflation rate will be exactly equal to the money supply growth rate, and 42.69% believe that the inflation rate will be higher than the money supply growth rate. It is apparent that there is a

significant heterogeneity of beliefs. In any case, the percentage of subjects whose beliefs is compatible with the quantity theory of money (Friedman, 1956b; 1989) or neutrality of monetary policy (Wallace, 1981) is rather low. It goes beyond the scope of this paper to investigate the actual effectiveness of monetary policy. Yet, the beliefs elicited from subjects, and correlation of decisions with the expected money supply growth, does suggests that monetary policy will likely to have some effect, at least in affecting people's behavior. We find that expected change in consumption, saving, and investment in 2020 are all positively correlated with the expected money supply growth in 2020.

Result 7: *The expected inflation rate is positively correlated with expected money supply growth rate. About 46.85% of subjects hold the belief that price is rigid, 10.46% believe that the inflation rate will be exactly equal to the money supply growth rate, and 42.69% believe that the inflation rate will be higher than the money supply growth rate.*

3.7 Income

We find that 32.74% of the subjects expect that the Covid-19 outbreak will cause personal income to decrease in 2020, and the proportion expecting increase and no change are 62.41%, and 4.85%, respective. On the other-hand, 16.5% expect that it will cause personal income to decrease in 2021–2025, and the proportion expecting increase and no change are 79.85%, and 3.66%, respectively. On average, the subjects expect their personal income will be increased by 5.05% (2020) and 8.73% (2021–2025) each year.

Column 1 of Table 10 reports the marginal effect estimates of the probit regression in which the dependent variable is the expectation of lower income in 2020 because of the Covid-19. The coefficient on discount factor 2 is significantly positive. A similar result is obtained for year 2021–2025, see Columns 2 of Table 10. The effect of social distancing is weakly significant for 2020, but not for 2021–2025. The coefficients for prevalence rate are not significant in either regressions.

Table 9: Determinants of Inflation Rate Expectations

	Dependent variables:			
	(1)Higher Infla 2020	(2)Higher Infla 2021–2025	(3) Expected Infla 2020	(4) Expected Infla 2021–2025
Money Supply 2020	-0.00	-0.00	0.09***	0.14***
	(0.00)	(0.00)	(0.02)	(0.02)
Discount Factor1	0.08	-0.01	-0.96	-0.60
	(0.06)	(0.06)	(0.87)	(0.99)
Discount Factor2	0.08	0.14***	2.52***	2.33**
	(0.05)	(0.05)	(0.80)	(0.91)
Risk Aversion	0.02	0.01	0.10	0.40
	(0.02)	(0.02)	(0.27)	(0.31)
Ambiguity Averse	-0.01	0.01	0.23	0.37
	(0.03)	(0.03)	(0.52)	(0.59)
Social Contact Change	-0.06*	0.01	-1.29**	0.47
	(0.04)	(0.04)	(0.57)	(0.66)
Prevalence Rate	-106.45	77.37	-1,777.73	2,067.49
	(96.41)	(94.25)	(1,493.26)	(1,714.30)
Constant			5.22**	10.67***
			(2.21)	(2.50)
Control	Yes	Yes	Yes	Yes
Observations	1,085	1,090	1,085	1,090
R-squared	0.03	0.02	0.07	0.07

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is the belief that the 2020 inflation rate will be higher because of the Covid-19 outbreak. Column 2 reports the marginal effect of the probit regression in which the dependent variable is the belief that the 2021–2025 annual inflation rate will be higher because of the Covid-19 outbreak. Column 3 reports the OLS regression in which the dependent variable is the 2020 expected annual inflation rate for the sub-sample (92.9% of the whole sample) in which the subjects' expected inflation rate is less than 50%. Column 4 reports the OLS regression in which the dependent variable is the expected annual inflation rate in 2021–2025 for the sub-sample (93.2% of the whole sample) in which the subjects' expected inflation rate is less than 50%. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 10: Determinants of Income Expectations

	Dependent variables:	
	(1) Lower Income 2020	(2) Lower Income 2021–2025
Religiosity	-0.05***	-0.01
	(0.01)	(0.01)
Discount Factor1	0.08	0.01
	(0.05)	(0.04)
Discount Factor2	0.13***	0.07**
	(0.05)	(0.04)
Risk Aversion	-0.01	0.02
	(0.02)	(0.01)
Ambiguity Averse	-0.00	-0.01
	(0.03)	(0.02)
Female	0.05*	0.05**
	(0.03)	(0.02)
Social Contact Change	-0.06*	-0.03
	(0.03)	(0.03)
Prevalence Rate	-50.74	35.52
	(88.13)	(64.51)
Control	Yes	Yes
Pseudo R-squared	0.07	0.04
Observations	1,169	1,169

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is the belief that income in 2020 will be lower because of the Covid-19 outbreak. Column 2 reports the marginal effect of the probit regression in which the dependent variable is the belief that the income in 2021-25 will be lower because of the Covid-19 outbreak. The other variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Result 8: *Subjects with a lower discount factor, and those being more religious are more optimistic about the effect of Covid-19 on income.*

From Panel C of Figure 2, we can see that in the long run, most subjects do not expect a negative impact. Interestingly, subjects in Hubei province where Wuhan is located are relatively more pessimistic in year 2020-25 than the other provinces immediately adjacent.

3.8 Unemployment Rate

The average expected unemployment rate in 2020 is 10.29% (median: 5.8%, std. dev.:10.60) and 9.68% (annual; median: 5%, std. dev.:10.28) in 2021–2025.[20] Columns 1 and 2 of Table 11 report the OLS regressions for expected unemployment rate in 2020 and 2021–2025, respectively.[21] The expected unemployment rate in 2020 correlates positively with the prevalence rate, and the expected annual unemployment rate in 2021–2025 is positively correlated with discount factor 1.

Result 9: *The expected unemployment rate in 2020 correlates positively with the prevalence rate, and the expected annual unemployment rate in 2021–2025 is positively correlated with the discount factor.*

3.9 Consumption, Saving, and Investment

Consumption

Some subjects are rather optimistic about consumption. The survey results show that 66.33% of the subjects indicate that they will increase their consumption in 2020 because of the Covid-19 outbreak, and 31.12% indicate that they will reduce their consumption. For 2021–2025, 81.8% of subjects indicate that they will increase their consumption, and 15.48% prefer reducing their consumption. The

[20] The average expected unemployment rate in 2020 is based on the sub-sample with expected unemployment rate at least 0 and equal or smaller than 50 (94.5% of the whole sample).The average expected unemployment rate in 2021-25 is based on the sub-sample of observations with expected unemployment rate at least 0 and equal or smaller than 50 (96.1% of the whole sample).

[21] Interestingly, in both regressions, there is positive correlation between expected inflation rate and expected unemployment rate. This finding is counter to the idea of trade-off between inflation and unemployment, and inline with the theory of Berentsen, Menzio and Wright (2011) that in the long-run there is a positive relationship between inflation and unemployment.

Table 11: Determinants Unemployment Rate Expectations

	Dependent variables:	
	(1) Expected Unemployment Rate 2020	(2) Expected Unemployment Rate 2021–2025
Expected Inflation Rate 2021–2025	0.06***	0.03***
	(0.01)	(0.01)
Risk Aversion	0.39	0.57
	(0.36)	(0.35)
Ambiguity Averse	-0.15	0.59
	(0.69)	(0.67)
Discount Factor1	1.46	1.86*
	(1.15)	(1.11)
Discount Factor2	-0.79	0.06
	(1.04)	(1.01)
Social Contact Change	0.96	-0.40
	(0.76)	(0.74)
Prevalence Rate	4,033.42**	-93.26
	(1,986.75)	(1,934.95)
Constant	11.57***	11.37***
	(2.95)	(2.83)
Control	Yes	Yes
Observations	1,104	1,123
R-squared	0.07	0.06

Notes: Column 1 reports the OLS regression where the dependent variable is expected unemployment rate in 2020 for observations with expected unemployment rate at least equal to zero and equal or smaller than 50 (94.5% of the whole sample). Column 2 reports the OLS regression where the dependent variable is expected annual unemployment rate in 2021–2025 for observations with expected unemployment rate at least equal to zero and equal or smaller than 50 (96.1% of the whole sample). The other variables are as defined in Table 2. *, **, *** denotes significance at 10%, 5%, and 1% levels, respectively.

average expected consumption increases by 5.31% (2020) and 9.62% (annual; 2021–2025). The expected increase in consumption is consistent with the theoretical prediction of belief-based utility —that is, present bias subjects are more likely to be optimistic about the future and hence more likely to increase consumption despite the outbreak.[22] The decrease in consumption is consistent with the theory of precautionary saving (Kimball, 1990; Berger, 2014).

Column 1 of Table 12 reports the marginal effect estimates of the probit regression on whether a subject will lower her consumption in 2020 because of the outbreak. Ambiguity averse subjects are 8% more likely to lower their consumption in 2020, and present bias subjects are 7% less likely to lower their consumption. We find that subjects who expect lower income and a lower economic growth rate in 2020 because of the outbreak are, respectively, 42% and 11% more likely to lower their consumption in 2020.

Column 2 reports the marginal effect estimates of the probit regression on whether a subject will lower her consumption in 2021–2025 because of the Covid-19 outbreak. The coefficient on ambiguity averse is lower and weakly significant, and the effect of present bias is insignificant. The coefficient on the prevalence rate is significantly positive, which suggests that subjects in provinces with a higher prevalence rate are more likely to reduce their consumption in 2021–2025. From both regressions we observe that when expected income decreases, the probability of reducing consumption increases.

Result 10: *The probability of expecting lower consumption is positively correlated with ambiguity aversion and the prevalence rate, while negatively correlated with present bias.*

Panel A of Figure 6 shows that the effect of the Covid-19 outbreak on a subject's propensity to reduce consumption is stronger in 2020 than in 2021–2025.

[22] This finding is consistent with Bloom et al.'s model (2018), which predicts that a shock lowers the expected return on savings and thus making immediate consumption more attractive.

Table 12: Determinants of Consumption Expectations

	Dependent variables:	
	(1) Lower Consum 2020	(2) Lower Consum 2021–2025
Neg Income Effect 2020	0.42***	
	(0.03)	
Neg Income Effect 2021–2025		0.44***
		(0.04)
Lower Econ Growth 2020 by Covid	0.11***	
	(0.03)	
Lower Econ Growth 2021–25 by Covid		0.00
		(0.02)
Risk Aversion	-0.03*	0.01
	(0.02)	(0.01)
Ambiguity Averse	0.08**	0.04*
	(0.03)	(0.02)
Present Bias	-0.07**	-0.02
	(0.03)	(0.02)
Social Contact Change	-0.04	0.04*
	(0.03)	(0.02)
Prevalence Rate	24.33	162.34***
	(90.03)	(56.82)
Control	Yes	Yes
Pseudo R-squared	0.19	0.20
Observations	1,169	1,169

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is the belief that subject's 2020 consumption decrease because of the Covid-19 outbreak. Column 2 reports the marginal effect of the probit regression in which the dependent variable is the belief that the subject's 2021–2025 consumption will decrease because of the Covid-19 outbreak. The other variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

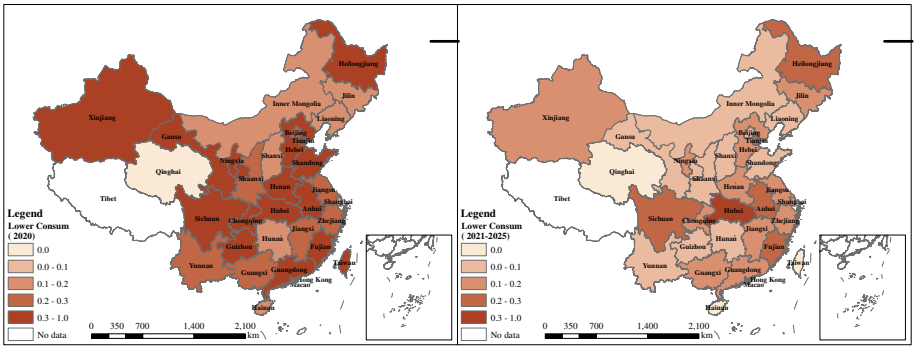
Interestingly, a higher proportion of subjects in the Hubei province expect to have lower consumption in 2021–2025 than the adjacent provinces.

Savings

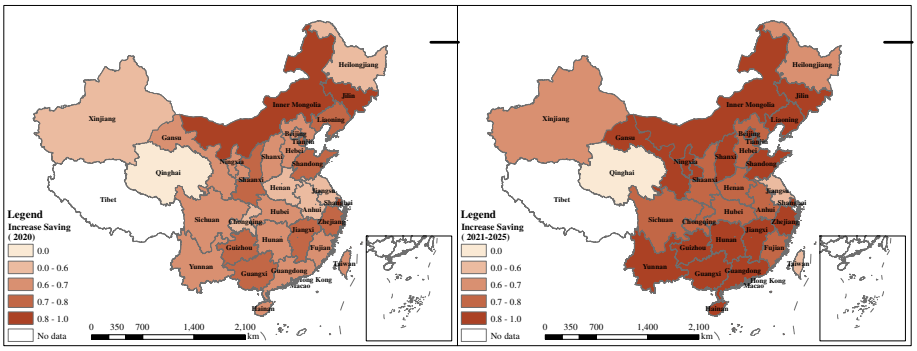
Most subjects plan to increase savings because of the Covid-19 outbreak, as shown in Panel B of Figure 6, a result consistent with the theory of precautionary saving (Kimball, 1990; Berger, 2014). The average expected savings increases by 5.8% (2020) and 9.35% (annual; 2021–2025). For 2020, 68.37% of the subjects indicate that the Covid-19 outbreak will induce them to increase their savings, 28.74%

Figure 6: Expectations on Consumption, Savings, and Investment

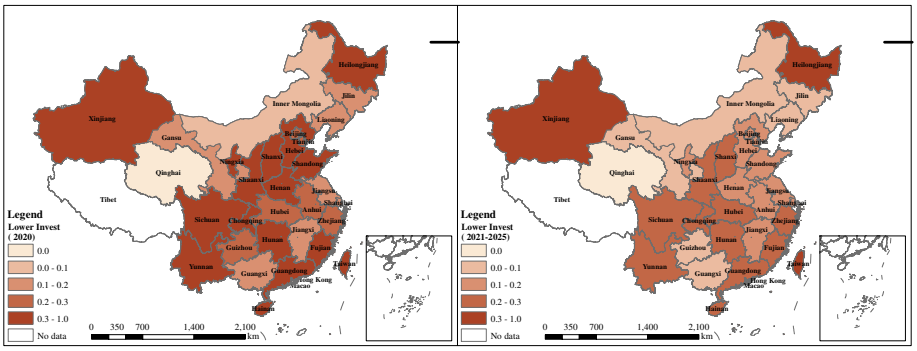
(a) Lower Consumption



(b) Increase Saving



(c) Lower Investment



to decrease their savings, and 2.89% to make no change. For 2021–2025, the proportions percentages are 79.34% (increase), 17.43% (decrease), and 3.23% (make no change).

Column 1 of Table 13 reports the estimates of the probit regression on whether a subject expects to increase her savings in 2020 because of the Covid-19 outbreak. Column 2 reports the estimates of the probit regression on whether the subject expects to increase her savings in 2021–2025 because of the Covid-19 outbreak. The coefficient on discount factor 1 is weakly significant in column 1 and significant in column 2. This may be due to the fact that subjects with higher discount factor anticipate a higher drop in income in the future as they are more pessimistic (as shown previously), and hence they are less likely to increase saving despite they are willing to.

Result 11: *Most subjects plan to increase savings because of the Covid-19 outbreak, a result consistent with precautionary saving.*

Investment

The subjects are rather optimistic about investment. The survey results show that only 28.34% (2020) of the subjects plan to reduce their personal investment because of the outbreak. The average expected personal investment will increase by 4.54% (2020) and 7.73% (annual; 2021–2025). Panel C of Figure 6 shows that the effect of the Covid-19 outbreak on lowering investment is more pronounced in 2020, as a lower proportion of the subjects expect to lower investment in the longer term (2021–2025).

Column 1 of Table 14 reports the marginal effect estimates of the probit regression on whether a subject will increase her investment in 2020 because of the Covid-19 outbreak. Subjects with a higher discount factor 1 are more likely to reduce their investment in 2020. A higher decrease in social contacts also leads to a higher probability of reducing investment. Column 2 of Table 14 runs the same

regression for 2021–2025. The coefficients on the income effect for 2021–2025 are significantly negative, but the coefficients on the other variables are not significant.

Result 12: *Subjects are rather optimistic about investment. The survey results show that only 28.34% (for year 2020) of the subjects plan to reduce their personal investment because of the outbreak.*

4 Conclusion

We experimentally investigate the determinants of macroeconomic expectations. One innovation of our approach is that we elicit a large set of expectations related to the macroeconomy and a set of preferences at the individual level. This approach differs from those of studies that use survey to measure individuals' macroeconomic expectations, as individual preferences often are not elicited. Our approach of identifying individual preferences offers a new way to understand the determinants of heterogeneity in expectations. We show that some of the individual heterogeneity can be explained by differences in people's ambiguity attitude, probability overweighting, time preference, and religiosity.

Our main findings can be summarized as follows. We find that religious subjects, those exhibiting probability overweighting (Kahneman and Tversky, 1979), and having lower discount factor are more optimistic on economic growth and income. Overall, subjects form optimistic expectations, supporting the implication of belief-based utility (Brunnermeier and Parker, 2005) and wishful thinking (Seybert and Bloomfield, 2009) that individuals overestimate the likelihood of desirable events.

We observe widespread variations in macroeconomic expectations, a result consistent with Coibion, Gorodnichenko, and Kumar (2018). Our finding suggests that some households do not have good understanding on macroeconomic variables as their expectations are beyond "reasonable" levels. We measure the forecast errors of economic growth, inflation rate 2020, and unemployment rate in 2020. We find

Table 13: Determinants of Savings Expectations

	Dependent variables:	
	(1)Increase Saving 2020	(2) Increase Saving 2021–2025
Income Effect 2020	0.04***	
	(0.00)	
Income Effect 5yrs		0.06***
		(0.00)
Lower Econ Growth 2020 by Covid	-0.22**	
	(0.09)	
Lower Econ Growth 2021–2025 by Covid		-0.22**
		(0.09)
Ambiguity Averse	-0.10	-0.01
	(0.09)	(0.10)
Risk Aversion	-0.05	0.02
	(0.05)	(0.06)
Discount Factor1	-0.28*	-0.40**
	(0.15)	(0.17)
Discount Factor2	-0.07	-0.01
	(0.14)	(0.15)
Social Contact Change	0.12	-0.02
	(0.10)	(0.11)
Prevalence Rate	210.89	-114.19
	(271.88)	(294.38)
Constant	0.79**	1.00**
	(0.40)	(0.45)
Control	Yes	Yes
Pseudo R-squared	0.18	0.19
Observations	1,162	1,161

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is whether the subject will increase savings in 2020 because of the Covid-19 outbreak. Column 2 reports the marginal effect of the probit regression in which the dependent variable is whether the subject will increase savings in 2021–2025 because of the Covid-19 outbreak. The other variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 14: Determinants of Investment Expectations

	Dependent variables:	
	(1) Lower Invest 2020	(2) Lower Invest 2021–2025
Income Effect 2020	-0.01***	
	(0.00)	
Lower Econ Growth 2020 by Covid	0.01	
	(0.03)	
Income Effect 2021–2025		-0.01***
		(0.00)
Lower Econ Growth 2021–2025 by Covid		0.02
		(0.02)
Risk Aversion	-0.00	0.02
	(0.02)	(0.01)
Ambiguity Averse	0.03	-0.01
	(0.03)	(0.02)
Discount Factor1	0.12***	0.05
	(0.05)	(0.04)
Discount Factor2	0.02	0.01
	(0.04)	(0.03)
Female	0.08***	0.07***
	(0.03)	(0.02)
Social Contact Change	-0.08***	-0.03
	(0.03)	(0.02)
Prevalence Rate	-187.65**	-31.53
	(84.88)	(64.73)
Control	Yes	Yes
Pseudo R-squared	0.12	0.18
Observations	1,169	1,169

Notes: Column 1 reports the marginal effect coefficient estimates of the probit regression in which the dependent variable is whether the subject will reduce investment in 2020 because of the Covid-19 outbreak. Column 2 reports the marginal effect of probit regression in which the dependent variable is whether the subject will reduce investment in 2021–2025 because of the Covid-19 outbreak. The other variables are as defined in Table 2. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

that subjects with higher degree of religiosity, living in small towns and villages, and with higher SES are more likely to have higher forecast error on economic growth rate, inflation rate, and unemployment rate, while subjects with better education have lower forecast errors. Significant proportion of subjects' forecasts exhibit the property of rounding (multiple of 5).

Another interesting finding of this study is that subjects who are more religious are more optimistic about economic growth and income. While there are evidence on the importance of religion on economics (see e.g., Iannaccone, 1998; Barro, and McCleary, 2003), no existing study has investigated the relationship between religiosity and macroeconomic expectations. Our finding on effect of religiosity suggests that people may be motivated to hold biased belief when forming macroeconomic expectations especially when facing possible economic downturn. It should be mentioned that we believe that Covid-19 is not necessary to obtain most of the results (relation between macroeconomic expectations and preferences such as ambiguity aversion) of the study. That is, we would expect to obtain similar results even before Covid-19.

Most subjects plan to increase savings because of the Covid-19 outbreak, a result consistent with precautionary saving. Subjects are rather optimistic about investment. Only 28.34% (for year 2020) of the subjects plan to reduce their personal investment because of the outbreak.

The expected inflation rate is positively correlated with expected money supply growth rate. More specifically, about 46.85% of subjects hold the belief that price is rigid, 10.46% believe that the inflation rate will be exactly equal to the money supply growth rate, and 42.69% believe that the inflation rate will be higher than the money supply growth rate. The percentage of subjects whose beliefs is compatible with the quantity theory of money (Friedman, 1956b; 1989) or neutrality of monetary policy (Wallace, 1981) is rather low.

We find that social distancing leads to higher expected inflation, lower expected income, and lower expected investment for 2020. Moreover, a higher prevalence

rate induces higher expected unemployment in 2020 and lower expected consumption for 2021–2025.

Our study has some limitations. First, we take the elicited preferences as given and do not investigate the possible effect of the Covid-19 outbreak on individual preferences. It is possible that the outbreak affects individuals' preferences, which in turn can affect their macroeconomic beliefs. Although this point is valid, we are more interested in the relationship between preferences and macroeconomic expectations, and thus leave the question of the outbreak's effect on preferences for future research. Second, our survey was conducted about 3 months after the Covid-19 outbreak when uncertainty about the outbreak was still high. It would be interesting to investigate the changes in beliefs at a later time when uncertainty was reduced. Third, our survey was conducted in China. Conducting a similar study in other countries would be valuable. We believe these are interesting directions for future research.

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Online Appendix. Theoretical Framework

Baseline

Consider a decision marker (DM) who faces the following decision-making problem. She forecasts the value of x which has value of H with probability of p, and L with probability $1-p$. The payoff for the DM's forecast equals $-(f-R)^2$ where f is the forecasted value and R is the realized value.

Now consider there is a shock to the economy in the sense that the probabilities become unknown. Then, the DM's forecast will depend on her ambiguity attitude. For example, if the DM's ambiguity attitude follows Maximin preference, then she holds the belief that $p = 0$. That is, the worst case will happen for sure. Denote f_a as the forecasted value under ambiguity, and f_r as the forecast value under risk. Ambiguity aversion implies $f_a < f_r$, ambiguity loving implies $f_a > f_r$, and ambiguity neutral implies $f_a = f_r$. This simple theory suggests that an ambiguity averse DM will be more likely to be pessimistic about the effect of the shock.

Hope

Now, instead of assuming this is a one-period problem, suppose the decision marker faces the following two period decision-making problem. In period 1, she makes the forecast. The actual value of the event will be realized in period 2, and the payoff of the forecast will be delivered in period 2. Suppose the DM can derive utility in period 1 from her forecast, in the sense of getting hope. The DM's utility is then consisted of two parts, the utility from payoff of the forecast (from period 2) and the utility from the forecast value (from period 1) which can be considered as the "hope" utility. The idea is that by forecasting a higher value x, the DM enjoys the hope of a positive outcome in period 1, while it comes with a cost that the payoff from the forecast itself in period 2 may be lower. Hence, there is a trade-off between being optimistic vs. accurate. In other word, the utility of the DM is then equal to

$au(f) + \beta(1-a)u(-(f-R)^2)$ where $0 \leq a \leq 1$ is the weight of utility from period 1, $1-a$ is the weight of utility from period 2, $0 \leq \beta \leq 1$ is the discount rate.

Obviously, this is a more general case. When $\beta = 0$, the DM only cares about her payoff in period 1, and hence she will make optimistic forecast for sure. When $\beta > 0$ and $a > 0$, the DM's forecast will then depend on her weighting of period 1 and period 2 utility. When the ambiguous shock arrives, the DM's forecast will depend on her ambiguity attitude and weighting of period 1 and period 2 utility. If the DM puts a positive weight on the hope utility, she will then make a relatively more optimistic forecast compared with the case she does not have hope utility.

Online Appendix. Comparing Hubei and Its Adjacent Provinces

An alternative approach to understand the impact of the Covid-19 is to compare the differences in the macroeconomic expectations between subjects who live in Hubei and subjects who live in its adjacent provinces (Hunan, Jiangxi, Anhui, Henan, Shanxi, and Shaanxi) before and after the Covid-19 outbreak. Thus, we can take advantage of the difference in prevalence rate and social distancing policy. Hubei had a significantly higher prevalence rate than its adjacent provinces (p-value=0.00, two sample t-test) and a significantly higher reduction in social contacts (p-value=0.00, two sample t-test). Comparing Hubei and its adjacent provinces, we find that the subjects from Hubei are significantly more likely to expect lower economic growth rate (2021–2025, p-value=0.06), lower consumption (2021–2025, p-value=0.00), and a higher unemployment rate (2021–2025, p-value=0.06). In the scenario in which there was no outbreak, we observe no significant differences between the expectations of subjects from Hubei and those of subjects from its adjacent provinces for economic growth rate and inflation rate. There are also no significant differences in ambiguity aversion, present bias, or risk aversion. Taken together, these findings suggest that the differences in expectations between subjects in Hubei and its adjacent provinces are due to the differences in prevalence rate and social distancing policy.