Consumption and Account Balances in Crises: Have we Neglected Cognitive Load?*

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Abstract

Major crises, including covid, geopolitical, financial, and fiscal crises, but even life events and difficulties occupy people's minds while they make important economic decisions and may create (further) deviations from optimality and financial stability risks. To investigate the implications of a taxing and persistent cognitive load and its interaction with adverse labor market shocks for consumption, saving, and borrowing choices, we design and conduct an incentivized online experiment among a representative sample of 2000 households in France. We find that facing a cognitive load has a significant downward effect on chosen consumption and an upward effect on chosen account balances, with the former being proportionately bigger for those not facing a prospect of furlough, and the latter being more pronounced for workers that do. These are additional to any effects that a furlough prospect alone has, and they do not arise from supply constraints or worsening of borrowing constraints. Cognitive load worsens the ability of the workhorse intertemporal model to describe consumption behavior, primarily by interfering with the optimality of the policy rules chosen by subjects, and to a lesser extent with how the evolution of the endogenous state (net financial assets) influences optimal consumption. College educated subjects facing cognitive load as well as furlough risk tend to exhibit a smaller deviation from optimal model behavior and to lower their consumption less as a result of cognitive load. Subjects with greater short-term patience tend to lower their consumption and to deviate more from the workhorse model.

Keywords: consumption, saving, borrowing, cognitive load, online experiments, RCT, covid crisis, war, furlough.

JEL Codes: G5, C9, D9, E2.

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1 Introduction

The current century has already been associated with a number of crises, on the financial, fiscal, environmental, health, and socio- and geo-political level. Undoubtedly, these crises include important purely economic aspects relevant for household behavior, such as income and return shocks and processes, supply and borrowing constraints, expectations and perceptions. Yet, crises, whether general or personal, also impose significant demands on people's minds, who now have to make the same choices, such as consumption, saving, and borrowing, while their mind is also paying attention to other background issues. Indeed, such cognitive load is pervasive, both as a result of major general crises and of taxing aspects of people's everyday life, such as stressful work environments, young kids, health problems, and marriage problems.[1] In principle, consumption, saving and borrowing decisions of households made under psychological stress could result in increased likelihood of future financial distress, emanating from inadequate savings, over-utilized credit lines, and ill-thought commitments. Alternatively, cognitive load and the inability to focus on making informed financial decisions may actually encourage more conservative consumption behavior and accumulation of larger financial assets for future use. Indeed, reduced consumption and increased bank account balances were observed after the onset of the Covid crisis, but they are normally attributed fully to some combination of supply constraints and precautionary motives.[2]

This paper asks the following questions. Does the presence of cognitive load encourage people to over-consume and go into debt or does it have the opposite effects of lower consumption and accumulation of account balances for the future? How does the presence of cognitive load interact with changes in background risk, through the introduction of a probability of income reduction (furlough or unemployment) for an unknown period of

[1]For example, the outbreak of Covid-19 and the lockdown measures imposed in several countries have generated considerable psychological costs, with symptoms like stress, anxiety and insomnia having been documented already in early stages (Brooks et al., 2020; Pfefferbaum and North, 2020). Healthcare studies find that excessive stress, attentional narrowing and distractibility are often associated with impaired performance (Bong et al., 2016).

[2]In a completely different setting, Iverson (2018) finds evidence consistent with judges who face high caseload being hesitant to end bankruptcies and to push large firms into liquidation, preferring instead to prolong bankruptcies and keep options open.

time? Are effects of cognitive load on consumption and financial asset choices (account balances) more pronounced among particular demographic groups, such as those with lower education or financial literacy, or those who exhibit behavioral biases, calling for targeted policies? Finally, how does neglecting the presence of cognitive load influence the ability of our workhorse consumption-saving model to describe behavior, and can such departures be traced primarily to suboptimal policy rules or to the evolution of endogenous state (account balance) levels? To this end, the paper employs a specially designed online RCT experiment with suitably chosen treatment and control groups, so as to distinguish between effects of economic shocks and those of the presence of cognitive load, but also to study the interaction between them. Although the impetus for this study has been the Covid-19 crisis, the experimental design and the tools of analysis have been chosen to be generic enough for conclusions to apply to behavior more generally under general or personal crises that occupy people's minds.

To decompose the various effects, we divide up the sample of approximately 2000 subjects, representative of the French population along various dimensions, into four groups that we face with different setups in incentivized online experiments. While all setups involve stochastic labor income, each of them is defined by a different combination of the presence of a persistent cognitive load (a recurring numerical task) and of the introduction of "furlough" risk, namely of a probability of a 30% income drop for an unknown number of model periods.[3] One group receives the benchmark risky labor income process, with no prospect of furlough and no cognitive load. Group 2 faces a furlough prospect but no cognitive load. Group 3 experiences cognitive load but no furlough prospect, while group 4 operates under both a furlough prospect and cognitive load. In all cases, we induce a preference for maximization of expected utility over a longer horizon, as well as attention to the cognitive load, through suitable definition of the experimental payoff. Different pairwise comparisons allow a decomposition of the effects.

Our outcome variables for study are the chosen consumption levels and resulting

[3] This can also be thought of as unemployment risk involving a 30% drop in labor income, but we will be referring to it as furlough, given the size of the income drop.

financial assets (account balances), the deviations in behavior from the implications of a standard workhorse model of consumption, saving, and borrowing, and the decomposition of these deviations into a suboptimal consumption policy rule versus suboptimal evolution of the endogenous state (account balances) with an optimal rule. Finally, we study whether a number of subject attributes interact with the effects or their decomposition. For example, we examine whether cognitive load and psychological distress loom larger in the mind of more anxious people (Ashcraft and Krause, 2007) or of those less financially literate or more risk averse. The attributes we explore include demographics (educational background, financial literacy, cognitive abilities, age, gender), attitudes (e.g., risk aversion), and traits (e.g., stress tolerance, anxiety).

Specifically, in the treatments involving cognitive load, we introduce an incentivized impulse task: while the subjects decide on consumption, saving, or borrowing, a sequence of numbers appears on the screen of the treated subjects at a predetermined frequency and subjects must press the space bar if the number is in a certain range only. Subjects were informed that failure to execute this additional task within a given short time frame comes at a cost, so as to prevent that the implementation of the cognitive load is bypassed or ignored, reflecting the compelling nature of the crisis. We elicit characteristics, attitudes, and traits of all subjects through a combination of survey questions and preliminary tasks that have been used in existing literature on such elicitation. First, all subjects in the four groups perform a series of standard tests with a view to acquiring information about their risk attitudes, financial literacy, attention capacity, cognitive abilities, and memory capacity. Second, subjects are asked questions to elicit information about personality traits, such as stress tolerance and state-trait anxiety. Third, since we have conducted the experiment within the covid crisis period, we also include a set of questions to evaluate whether the outbreak of Covid-19 has posed significant psychological distress in the daily life of participants.

We perform comparisons between various relevant treatment and control group pairs using descriptive, as well as econometric methods that control for a range of characteristics, attitudes, attributes, and subject performance during the experiment. We find that facing a cognitive load has a significant downward effect on chosen consumption and an upward effect on accumulated account balances, with the former being proportionately bigger for those not facing a prospect of furlough, and the latter being more pronounced for workers that do. These are separate from any effects that a furlough prospect alone has, and they do not arise from supply constraints or worsening of borrowing constraints, as these are not imposed. Cognitive load worsens the ability of the workhorse intertemporal model to describe consumption behavior, primarily by interfering with the optimality of the policy rules chosen by subjects, and to a lesser extent with how the evolution of the endogenous state (net financial assets) influences optimal consumption. College educated subjects facing cognitive load as well as furlough risk tend to exhibit a smaller deviation from optimal model behavior and to lower their consumption less in response to cognitive load. Subjects with greater short-term patience tend to lower their consumption and to deviate more from the workhorse model.

Relevant Literature

Literature in household finance, recently reviewed in Gomes et al. (2021), considers the role of cognition in financial decisions, but not of cognitive load. Particularly relevant is a strand focusing on the role of cognitive abilities for investment and borrowing decisions, and on the determinants of personal delinquencies, defaults, and financial distress (Agarwal and Mazumder, 2013; Christelis et al., 2010; Gerardi et al., 2013; Gomes et al., 2021). Recently, D'Acunto et al. (2021) study the effect of IQ on consumption via inflation expectations, while D'Acunto et al. (2022) provide evidence that most households with below-median cognitive abilities fail to adjust their consumption and borrowing to fiscal and monetary policies.

In experimental economics, there have been studies of financial choices and their optimality, but without focusing on the effects of cognitive load. Most relevant are Meissner (2016) and Duffy and Li (2019). Meissner (2016) conducts a lab experiment with 78 undergraduates asked to make consumption choices with incentivized CARA utility over life cycles of 20 years under two stochastic income processes. The objective is to compare consumption choices when borrowing or saving is optimal. The paper finds evidence of underconsumption (debt aversion) in the borrowing treatment, with only weak evidence of overconsumption in the saving treatment. Duffy and Li (2019) induce logarithmic preferences with non-stochastic income and no borrowing possibilities to a sample of university students in a lab in order to study the effects of different pension replacement rates on consumption behavior.

Ballinger et al. (2011) run a lab experiment to study the relationship between cognitive abilities and saving decisions, using a wide range of measures of cognitive abilities grounded in psychology. Enke and Graeber (2022) study cognitive processes that are noisy with respect to valuing payments across different points of time, due to uncertain discount rates or computational difficulties faced by subjects. They find evidence that cognitive uncertainty, i.e., uncertainty regarding the utility-maximizing decision, is strongly related to behavior that is inelastic to the time delay of payoffs, and to whether subjects are likely to follow financial advice. They also find that increased task complexity, through incorporation of a math problem, raises cognitive uncertainty and leads to more hyperbolic discounting.

Deck and Jahedi (2015) review experimental research on the effect of cognitive load on various economic decisions, from risk taking and intertemporal choice to math ability and generosity. There is evidence that, under cognitive load, subjects tend to take fewer risks (Benjamin et al., 2013; Whitney et al., 2008). The effect of cognitive load on impatience is less clear. Although Hinson et al. (2003) find that cognitive load tends to result in more impatient behavior, Franco-Watkins et al. (2006) reinterpret the same data as suggesting more randomness in behavior and provide experimental evidence that cognitive load leads to more inconsistent choices (Franco-Watkins et al., 2010). Still, these findings are at odds with the literature on cognitive abilities, which finds a positive association between cognition and patience (Shamosh and Gray, 2008).

Finally, with respect to the voluminous literature on the covid crisis, recent research has demonstrated that the labor market outcomes, even within countries, exacerbate existing inequalities (Adams-Prassl et al., 2020), and that the lockdowns have had profound effects on consumer spending, account balances, and subjective expectations (Coibion et al., 2020).

As far as we know, no existing study investigates whether and how a tax on the brain, that increases distractibility by driving attention towards urgent needs and away from important financial choices, and its interaction with adverse labor market shocks tend to impact the consumption, saving, and borrowing choices made by heterogeneous individuals and to generate deviations from the optimal behavior described by a workhorse model. This is the focus of our paper.

Section 2 introduces the design of the experiment and associated survey, the data collection method, and the features of the sample. Section 3 describes average behavior and its deviation from the workhorse model across treatment groups and over the life cycle of the model. Section 4 presents regression analysis of treatment effects focusing on the average behavior of the subjects, their model departures, and any systematic relationship of both to subject characteristics. Section 5 concludes.

2 Survey Design, Data Collection, and Sample

2.1 Sample and data collection

We employ a sample of the French population including 1881 respondents aged more than 18 years old. We ran the survey from December 17, 2021 to January 29, 2022. The survey company Qualtrics distributed and was in charge of rewarding respondents for completing the survey. After clicking on the survey link, respondents are presented a consent form providing information about the nature and research purposes of the survey. They are informed they are taking part in an academic research survey and they are told that participation is entirely anonymous and voluntary. In order to screen out participants leading to potentially low quality observations, after the first demographic questions, we implement a simple but widely used attention check (Faia et al., 2021; Roth and Wohlfart, 2020). The median completion time was 24.33 minutes. The sample is by construction representative of the French population along the imposed quota dimensions of age, gender and education. Moreover, it is also representative on non-targeted quotas

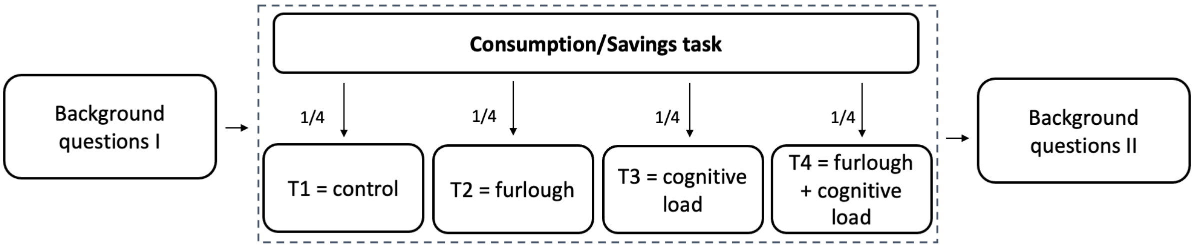

Figure 1: Survey structure

such as income, the employment rate or the region of residence (Table 1). Finally, as shown in Table 2, the sample is balanced across the control and treatment groups.

2.2 The survey

In Figure 1 we illustrate the structure of the survey. It is built around the experimental section in which respondents are asked to make consumption/saving decisions in the four different groups. The full survey is reported in Appendix C.

Consumption/financial assets task. We start by describing the implementation of the experimental core of our survey. The main task implements the workhorse consumption-saving choice model with stochastic labor income, a riskless asset, an interest-rate wedge between saving and borrowing, and a borrowing limit. The subject has the following objective:

$$\begin{aligned} \max_{\{C_t\}} \quad & \mathbb{E}_0 \quad \sum_{t=0}^{T-1} \beta^t U(C_t) \qquad (1) \\ \text{s.t.} \quad & A_{t+1} \;= (1+r)A_t + \theta_t Y_t - C_t \\ & A_{t+1} \;\geq \phi Y_t \\ & C_t \;\geq 0, \quad A_{T-1} = 0 \end{aligned}$$

where $Y_t = (1+g)Y_{t-1}e^{x_t}$; $x_t \sim AR(1)$; θ is a furlough shock that lowers income by 30% when it materializes, while being equal to one, otherwise; ϕ is the borrowing constraint parameter; r is a risk-free rate that can take a low ($r = r_f$) or high value ($r = r_c$) when the agent is saving or borrowing respectively. Note that the subjects' choice of consumption determines the net borrowing or net saving amount, given cash on hand. We do not ask

Table 1: Sample characteristics

	(1) France	(2) Survey
Female	51.64%	51.83%
Median age	41.28	46.63
Married or domestic partnership(*)	58.8%	64.75%
Average household size(*)	2.19	2.62
Employment rate	67.30%	63.00%
Income(*)		
€0–€14,999	12.95	11.96
€15,000–€24,999	25.19	21.48
€25,000–€49,999	40.85	44.07
€50,000–€74,999	11.53	12.81
€75,000–€99,999	1.35	3.46
€100,000–€149,999	2.71	2.97($^{+}$)
€150,000–€199,999	2.71	1.75($^{+}$)
€200,000+	2.71	1.49($^{+}$)
Region of residence (%)		
Auvergne-Rhône-Alpes	0.12	0.12
Bourgogne-Franche-Comté	0.04	0.05
Bretagne	0.05	0.05
Centre-Val de Loire	0.04	0.05
Corse	0.005	0.003
Grand Est	0.08	0.09
Hauts-de-France	0.09	0.12
Île-de-France	0.19	0.16
Normandie	0.05	0.05
Nouvelle-Aquitaine	0.09	0.08
Occitanie	0.09	0.09
Pays de la Loire	0.06	0.05
Provence-Alpes-Côte d'Azur	0.08	0.08
COVID: two doses of vaccine received($^{-}$)	78.30%	83.63%

Notes. The table reports French representative statistics from the INSEE in the year 2021 (column 1) alongside summary statistics from our survey (column 2). (*) latest data available 2018. The data for income distribution for France are obtained through interpolation of the survey data with the true data (expressed in deciles). ($^{+}$) We assume that the 4.15% of respondents choosing "Prefer not to answer" are equally distributed in the three last categories of higher income. The median age in France population is determined over the total population, while in our survey is calculated only over the population of 18 years old and over. The employment rate in France is calculated over the population aged between 15 and 64 years old, in our survey is calculated over the population of 18 years old and over. ($^{-}$) Data on January 30, 2022 (source: ameli.fr)

Table 2: Balance of sample

	(1) T1	(2) T2	(3) T3	(4) T4
Age	47.38	46.86	45.73	46.42
Women	48.23	52.67	52.76	53.78
Married or domestic partnership	66.39	60.99	66.59	65.44
Income (€25,000 - €49,999)	47.81	41.98	42.63	43.84
College education	42.59	44.16	41.94	38.23
Currently employed	62.84	61.58	62.21	65.44
Observations	479	505	434	463

Notes. Share of subjects in each condition across socio-demographic variables [for Age: average value].

them to determine separately deposits and loans, so there is no co-holding of those in the experiment and no need to define them separately in the model.

In the following we assume a CRRA utility function $U(C_t) = \frac{C_t^{1-\sigma}}{1-\sigma}$ with σ representing the degree of (constant) relative risk aversion. Moreover, we can re-write the individual's problem in terms of the value function:

$$v(a_t, s_t) = \max_{c_t} \gamma_t^{1-\sigma} \left[\frac{c_t^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}_t v(a_{t+1}, s_{t+1}) \right] \tag{2}$$

$$\gamma_t = \frac{Y_t}{Y_{t-1}} = (1+g)e^{x_t} \tag{3}$$

where $c_t = \frac{C_t}{Y_t}$, $a_{t+1} = \frac{A_{t+1}}{Y_t}$ and $s_t = (x_t, \theta_t)$.

For each model period, subjects choose the level of consumption (C_t) that maximizes expected lifetime utility under the budget constraint and the borrowing constraint. When solving numerically the model and in the experiment we assume the life-cycle consists of 20 periods and is split into two time windows i.e., working life until period 14 and from period 15 until the end the agent retires and receives a retirement pension that equals 74% of her income in period 14.

Appendix A reports the model parametrization. Figure A1 shows the optimal path for consumption and financial assets, given the chosen income realization, in the absence of the furlough shock, namely when $\theta = 1$ in all periods. Figure A2 displays the optimal path for consumption and financial assets, when the furlough shock hits from periods 6

Figure 2: Screenshot decision task

until 10.

Subjects are provided with instructions describing the environment and a qualitative explanation of the model. For each model period, they are asked to decide on the level of consumption, which also implies the level of financial assets to be set aside for next period, given the exogenous labor income process. Given that there is no portfolio choice in the model and co-holding is not allowed, financial assets correspond either to the amount agents would put in a payment/savings account with their bank for future transactions purposes or to loans. We will be referring to this amount as "account balances" for short, and in fact positive account balances were chosen by most subjects. Moreover, we explain to them their task and the incentives scheme. In order to make sure that they understand the instructions, they are asked a few questions at the end of the instructions block immediately before the task starts. We include also a short training phase to allow subjects to familiarize themselves with the task and the screen appearance during the consumption/account balance task (Figure 2 reports a screenshot). This should avoid biased results due to a learning process in the first few periods.

We explain the task to subjects by making use of experimental tokens. The subjects' task consists in choosing how many tokens they want to spend to purchase points in each period. They are also told that this choice can imply debt up to a borrowing limit. They receive (pay) an interest rate on account balances (borrowing) in the form of tokens at the beginning of the next period. Moreover, we explain to them that their choice of tokens in each period is converted into points taking into account both the current period decision

Figure 3: Screenshot information to participants

and the maximum number of points that their current choice allows them to achieve in the remaining periods. We show them the function through which tokens chosen are converted into points (P):

$$P_t = -\frac{1}{2(Tokens_t)^2} + 0.96EP^r \tag{4}$$

where the term EP^r indicates the maximum number of points that can be achieved in the remaining periods with the financial assets set aside (positive or negative), while satisfying the budget and borrowing limits.

At the end of each experimental period, subjects observe a summary of the amount of tokens, the number of points purchased, the account balances and the their payoff (Figure 3).

Table 3: Treatments

	Cognitive load	**Furlough**
T1	No	No
T2	No	Yes
T3	Yes	No
T4	Yes	Yes

Notes. T1: control group; T2: furlough shock treatment; T3: cognitive load treatment; T4: combined furlough shock and cognitive load treatment.

Treatments. We have a control and three treatments (reported in Table 3)

- **T1-Benchmark**: it represents our control group, respondents make consumption/saving decisions only (according to the model).
- **T2-furlough shock treatment**: a furlough shock hits subjects during their working life. During this time window in every period t there is a probability $p = XXX$ that the shock occurs such that the agent's income equals 70% of the level of income in the period immediately preceding the shock.
- **T3-cognitive load treatment**: a permanent cognitive load hits in each and every period with random frequency.
- **T4-combined shocks treatment**: a combination of T2 and T3.

Notice that T2 serves as a treatment against the control group T1, in order to study the effects of the introduction of the furlough *per se* on subjects' decisions. T2 would also serve as a control group against T4, in order to study the impact of cognitive load in the presence of furlough. T3 serves as a treatment against the control group, in order to study the effects of the presence of cognitive load *per se* on consumption/saving decisions. T3 would also serve as a control group against T4, in order to study the impact of the introduction of furlough in the presence of cognitive load.

Cognitive load task. In treatments 3 and 4 the agents have to fulfil a cognitive load task, while making consumption/account balance decisions. The task is a *digit-search* task, similar to Greene et al. (2008). In each period, while deciding consumption, a sequence of numbers randomly drawn between 1 and 10 appears on the screen. Each number stays on the screen for a random number of seconds. The agent task is the following: If a number between 3 and 7 (both included) appears, she must press the space bar of the keyboard within 2 seconds. Hence, the agent makes a mistake when:

- she does not press the space bar within 2 seconds when the right number appears;
- she presses the space bar when the wrong number appears, that is a number that is not between 3 and 7.

Agents are told that mistakes in the task will impact their final payoff and payment (see below for more details).

Payoff function. We design the incentive schemes such that agents are required to maximize the utility function. Subjects are told that in each period the deviation of their choice from the choice of an agent that would behave rationally from t on determines their payoff. The deviation is:

$$x_t = \frac{P_t - P_t^r}{P_t^r} * 100\%$$

Moreover, we define the following payoff function:

$$PO_t = \begin{cases} 0.10 & \text{if } x_t \geq 100\% \\ 2.5 - 0.025x_t & \text{if } 0\% \leq x_t < 100\% \end{cases}$$

Hence, in each period we have that $0 \leq PO_t \leq 2.5$ Euro.

In treatments 3 and 4 we also compute the score in each t for the cognitive load task according to:

$$z_t = \frac{Tot_t - Errors_t}{Tot_t} * 100\%$$

Where Tot_t represents how many numbers were shown to you in period t; $Errors_t$ is the number of mistakes in period t. Hence, $0\% \leq z_t \leq 100\%$. With $z_t = 0\%$ indicating the agent made a mistake for every number shown in the cognitive load task, while $z_t = 100\%$ indicating she made no mistakes. Hence, the payoff function in treatment 3 and 4 is defined over life-time utility maximization and performance in the cognitive lad task:

$$PO_t = \begin{cases} 0.001z_t & \text{if } x_t \geq 100\% \\ (2.5 - 0.025x_t)0.01z_t & \text{if } 0\% \leq x_t < 100\% \end{cases}$$

Hence, in each period the payoff is between $0 \leq PO_t \leq 0.10$ euro if $x_t \geq 100\%$. While it is $0 \leq PO_t \leq 2.5$ euro if $0\% \leq x_t < 100\%$.

Moreover, in all treatments, we inform subjects that, at the end of the task, the computer will randomly draw 2 of the 20 periods and we will pay them the sum of the corresponding monetary payoffs for those two periods.

Background questions, in two blocks. In addition to implementing the consumption/saving task with or without cognitive load, we collect information on subject characteristics, in two blocks: one before the main task and the other after the main task is completed. These two blocks include standard demographic questions, together with respondents' socioeconomic background, such as income category, education attainment, religion, employment status, marital and family status. We elicit the subject's financial literacy, risk aversion (financial and non-financial), and time preferences. We also measure the tendency of subjects to rely on intuitive thinking using the Cognitive Refection Test (CRT) (Frederick, 2005), and we include some standard questions to elicit the respondent's degree of anxiety, procrastination, impulsivity and perseverance. Finally, we include some COVID-related questions, about their vaccination status and the current and expected impact of COVID on occupational status, health and finances.

To measure time preferences and estimate individual discount factors, we adopt the approach by Meier and Sprenger (2010). First, we present subjects with seven hypothetical choices from two multiple reward lists. Subjects have to decide between a smaller reward in period t and a larger reward ($y > x$) in period τ, where $y = 50\$$, while $x = [49\$, 47\$, 44\$, 40\$, 35\$, 27\$, 22\$]$. We present the same lists under two different time frames: a short-run time frame, in which t is the present and τ is in one month; a medium-run time frame, in which t is in six months and τ is in seven months.

We estimate the individual discount factors for the two time frames as $\beta_j = x^*/y$, where j indexes time frames. The short-run time frame is indexed by $(j = 1)$ and the medium-run by $(j = 2)$. x^* is the monetary choice corresponding to the point at which the participant switches from choosing the earlier payment to choosing the later payment, y. Finally, we characterize subjects as present (future) biased if $\beta_2 > \beta_1$ $(\beta_2 < \beta_1)$.

3 Differences in average group behavior

3.1 Consumption, account balances, and optimality

We first study the average differences across control and treatment groups for each model period and their evolution of the model life cycle. We focus on five average outcomes within each group. The first two are the average levels of consumption and of account balances chosen by subjects in each group, separately for each model period of life. This is useful, for example, in understanding the extent to which average consumption and account balances differ in the presence of cognitive load, or when labor market developments are introduced in the presence or in the absence of such load. The three other outcomes we study regard the average performance of our standard workhorse model of consumption and saving in approximating the behavior of people operating under cognitive load, furlough conditions, or a combination thereof, for each model period. These can also be thought of as indicators of departures from optimal behavior. We consider consumption deviations, but these mirror deviations from optimal account balances, given the exogenous labor income process. We go a step further and decompose the deviations from optimal consumption into two parts: one results from using a suboptimal policy rule when faced with a particular level of the endogenous state (account balances) at the start of the model period; the other is the part of deviation from optimality that results from having accumulated a suboptimal level of account balances but using the optimal policy rule for consumption. As we average across subjects in each model period to trace the evolution of outcomes over the life cycle of the model, the analysis in this section is informative but descriptive, in the sense that it cannot control for the socio-economic characteristics of subjects or their performance within the experiment. We control for such factors in the econometric analysis starting with section 4, where we focus instead on cross-sectional analysis of the average behavior and deviations of each subject i over all model periods.

Focusing for now on average group behavior in each model period, we construct the following measures involving root mean squared deviations and the IHS (arsinh) of consumption.

$$dev_t^m = \left\{ \frac{1}{N} \sum_{i=1}^{N} [\text{arsinh } C_{i,t}^m(a_{i,t}^r) - \text{arsinh } C_{i,t}^{xp}(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{5}$$

$C_{i,t}^m$ is the optimal consumption implied by the model for period t; $C_{i,t}^{xp}$ is consumption chosen by agents in the experiment for that period; dev_t^m is the average squared deviation between the (inverse hyperbolic sines of) the two measures of consumption across all subjects at time t. This provides a measure of the extent to which the theoretical model captures the consumption behavior of the actual subjects in the experiment.

$$dev_t^r = \left\{ \frac{1}{N} \sum_{i=1}^{N} [\text{arsinh } C_{i,t}^r(a_{i,t}) - \text{arsinh } C_{i,t}^{xp}(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{6}$$

$C_{i,t}^r$ is the optimal consumption agents should have optimally chosen in each t, given the endogenous state $a_{i,t}$ attained in the experiment, had they been rational from t onwards; dev_t^r is the average squared deviation between the (inverse hyperbolic sines of) this measure and the actual level of consumption chosen across all subjects at time t. This measures the extent to which subjects depart from optimal consumption implied by the model because they fail to optimize their chosen consumption level to the amount of cash on hand available to them at the start of the period. This can be thought of as the deviation in consumption behavior resulting from a suboptimal policy rule in period t.

$$dev_t^s = \left\{ \frac{1}{N} \sum_{i=1}^{N} [\text{arsinh } C_{i,t}^m(a_{i,t}^r) - \text{arsinh } C_{i,t}^r(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{7}$$

This measures the extent to which a rational optimizing agent would depart from the optimal level of consumption for that period implied by the model as a result of not having attained the model-implied optimal level of cash on hand in period t but rather the one observed in the experiment. In view of Bellman's principle of optimality, the policy rule of the fully rational model agent and the one where the agent optimizes from period t onwards, are the same ($C_{i,t}^m(.) = C_{i,t}^r(.)$).

We alert subjects to the importance of minimizing the policy rule deviation, we incentivize them, and we give them feedback on how they are performing in this respect. In essence, subjects get a fresh start in each period, conditional on the amounts of account balances they have accumulated up to then, and they are asked to make a consumption choice fully consistent with the rational workhorse model, taking into account optimal decisions from that time onwards. Under the Bellman principle of optimality, the policy rule a rational agent would choose in that period would be exactly the same as the one that was planned at the start of economic life, namely the "model" policy rule for that period. So, tracking this deviation over model periods records subject performance with respect to Bellman optimality as the experiment progresses, under different treatments. Correspondingly, tracking the deviation attributable to the suboptimal evolution of account balances (the endogenous state) indicates whether deviations from optimal consumption and additions to account balances in earlier model periods have a cumulative impact on deviations from model predictions or they are attenuated over model time.

3.2 Average group consumption and account balances

We start with an analysis of how the levels of consumption and of account balances, both in inverse hyperbolic sign (IHS or arsinh) differ across the control group and the different treatment groups. Figure 4 reports average consumption choices of subjects in each model period, distinguished by treatment. We see that average consumption choices of the subjects are highest in the control group, that does not operate under cognitive load or a threat of furlough, and this is true throughout the model periods ($T1$). The introduction of the possibility of furlough ($T2$) depresses consumption from early on, consistent with a precautionary motive, and consumption remains at a lower level on average throughout the model periods, even after subjects enter retirement and the threat of furlough is no longer present.

In $T3$, we introduce cognitive load without a threat of furlough. Average consumption experiences a downward shift relative to $T1$, again throughout the model periods, despite the absence of labor market changes and, of course, of any supply constraints that are absent from the model and the experimental setup. This suggests that a drop in consumption can be induced simply by subjects having more on their minds even without having to deal with labor market developments or with supply constraints.

$T4$ is the most demanding treatment, as it asks subjects to deal both with a cognitive load and a prospect of furlough. We see that, compared to $T2$ where only the furlough was present, subjects clearly depress their consumption on average, regardless of the model period. Thus, the imposition of cognitive load depresses average consumption both for people who are dealing with the possibility of furlough (those who cannot work online) and for those who can work online and do not face such labor market developments. Not surprisingly, those who cannot work online ($T4$) exhibit lower average consumption than those who can, for the most part of their model life.

Turning to Figure 5, we can see the treatment effects on average financial assets or account balances. Comparing $T2$ to $T1$, we see that the precautionary reduction in consumption resulting from the introduction of furlough without any cognitive load maintains is not sufficient to maintain average account balances at the same level for all of the working life following the occurrence of furlough, because of the income consequences of this development, but subjects choose on average to keep balances at roughly the same levels with those not experiencing furlough in the early part of working life and in the retirement periods.

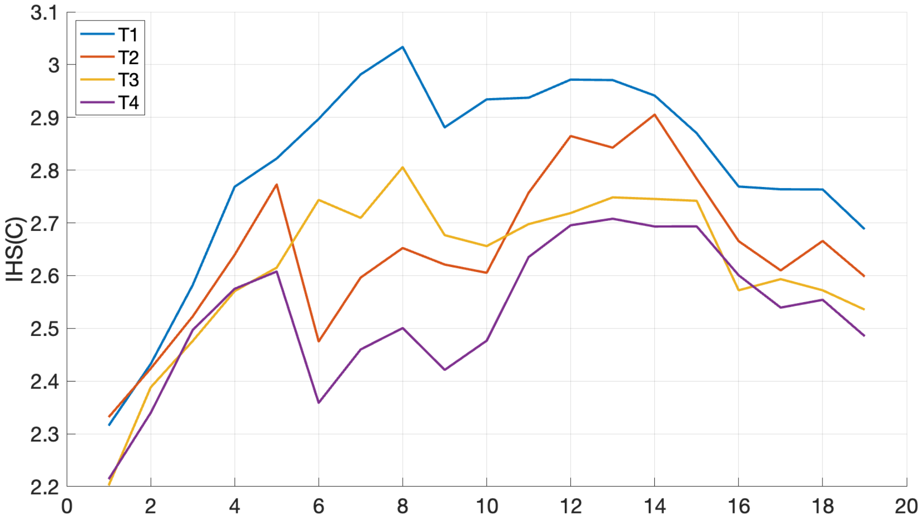

Figure 4: Average consumption (in IHS) per treatment.

Remarkably, the mere imposition of cognitive load without labor market consequences or supply constraints ($T3$ versus $T1$) generates a parallel upward shift in average account balances during model working life, and this increase widens during model retirement years. The same is true even under conditions of a furlough risk ($T4$ versus $T2$). In fact, the size of the upward shift is quite comparable for those who can work online and for those who cannot.

3.3 Average group deviations from optimality

We are interested in analyzing differences across treatments in the group average (root mean squared) deviation from optimal consumption in the model, dev_t^m, in the part coming from using a suboptimal consumption policy rule for the available level of the endogenous state (account balances), dev_t^r, and in the part attributable to attaining a suboptimal level of the endogenous state in period t but using the optimal consumption policy rule, dev_t^s. Results are shown in Figures 6 to 8.

Figure 6 shows that, in all cases, average deviations of actual subject consumption behavior from that implied by the workhorse model are fairly flat during working life but grow during the retirement years, as subjects typically tend to overaccumulate balances in the early model years and can afford to consume more during retirement than the

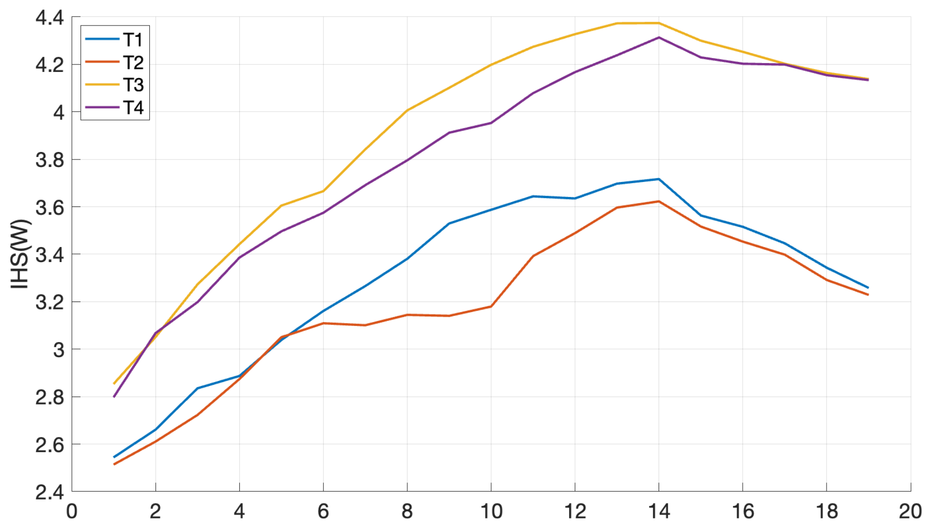

Figure 5: Average account balances (in IHS) per treatment.

model would imply. Introduction of the prospect of a furlough induces a parallel upward shift in average deviations of chosen consumption from the model, possibly associated with the more challenging task facing subjects. Remarkably, the imposition of cognitive load induces a bigger increase in deviations of actual consumption behavior from the model, and the observed deviations from the model are equally large, regardless of the presence or absence of the threat of furlough.

A comparison of Figures 7 and 8 shows that the largest part of the deviations from optimal behavior relative to model predictions arises from the use of a suboptimal policy rule for consumption given the level of account balances, rather than from the consequences of suboptimal account balances for optimal consumption behavior.

4 Regression analysis of treatment effects

4.1 Measures and specification

In this section, we report cross-sectional regression results regarding the magnitude and statistical significance of treatment effects on average consumption, account balances, and deviations from optimality of a subject across the model life cyle. The deviations from optimal behavior introduced in section 3 are now expressed as average deviations

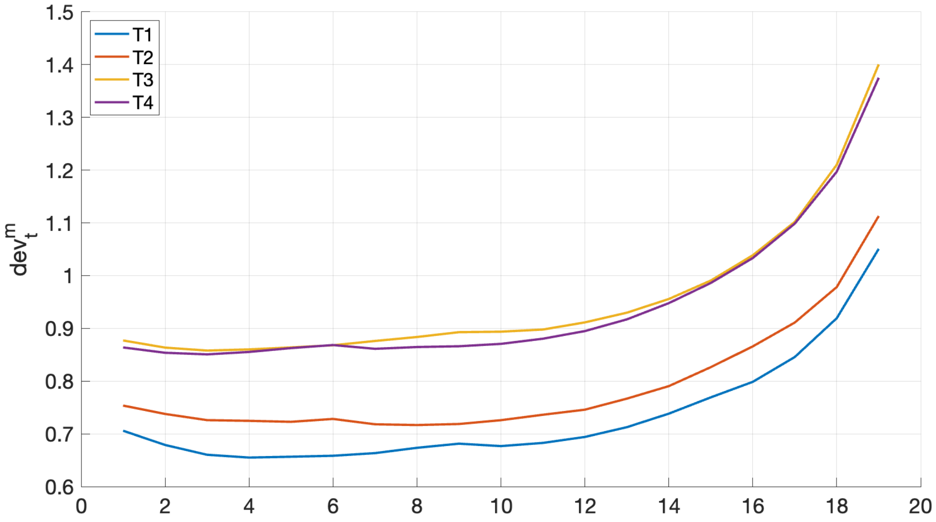

Figure 6: Average value of dev_t^m per treatment.

over the duration of the experiment for a given participant i, denoted by dev_i^m, dev_i^r, dev_i^s:

$$dev_i^m = \left\{ \frac{1}{T} \sum_{t=0}^{T-1} [\text{arsinh } C_{i,t}^m(a_{i,t}^r) - \text{arsinh } C_{i,t}^{xp}(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{8}$$

$C_{i,t}^m$ is the optimal consumption implied by the model for period t; $C_{i,t}^{xp}$ is consumption chosen by subject i for that period; dev_i^m is the average squared deviation between the (inverse hyperbolic sines of) the two measures of consumption chosen by subject i across all model time periods. This provides a measure of the extent to which the theoretical model captures the consumption behavior of subject i in the experiment (or, equivalently, the extent to which the consumption choices of subject i are consistent with optimal behavior based on the model).

$$dev_i^r = \left\{ \frac{1}{T} \sum_{t=o}^{T-1} [\text{arsinh } C_{i,t}^r(a_{i,t}) - \text{arsinh } C_{i,t}^{xp}(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{9}$$

$C_{i,t}^r$ is the consumption level subject i should have optimally chosen in t, given the endogenous state $a_{i,t}$ attained in the experiment, had the subject been rational from t onwards; dev_t^r is the average squared deviation between the (inverse hyperbolic sines of) this mea-

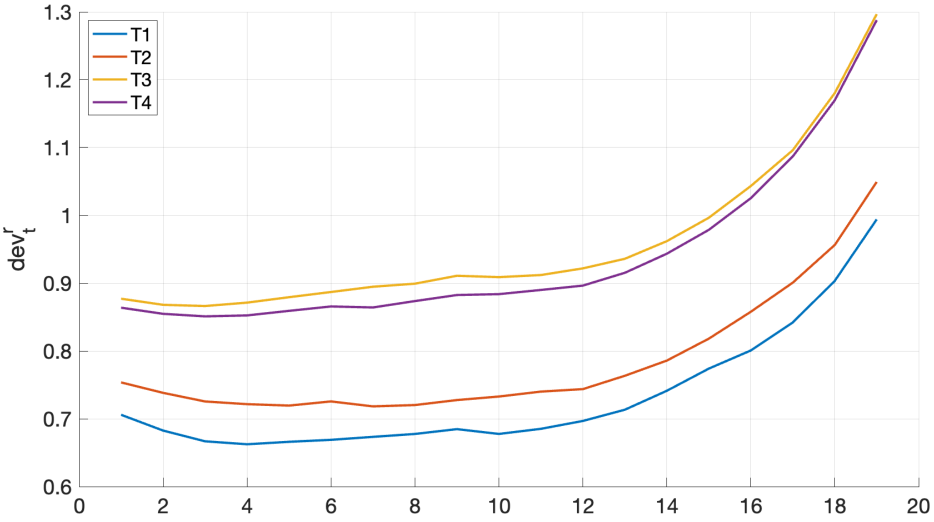

Figure 7: Average value of dev_t^r per treatment.

sure and the consumption level actually chosen by subject i across all experiment time periods. This measures the extent to which subject i departed from optimal consumption implied by the model because of a suboptimal policy rule.

$$dev_i^s = \left\{ \frac{1}{T} \sum_{t=0}^{T-1} [\text{arsinh } C_{i,t}^m(a_{i,t}^r) - \text{arsinh } C_{i,t}^r(a_{i,t})]^2 \right\}^{\frac{1}{2}} \tag{10}$$

This measures the average extent, across the model life cycle, to which a rational optimizing agent would depart from the optimal level of consumption implied by the model as a result of not having attained the model-implied optimal level of cash on hand in each period t but rather the one chosen by subject i in the experiment. In view of Bellman's principle of optimality, the policy rule of the fully rational model agent and the one where the agent optimizes from period t onwards are the same $(C_{i,t}^m(.) = C_{i,t}^r(.))$.

We run OLS regressions on T_i, i.e. a dummy variable equal to 1 if subjects belong to the selected treatment group and 0 if they belong to the chosen reference group, and we control for various subject characteristics. As we discuss the separate effects of different treatments, we vary the group chosen as the control group for the relevant comparison. So, T_2 versus T_1 refers to introduction of the furlough possibility in the absence of cognitive load, while $T4_2$ versus T_2 refers to introducing furlough when cognitive load is present.

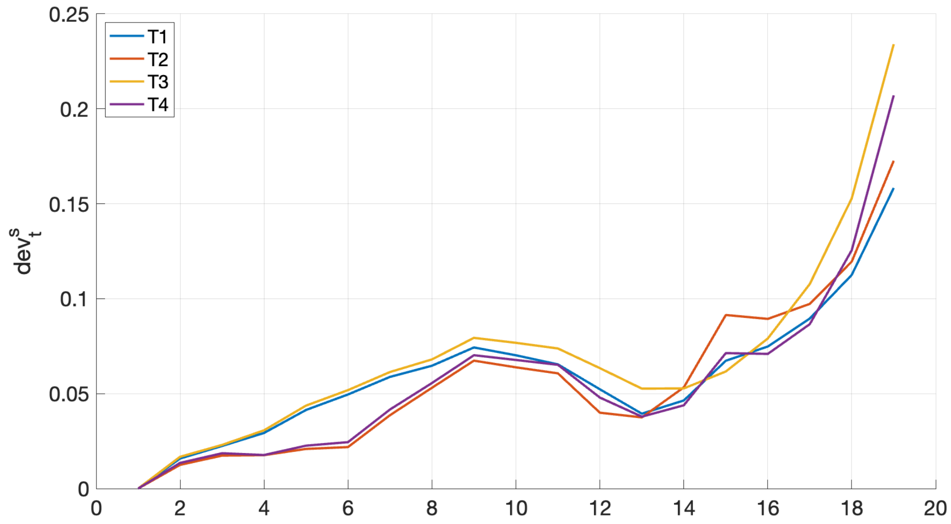

Figure 8: Average value of dev_t^s per treatment.

Our baseline model is as follows:

$$Y_i = \alpha_0 + \alpha_1 T_i + \beta \mathbf{Z}_i + \epsilon_i \tag{11}$$

where $\mathbf{Z}_i$ represents a vector of socio-demographic characteristics of the subjects: age group, gender, income group, educational attainment, work status, residential area, marital status, and religion as a proxy for culture. We expand this list with indicators of subject performance during the experiment in the robustness section below. The baseline findings are reported in Table 4.

4.2 The effect of furlough

Comparison of treatment $T2$ to the control $T1$ in Panel A finds a statistically significant negative effect on average consumption choices upon introduction of the furlough possibility in the absence of cognitive load, relative to those of a participant in the control group of similar socio-demographic characteristics. Such reaction of the subjects to the introduction of a possible furlough is appropriate, given the expected drop in lifetime income and the increase in background labor income risk, based on precautionary saving models that include the workhorse model employed here. The response of subjects to the

Table 4: Treatment effects

	(1) Consumption	(2) account balances	(3) dev_i^m	(4) dev_i^r	(5) dev_i^s
Panel A: T2 vs T1					
Treatment	-0.141***	-0.143	0.0494	0.0429	-0.0018
	(-6.81)	(-1.40)	(1.65)	(1.46)	(-0.96)
Observations	984	984	984	984	984
Adjusted R^2	0.049	0.026	0.003	0.002	0.004
Panel B: T3 vs T1					
Treatment	-0.145***	0.563***	0.232***	0.224***	0.0183***
	(-7.17)	(6.22)	(7.81)	(7.73)	(7.83)
Observations	913	913	913	913	913
Adjusted R^2	0.061	0.056	0.069	0.068	0.071
Panel C: T4 vs T2					
Treatment	-0.0914***	0.633***	0.171***	0.165***	0.006***
	(-4.30)	(6.53)	(5.95)	(5.92)	(3.54)
Observations	968	968	968	968	968
Adjusted R^2	0.016	0.045	0.033	0.033	0.020
Panel D: T4 vs T3					
Treatment	-0.0904***	-0.0885	-0.00984	-0.0151	-0.0135***
	(-4.40)	(-1.07)	(-0.35)	(-0.55)	(-6.15)
Observations	897	897	897	897	897
Adjusted R^2	0.027	0.003	0.005	0.005	0.051
Controls	Yes	Yes	Yes	Yes	Yes

Notes. OLS estimates of the treatment effect. All specifications control for age group, gender, income group, education attained, work status, residential area, marital status and religion. Robust standard errors in parentheses. $p < 0.10^{*}$, $p < 0.05^{**}$, $p < 0.01^{***}$

introduction of furlough risk is not only in the right direction but also by a magnitude that does not generate a statistically significant effect on average account balance choices over the model periods, nor on the average deviations of the subject's chosen behavior from the theoretical model.

4.3 The effect of cognitive load

Panel B in Table 4 shows that the introduction of cognitive load to subjects not facing furlough risk produces a significant effect across all observed outcomes. In fact, subjects who face cognitive load display both significantly lower consumption and greater account balances relative to subjects with comparable socio-economic characteristics who do not face such cognitive load. Interestingly, this combined effect on consumption and account balances is not only in accordance to the respective changes observed during the onset of the Covid crisis, but it is also observed in the absence of any perceived supply constraints (e.g., of the type associated with lockdowns) nor with any changes in future borrowing constraints. The effects are also quantitatively significant, representing on average reductions of 14.5% in consumption and increases of 56.3% in chosen account balances across the run of the experiment.

We find that participants subjected to that load deviate more from the model on average. This is to be expected, as the model does not incorporate any effect of cognitive load, but there is a statistically significant effect on all three deviations considered. While most of the induced deviation is reflected in the use of a model-suboptimal policy rule for consumption, there are also statistically significant effects arising from a suboptimal evolution of the account balances that would have affected consumption even if the model-implied consumption rules were followed by subjects. These findings suggest that cognitive load represents a factor accounting for significant deviations of observed consumption and account balances behavior from what could have been expected on the basis of models estimated over periods in which cognitive load was not present or not as widespread. This deterioration in performance comes from the demand side and not from any additional restrictions to behavior arising from supply bottlenecks or lending restrictions imposed by the financial sector.

4.4 The effect of cognitive load under furlough

Do our findings imply bigger or smaller effects of cognitive load among subjects facing the prospect of furlough? This question is relevant for the part of the population that cannot work online in the Covid crisis, for example. To answer this question, we compare treatments $T4$ and $T2$ in Panel C. We find that in this case, too, the effect of introducing cognitive load is statistically significant throughout the five outcomes we consider. Introducing cognitive load on top of the prospect of a furlough depresses consumption by 9% on average in our experiment,and increases average money holdings by about 63%. This worsens the performance of the workhorse model in capturing the consumption behavior of subjects, with both policy-rule deviations and suboptimal evolution of the endogenous state contributing significantly to this. So, cognitive load is important regardless of whether subjects are available to work online or face the possibility of furlough. However, comparing Panel C to Panel B, we see that the percentage average drop in consumption among people who already moderate their consumption in response to the furlough is estimated to be lower and the increase in average account balances higher. Moreover, the increase in all three model-related deviations generated by cognitive load is smaller when the model incorporates the prospect of a furlough than when it does not.

4.5 The effect of furlough under cognitive load

Our experiment further allows us to examine the effects of introducing the prospect of furlough in the presence of cognitive load (Panel D) and to compare these to what happens when furlough is introduced in the absence of cognitive load (Panel A). Panel D shows that subjects facing furlough in addition to cognitive load tend to reduce their average consumption significantly (by about 9%), but less so than comparable subjects do in the absence of cognitive load (14%). Moreover, the response of subjects to furlough under cognitive load triggers significant average deviations from the model that are related to a suboptimal evolution of the endogenous state, namely account balances, while no such significant contribution to deviations from optimality was observed in the absence of cognitive load (Panel A). Thus, our findings suggest that cognitive load contributes to a muted reaction of consumption to the prospect of furlough and a significant deviation from workhorse model consumption arising from a suboptimal evolution of account balances. Nevertheless, we do not find evidence that an introduction of furlough (which enters both people's minds and the model) leads to significant deviations of participant behavior from overall model implications for consumption, regardless of the presence or of the absence of cognitive load.

4.6 Robustness to additional controls

We have examined robustness of the above findings on the size, direction, and statistical significance of treatments for the five outcomes under consideration to controlling for the behavior of subjects during the experiment. We have retained all socio-economic controls used in the base regression analysis, namely age group, gender, income group, education attained, work status, residential area, marital status and religion. We have also added (in turn, and then all together) further controls for whether the subject reported not having answered randomly at any point during the survey (Non-random responses), the average time spent in each model period in the task (Time), and the normalized score in the questions aimed at controlling the understanding of the instructions (CQ score). Results are reported in Tables B1 to B5, starting with treatment effects on the IHS of consumption and ending with treatment effects on the deviation from model consumption that arises from suboptimal account balances, dev_i^s.

With one exception, allowing for the behavior of subjects during the experiment does not alter our conclusions regarding the size, direction, and statistical significance of the treatments considered in Table 4. The only exception suggests additional significant treatment effects. Introducing the prospect of furlough ($T2$ versus $T1$) now has a positive and statistically significant effect on the deviation of consumption behavior from the theoretical model, dev_i^m, and on the part of this deviation associated with a suboptimal policy rule for consumption, dev_i^r. Both of these deviations from optimal behavior were significantly mitigated, in treatment and in control group, by spending more time performing the experimental tasks on average, and by having stated that there was no point in the experiment where choices were made at random. Controlling for such factors essentially compares subjects that were similar in these respects as well, and yields significant treatment effects of furlough not only on consumption but also on model and policy rule deviations, even in the absence of cognitive load.

As regards other treatments and the associated outcomes, where results are essentially unchanged, we find that the average time spent on the task, giving non-random responses, and having better understanding of the instructions are occasionally significant, in the direction of reducing deviations from model implications in treatment and in the control group. This suggests that average time spent is an indicator of engagement with the problem rather than of difficulty with the execution of the task. When significant, better understanding of the experiment (higher CQ) contributes to lower consumption and higher account balances. A longer average time spent tends to raise consumption choices (rarely) and to lower account balances (in several cases) across treatment and control groups. Finally, non-random responses tend to lower account balances but they are only significant in one case for (raising) consumption. All in all, these robustness exercises tend to confirm our baseline findings and to suggest that greater engagement and understanding of the subjects led them to exhibit smaller deviations from the behavior prescribed by the workhorse model.

4.7 The role of household heterogeneity

In this section, we explore whether the effects of our treatments on consumption and account balances, as well as on deviations from the model, tend to be more or less pronounced for participants with particular individual characteristics. We adopt an exploratory approach, augmenting the estimation model in Equation (11) through an interaction term of the treatment dummy, T_i, with one of a series of individual level socio-demographic factors, preferences and attitudes in turn. Table 5 reports the runs in which the interaction term was significant for at least one of the five outcome variables.

In panel A, we find only scattered significant effects, suggesting that heterogeneity does not play a major role in the response of subjects to the introduction of the prospect of furlough in the absence of cognitive load or even to the introduction of cognitive load for people who do not simultaneously face the furlough. By contrast, panel B provides evidence of a significant role of college education and of short-run patience in shaping

Table 5: Treatment effects with interactions

	(1) Consumption	(2) account balances	(3) dev_i^m	(4) dev_i^r	(5) dev_i^s
Panel A: T2 vs T1					
Treatment x CRT		0.217**			
		(2.23)			
Observations	984	984	984	984	984
Panel B: T4 vs T2					
Treatment x CRT		-0.183**			
		(-2.11)			
Treatment x FL		-0.224*			
		(-1.95)			
Treatment x β_1	-0.205***		0.252**	0.243**	0.0177***
	(-2.62)		(2.26)	(2.25)	(2.69)
Treatment x β_2					0.0164**
					(1.99)
Treatment x aged 41-65		0.403**			
		(1.99)			
Treatment x College	0.0763*		-0.122**	-0.119**	
	(1.83)		(-2.17)	(-2.17)	
Observations	968	968	968	968	968
Panel C: T4 vs T3					
Treatment x β_1	-0.178**		-0.174*		0.0182**
	(-2.25)		(-1.72)		(2.15)
Treatment x F-bias	-0.140**		0.164**	0.160**	0.0148**
	(-2.48)		(2.15)	(2.15)	(2.55)
Observations	897	897	897	897	897
Controls	Yes	Yes	Yes	Yes	Yes

Notes. OLS estimates of the treatment effect, interacted with the score in the Cognitive Reflection Test (CRT), a dummy equal to 1 if subjects are present-biased (P-bias), the financial literacy score (FL), the short-run discount factor (β_1), the medium-run discount factor (β_2), the age category (= 41–65), a dummy equal to 1 if subjects have college education (College), a dummy equal to 1 if subjects are future-biased (F-bias). Significant coefficients only. All specifications control for age group, gender, income group, education attained, work status, residential area, marital status and religion. Robust standard errors in parentheses. $p < 0.10^{*}$, $p < 0.05^{**}$, $p < 0.01^{***}$

responses to cognitive load among those who face the prospect of furlough. College educated subjects facing treatment $T4$, and thus cognitive load as well as furlough, tend to lower their consumption less in response to cognitive load than their less educated counterparts in the same treatment; and to exhibit a smaller deviation from optimal model behavior and from the optimal consumption rule under conditions of furlough. On the other hand, those who exhibit greater short-term patience (a larger one-period-ahead discount factor) tend to respond to cognitive load by lowering their consumption even more than their less patient counterparts in $T4$, in a manner that makes their behavior depart even more from the prescriptions of the model, mostly but not solely because of departures from the optimal policy rule for consumption.

Interestingly, financial literacy per se, as measured by our indicator, does not seem to have pervasive effects. It registers a significant moderating effect on the upward response of account balances to the introduction of cognitive load among subjects facing furlough, but even this fails to generate significant departures from model-implied optimal behavior in the presence of the furlough prospect.[4]

Finally, panel C indicates that both short-run patience and forward bias play a significant role in shaping the reaction of subjects to introduction of furlough in the presence of cognitive load. The more patient and the forward-biased subjects facing cognitive load tend to lower consumption more when also faced with furlough, and to deviate more from model-implied optimal behavior, mostly in terms of the consumption policy rule.

In the Appendix, we also consider whether measured risk aversion of the experimental subjects influences the effect of each treatment on the ability of the model to explain subjects' choices, both as a whole and in the decomposition of policy rule versus endogenous state. We find no statistically significant interaction of measured risk aversion with any of the treatment effects on overall deviation from model behavior and on the deviation from the model policy rule (Table B6). This is also true for deviations resulting from the evolution of the endogenous state, but with three small exceptions of low statistical significance.[5]

[4]A similar reaction is registered by CRT, proxying for intuitive thinking, while an opposite and more sizeable effect is observed among subjects aged 41-65 relative to the youngest group.

[5]High risk aversion boosts the treatment effect of introducing furlough prospects in the absence of cognitive load; and high and low risk aversion tend to reduce the deviation resulting from the endogenous state when furlough is imposed on top of cognitive load. The statistical significance level is 10% in all cases

5 Conclusions

In this paper, we design and conduct an incentivized online experiment among a representative sample of 2000 households in France to investigate whether and how the presence of a taxing and persistent cognitive load and its interaction with adverse labor market shocks tend to impact the consumption, saving, and borrowing choices and to interfere with attainment of life-cycle objectives. In addition to overall results, we also investigate whether the effects tend to be more pronounced for people with any of a rich array of socio-economic characteristics, and how they relate to the way in which subjects engage with the experiment.

Our approach allows us to compare the effects of cognitive load in the absence and presence of furlough risk; and of furlough in the absence and presence of cognitive load. The approach also allows a decomposition of departures from model-implied optimality into the part associated with a suboptimal consumption policy rule and that resulting from a suboptimal evolution of the endogenous state (account balances).

Cognitive load has a significant downward effect on chosen consumption and an upward effect on chosen account balances, with the former being proportionately bigger for online workers and the latter being more pronounced for workers facing furlough. The treatment and control groups are chosen so that these effects of cognitive load are in addition to any effects that furlough per se has, and they do not arise from supply constraints or worsening of borrowing constraints. Moreover, cognitive load worsens the ability of the workhorse model to describe consumption behavior, both in terms of policy rule and in terms of the underlying endogenous state, with such effects being proportionately bigger for those who do not face furlough, such as online workers.

In our analysis of subject heterogeneity, we find that college educated subjects facing cognitive load as well as furlough tend to lower their consumption less in response to cognitive load and to exhibit a smaller deviation from optimal model behavior and from the optimal consumption rule. On the other hand, those who exhibit greater short-term patience (a larger one-period-ahead discount factor) tend to respond to cognitive load by lowering their consumption and deviating from the model and the optimal policy rule even more than their less patient counterparts. Interestingly, financial literacy per se, as measured by our indicator, does not register pervasive significant effects in our experiments.

In the absence of cognitive load, the introduction of furlough risk tends to reduce chosen consumption, as implied by precautionary models, but does not lead to significant deterioration of the model's ability to explain behavior. The presence of cognitive load, however, moderates the downward effect of furlough on consumption. The more patient and the forward-biased subjects facing cognitive load tend to lower consumption more when also faced with furlough, and to deviate more from model-implied optimal behavior, mostly in terms of the consumption policy rule.

Our findings on lower consumption, higher balances, and model deviations induced by cognitive load even in the absence of supply constraints or uncertainty about future borrowing limits, and across people who face or do not face labor market consequences, have potentially important implications both for the Covid crisis and for other crises that significantly occupy people's minds.

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