Pandemic-induced wealth and health inequality and risk exposure

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- Views expressed here are those of the authors.

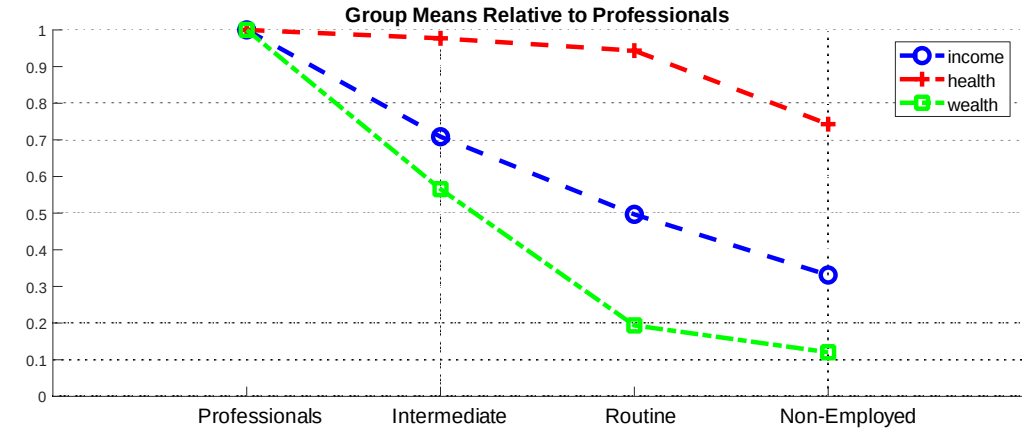
Wealth and health inequality before the pandemic

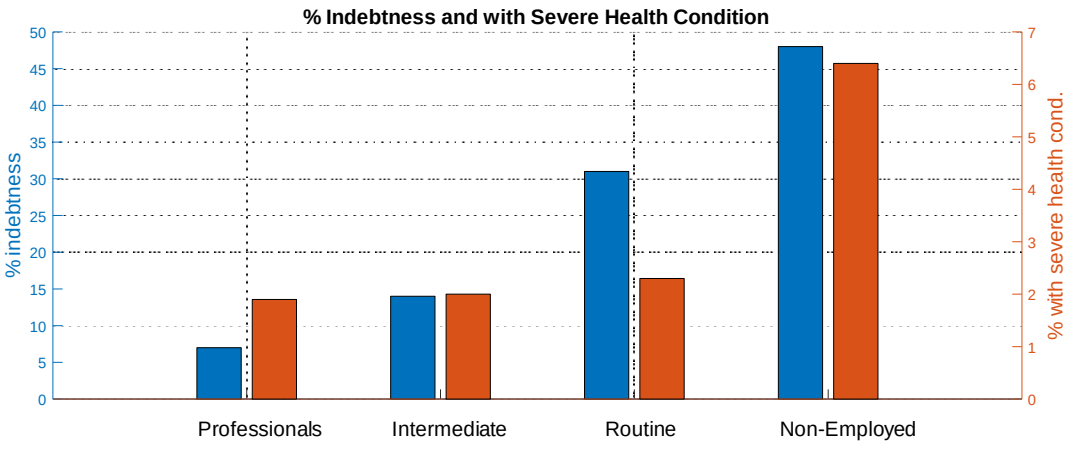
- Wealth inequality is relatively high in the UK. An important characteristic of the distribution of wealth is that there is a high proportion of households with very low (or zero) wealth (around 18%).
- The UK is also characterised by pronounced health inequality (e.g. **Marmot (2004)**, **Semyonov et al. (2013)**, **Payne (2017)**), evident in the association between health and income/wealth/social class.

- Since health and wealth are related, households with low wealth (and low health) consist an important group of vulnerable consumers.

- So, in times of crises, their potential for consumption and good health is *threatened*.

Figure 1: "Bird's eye view" of Inequality pre-COVID-19





- Households with heads who are of working age. Data sources: Understanding Society (waves 1-9); Wealth and Asset Survey (waves 1-5).

Post-pandemic inequality and risk exposure

- Pandemics create health and economic crises that affect households in **an unequal manner**.
- The short run inequality implications of the first waves of COVID-19 have been examined in several studies (e.g. **Stantcheva (2021)** for a review, **Marmot et al. (2020)** focusing on health inequality, **Tenreyro (2021)** for the short run effects in household deposits).
- Given the **persistence** of wealth and health, **pandemic-induced increases** in wealth and health inequality, and their implications, **can last for several years**.

Post-pandemic inequality and risk exposure

- Increased inequality can be further **amplified** by potential recurrent outbreaks that follow the main pandemic waves (e.g. **Kissler et al. (2020)**, **BMJ (2021)**, **Nature (2021)**, focusing on COVID-19, and **Schroeder et al. (2023)**.

- Recurrent outbreaks may occur due to re-introduction of the virus, new variants, waning immunity, human behaviour (e.g. vaccine refusal), or population turnover leading to reductions in population-level immunity (e.g. Anderson and May (1991)).

This paper

Focusing on the **UK working age households**, we study:

- the pandemic-induced changes in health and wealth across households over the **medium-run**
- the dependency of these changes on different **pre-pandemic conditions**
- the implication for the **vulnerability to income risk** for a part of the society

Literature

- COVID-19: there is a vivid literature of the *short-run effects* of the pandemic on economic outcomes (to name some Alfaro et al., 2020; Alvarez et al., 2020; Guerrieri et al., 2020; Bayer et al., 2020; Carvalho et al., 2020; Hacioglu et al., 2020; Kaplan et al. 2020; Miescu and Rossi 2021).

- Wealth and health inequality: Capatina (2015), Hosseini, Karen Kopecky, and Kai Zhao (2021) (but health is exogenous, but the households buy health insurance)

Model

- Households derive utility from both consumption and health and choose the levels of two state variables, health and wealth, in response to household-specific shocks to income and health that they experience and the risk of future shocks.
- Labour income (post policy) follows an exogenous process calibrated to UK data. Households belong to different socioeconomic groups, defined by professions, and the transitions between groups are stochastic. Socio-economic groups matter for both income and shocks to health, and the underlying joint distirbution is calibrated to match UK data.
- Households use their income from labour and assets for consumption, savings that increase future wealth, and expenditure that improves future health.

Model

- A household aims to maximise expected lifetime utility, which is a function of consumption and wealth:

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, h_{t+1}), \tag{1}$$

where c_t is consumption, and h_t is the level of health of the household (average level of health across members).

Model

- The budget constraint is given by:

$$c_t + a_{t+1} + x_t = (1 + r(z_t))a_t + w(e_t, z_t), \qquad (2)$$

where $a_t \geq a^{\min}$, $0 \leq c_t \leq c^l(z_t)$; z_t is a stochastic process capturing the aggregate state (e.g. an outbreak); $r(z_t)$ is the rate of return; $e_t = (n_t, l_t, s_t)$ includes household-specific shocks: n_t and l_t determine the highest profession of the household (n_t) and remaining variation in income between households (l_t), and s_t is a household-specific health shock.

- The idiosyncratic (household-level) shocks (n_t, l_t, s_t) are correlated, and depend on the aggregate state z_t.

Model

- Health evolves according to:

$$h_{t+1} = \delta(s_t, z_t) h_t + m(x_t), \tag{3}$$

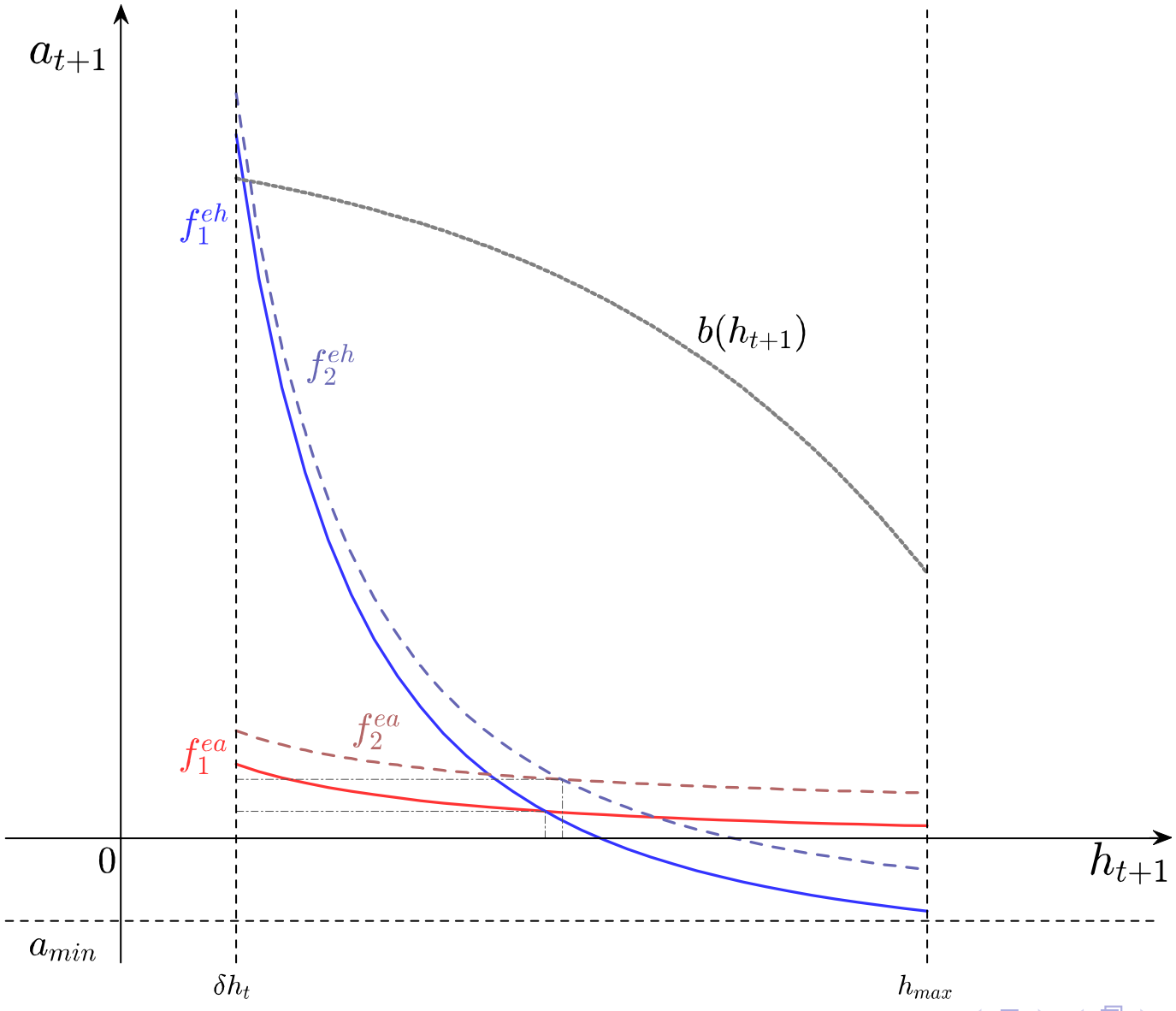
where $\delta(s_t, z_t)$ denotes stochastic health persistence and captures the effects of adverse health shocks that work to increase the rate at which health deteriorates.

- The function $m(x_t)$ captures improvements in health via own activity (x_t).

Theoretical Results: Health and wealth are substitutes in responses to pandemic

- Despite a positive cross-sectional relationship between health and wealth, household behaviour incorporates incentives to treat wealth and health as substitutes in:
  1. smoothing consumption (i.e. reducing wealth and/or investing less in health) following negative income shocks
  2. precautionary motives to mitigate risk
- A bigger response in wealth (health) is met by a smaller response in health (wealth) - implying that for some changes and for some housholds health and wealth) may change in the opposite direction.

An example of loci of combinations of choices (an increase in the *rhs* r.t.t lhs)



Model: distributions

- As individuals experience different histories of shocks, a cross-sectional distribution of wealth and health emerges. When and evolves over time depending on the evolution of z_t, i.e. on outbreak occurence.

- The cross sectional distribution of households over the joint state space of household-level state variables, $A \times H \times E$, which is denoted by $\lambda_t \left(a_t, h_t, e_t; z_t\right)$ changes over time as a result of time variation in the aggregate state z_t.

Stationary equilibrium: The pre-COVID-19 economy

Model outcomes for health and wealth

	Health				Wealth					
	Mean		Gini		Mean		Gini		% in debt	
Soc. Gr.	model	data	model	data	model	data	model	data	model	data
Prof.	0.75	0.72	0.08	0.05	1.88	1.91	0.45	0.60	8%	7%
Inter.	0.69	0.71	0.09	0.07	1.01	1.08	0.54	0.66	14%	14%
Rout.	0.63	0.68	0.10	0.08	0.47	0.37	0.65	0.80	33%	31%
N-emp	0.59	0.57	0.11	0.18	0.31	0.23	0.74	1.01	40%	48%
All.	0.68	0.68	0.10	0.09	1	1.00	0.59	0.71	19%	19%

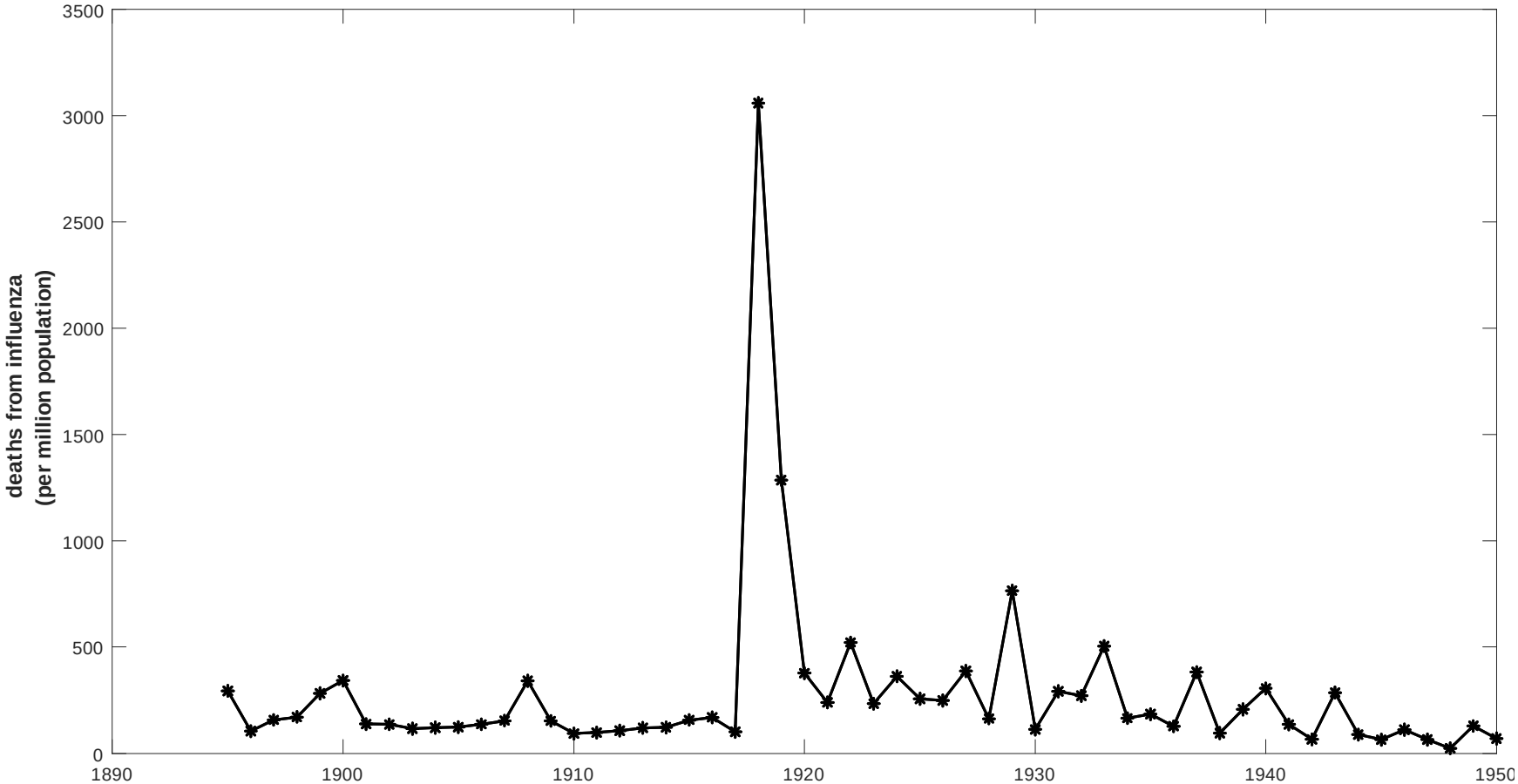
Notes: Mean of wealth is relative to mean for all households; % in debt refers to the share of households with zero or less than zero assets.

calibration details

Post-pandemic dynamics

- We assume that COVID-19, which happens in 2020, is a surprise shock that impacts income, changes risk and implies lock downs (consumption cap).
- The period after 2020 is characterised by epidemiological uncertainty: there is uncertainty about whether there will be recurrent outbreaks. Households make choices taking into account this uncertainty.

Death rate from influenza (average across eight cities from UK)



- Source: Schroeder et al. (2023), "An extended period of elevated influenza mortality risk follows the main waves of influenza pandemics", Social Science & Medicine

The aggregate state transition matrix

Q_Z :

$z_t \backslash z_{t+1}$	C	R	U	O
C	0.5	0.143	0.357	0
R	0	0.263	0.658	0.079
U	0	0.263	0.658	0.079
O	0.027	0	0	0.973

C : Health and economic crisis

R : Minor disease outbreak

U : Ordinary but with risk of an outbreak

O : Ordinary times

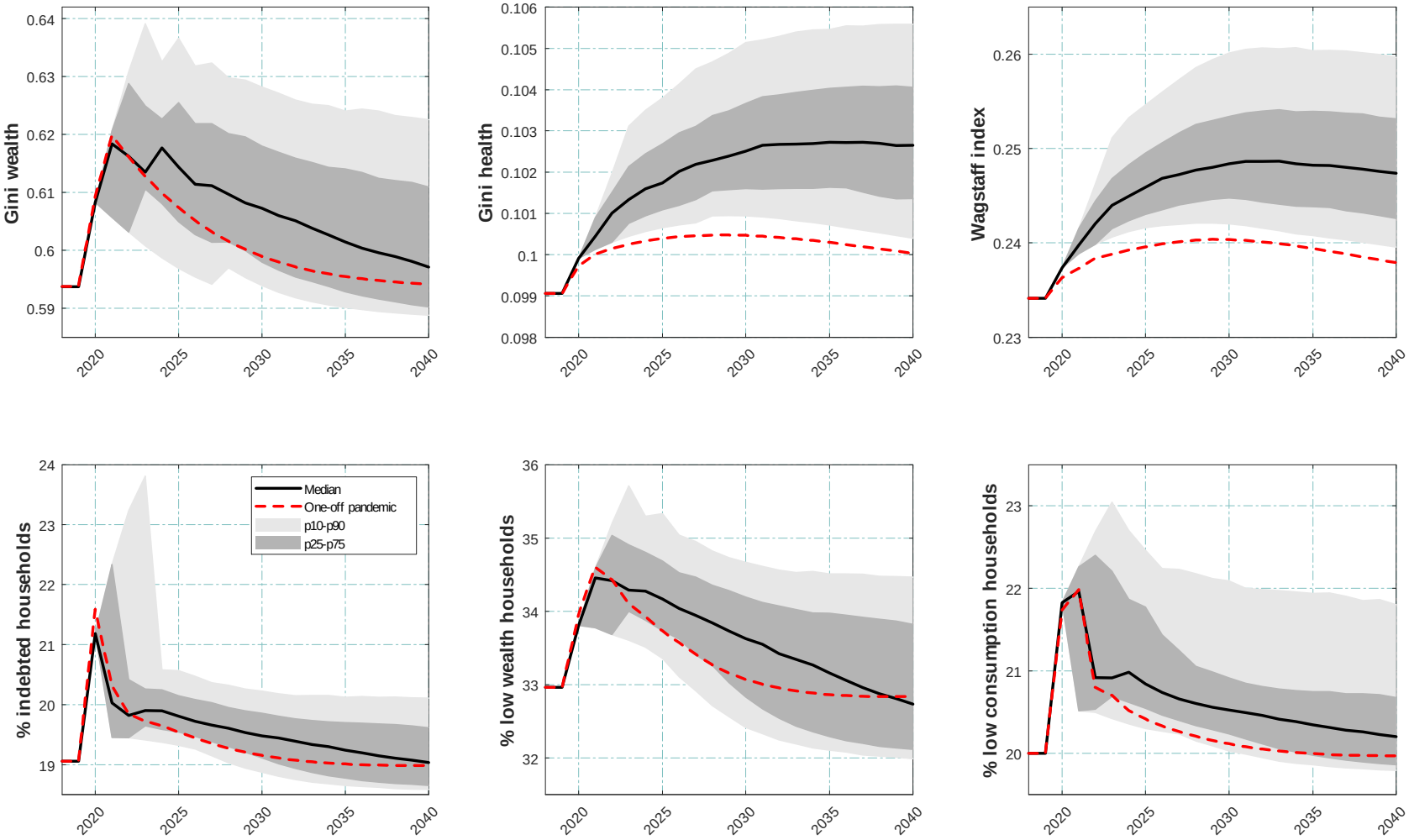
The aggregate state transition matrix

- Prob(from C to R or U): We set the expected duration of the pandemic period C to two years, which is in line with the main waves of the 1890-91 and 1918-19 pandemics and expectations about the COVID-19 pandemic.
- Prob(from R or U to O): We employ a Markov switching model to estimate the probability of exiting the post-pandemic period of recurrent outbreak risk to be 7.9%, implying an expected duration of 12.66 years.
- Prob(from O to C): estimated from the Markov switching model, 2.7%, implying a pandemic roughly every 35 years.
- We set the probability of an outbreak, conditional on being in the post-pandemic period, to 28.6%, using estimates from the post-COVID-19 model predictions for outbreaks exceeding 500 deaths in Schroeder *et al.* (2023).

Calibration of epidemiological shocks

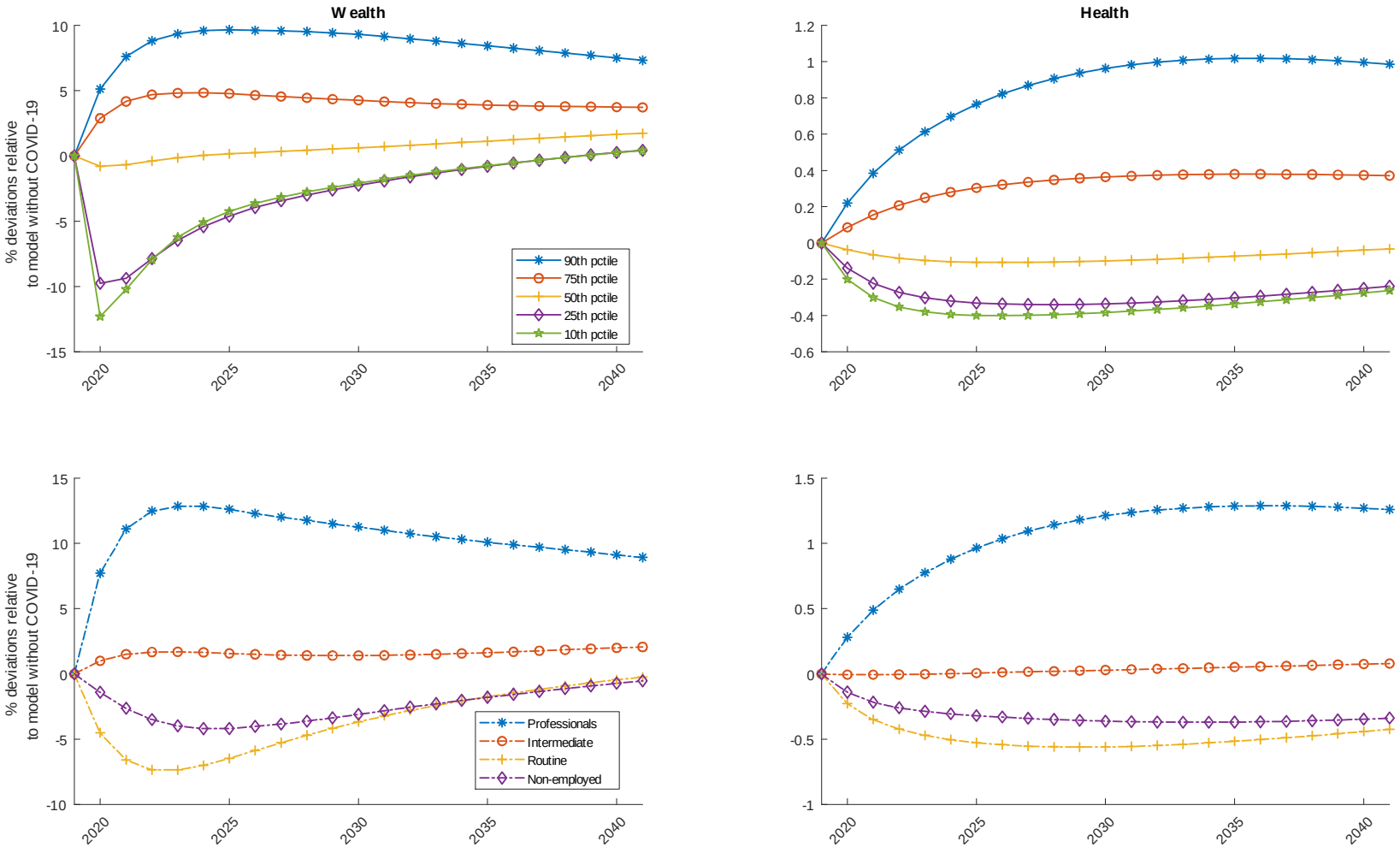
- **Progressive** post-policy income drops for 2020 were obtained from the HM Treasury distributional model (but **slightly regressive** in terms of total available resources).
- An increase in health risk (probability of receiving a severe health shock), reflecting **excess mortality** and r**eduction in patient treatment** (Roser *et al.* (2020), Gardner and Fraser (2021)).
- A **consumption limit**, motivated by economic restrictions, to match the observed change in consumption/savings for the top quintile (Hacioglu-Hoke *et al.* (2021), Tenreyro (2021), Davenport *et al.* (2020)).

Results (1): Wealth inequality implications of COVID-19



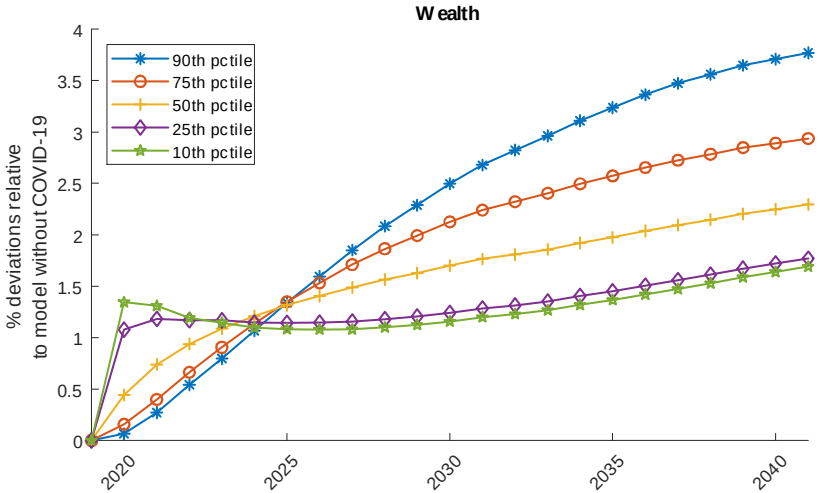
- Wealth/health inequality increase (despite a progressive drop in incomes). This also reflects changes in the left tail of the wealth distribution.

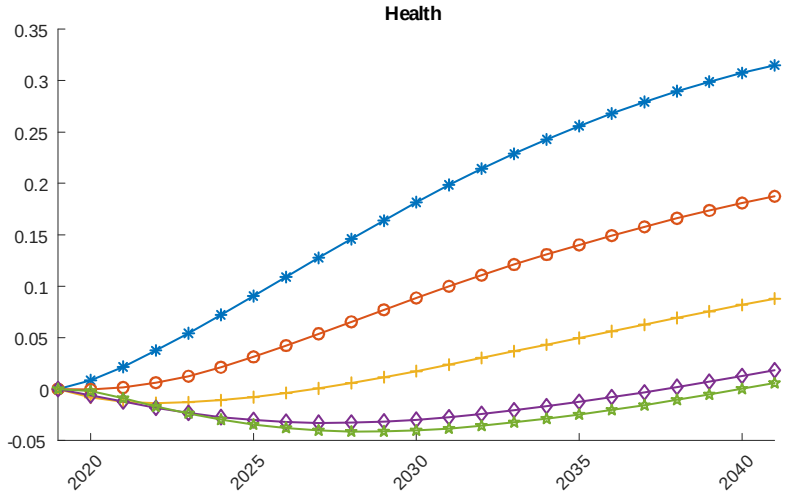
Results (2): Changes by initial wealth and socio-economic group

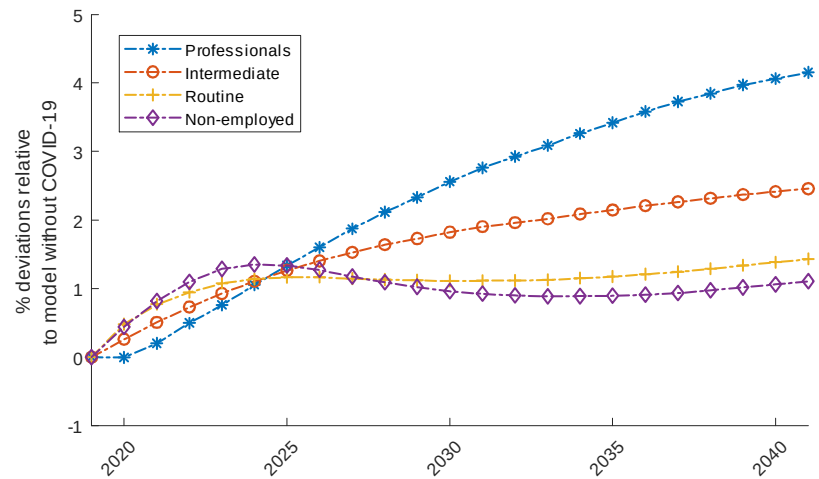


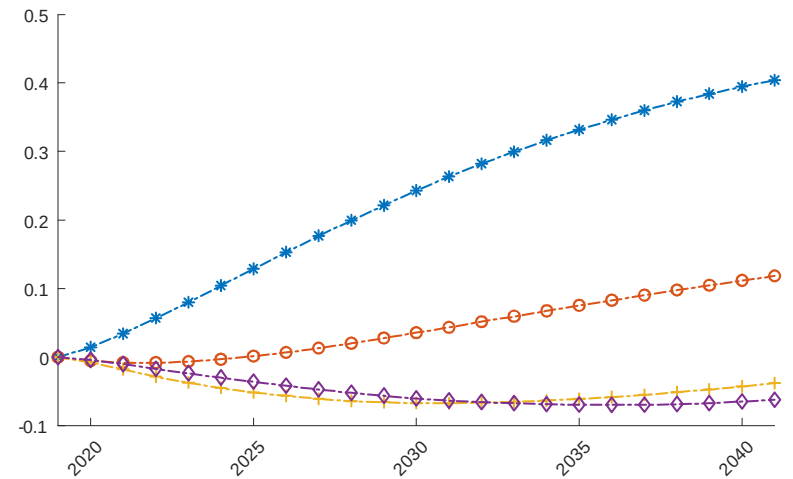
- Drop in wealth for those with low initial wealth reduces their means to mitigate future income shocks, thus putting them under pressure to reduce health promoting activities in the medium run to instead recover wealth buffers. Health declines persist longer.

Results: precautionary motives

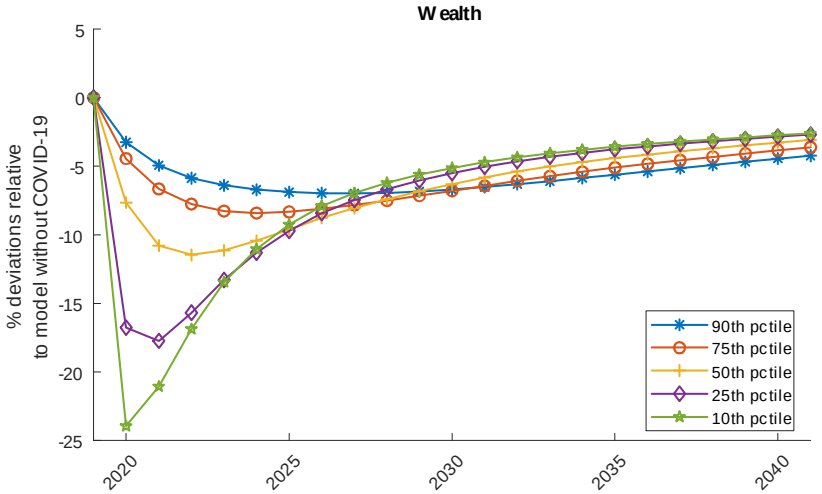


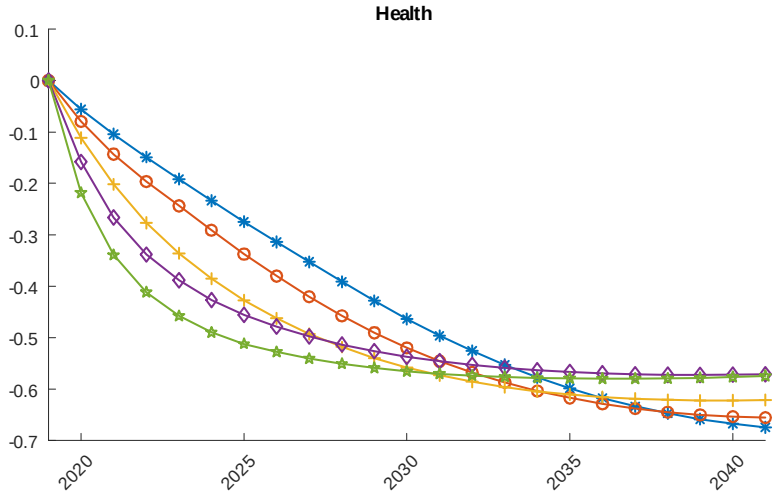


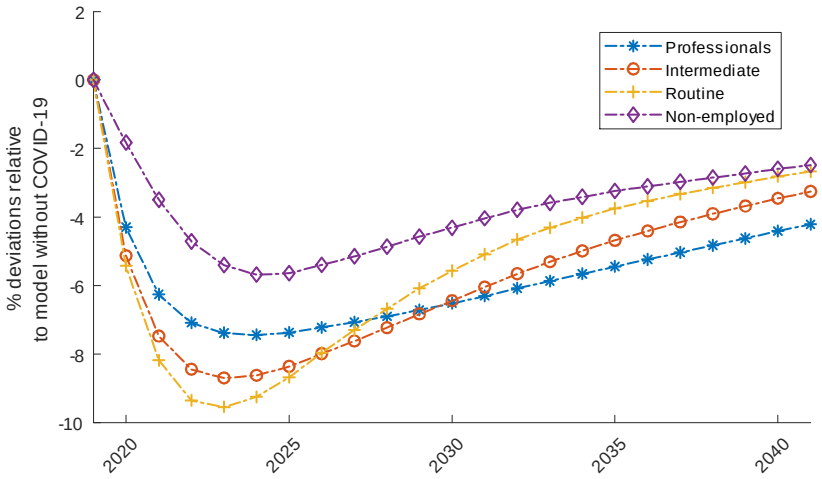


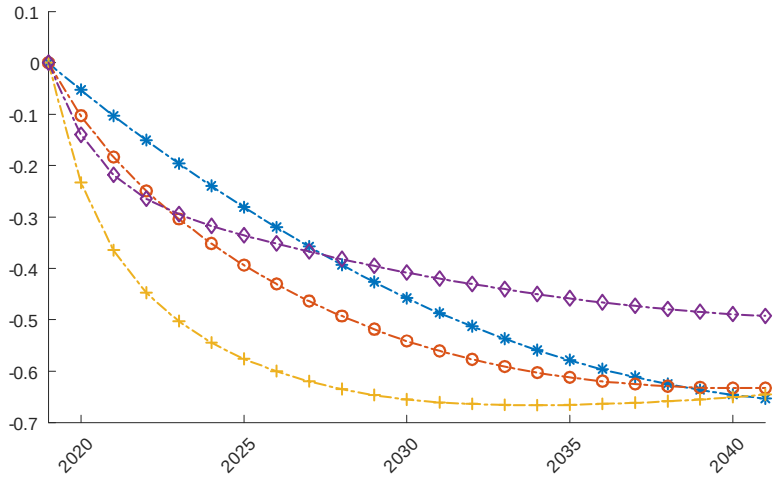


Results: without consumption cap

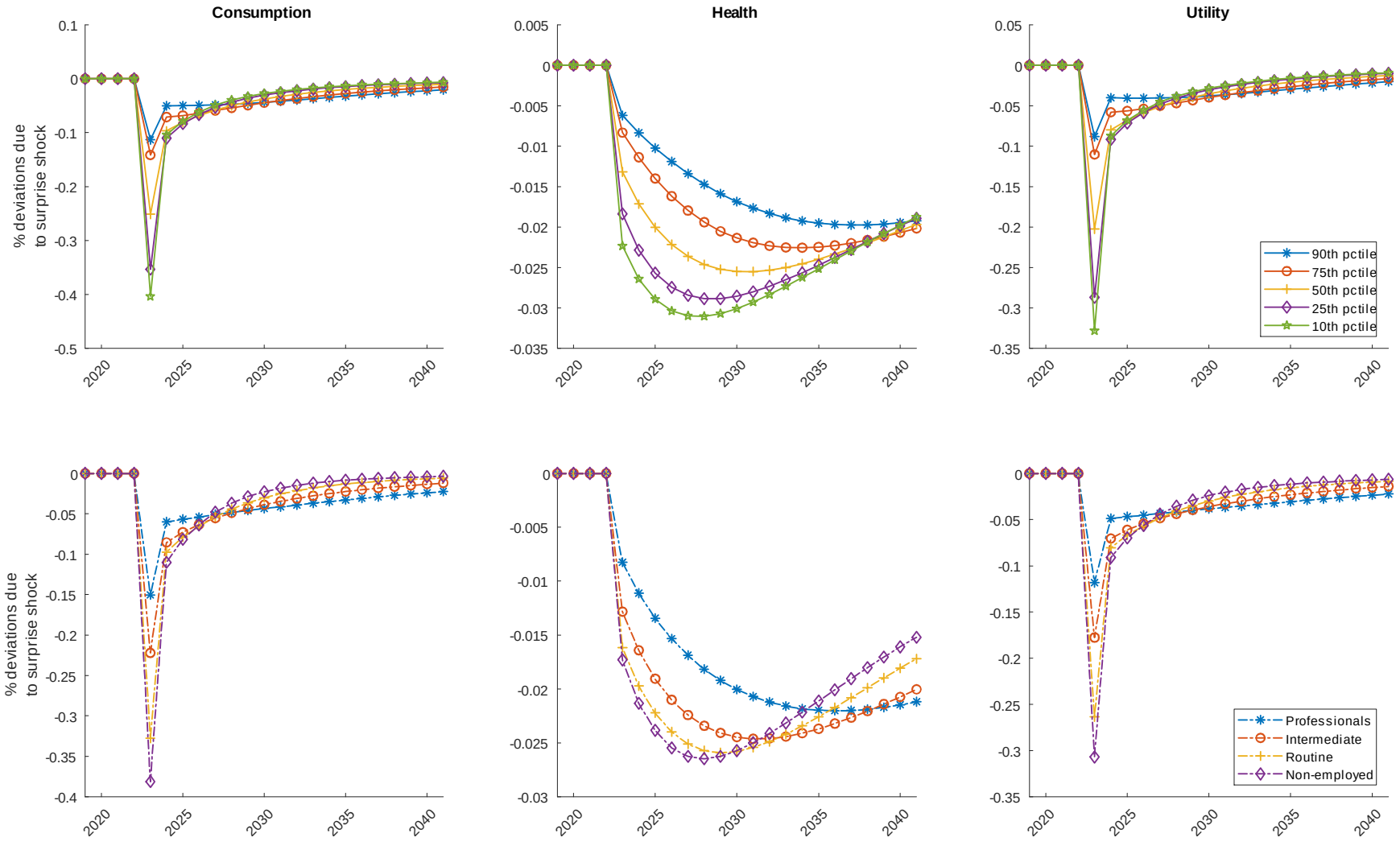






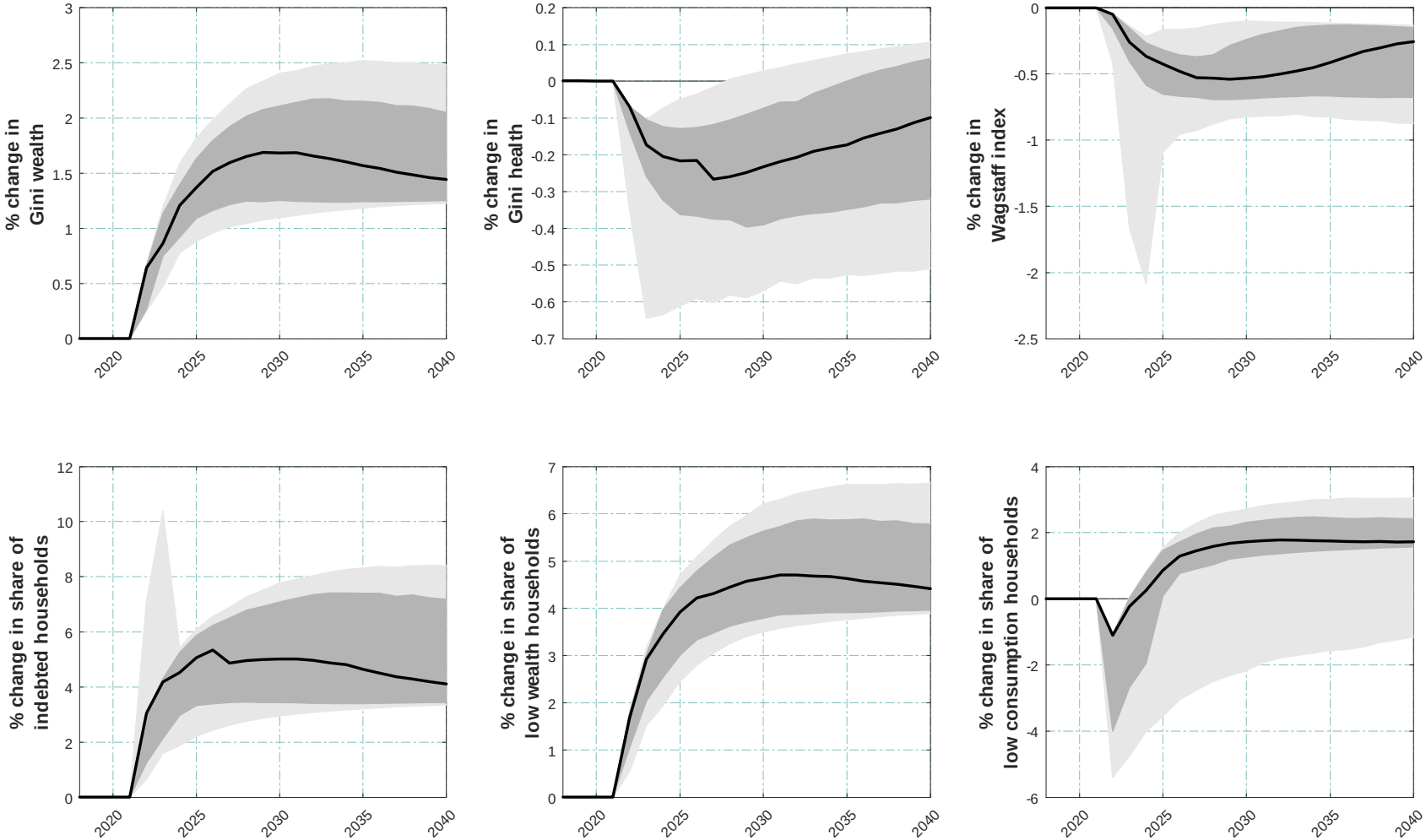


Results (3): Differential risk exposure and vulnerability



Note: Expected response of consumption and health to a uniform, one-time, unexpected household income shock of 1% that happens in 2023.

Results (4): The effect of policy on post pandemic inequality



Results: The effect of policy on post pandemic inequality

The intervention implies:

- A trade-off between effective insurance from income drops in the short- and in the medium run, and;
- Another trade-off between health and wealth inequality.

Summary of the results

We focus on the UK for the quantitative analysis:

- Existing inequalities in wealth and health are amplfied as a result of the pandemic. The increase in **inequality persists for more than a decade**.
- There is an **increased vulnerability to income risk** for those households that had lower resources to mitigate income shocks prior to the pandemic.
- We assess policies that mitigate this and we find that public insurance of income risk crowds in investment in health and crowds out self-insurance via wealth for households with low wealth.

Discussion

Our results probably represent **a lower bound** on inequality and its effects: First, emerging evidence seems to suggest longer-run and asymmetric changes in the income processes of households which might arise because of structural implications of the pandemic (e.g. new workplace technologies, loss of experience for low-skill workers). Here, we study the implications of the direct effect of the pandemic on incomes and show that these alone are already painful.

Second, in the UK, the increase in house prices has probably increased wealth inequality further, especially between home owners and non-owners. This should not have a strong effect on our results regarding vulnerability and health of those with low wealth prior to the pandemic. However, it might imply that low wealth households find it even more difficult to obtain good quality housing, with consequent effects on their health (see e.g. the report Housing and Health from Houses of Parliament)

Appendix

Income and health in the UK (pre-COVID-19)

Socioeconomic Group	Mean income (rel to All)	Mean health (rel to All)	Gini health	% of HH with Severe health event	Cond. prob of Severe health event
Professionals	1.57	1.06	0.05	1.9	0.0102
Intermediate	1.08	1.03	0.07	1.9	0.0092
Routine	0.75	1.00	0.08	2.3	0.0116
Non-employed	0.46	0.84	0.17	6.1	0.0248
All	1	1	0.09	2.7	

Income is household-level labour income, after taxes and including transfers. Health is the SF-12 Physical Component. Summary standardised in [0.1,1] and averaged across head and spouse. Source: Pooled Sample UnSoc Waves 1-9.

Socioeconomic mobilty and health in the UK (pre-COVID-19)

Transitions of households that have not experienced a severe health event

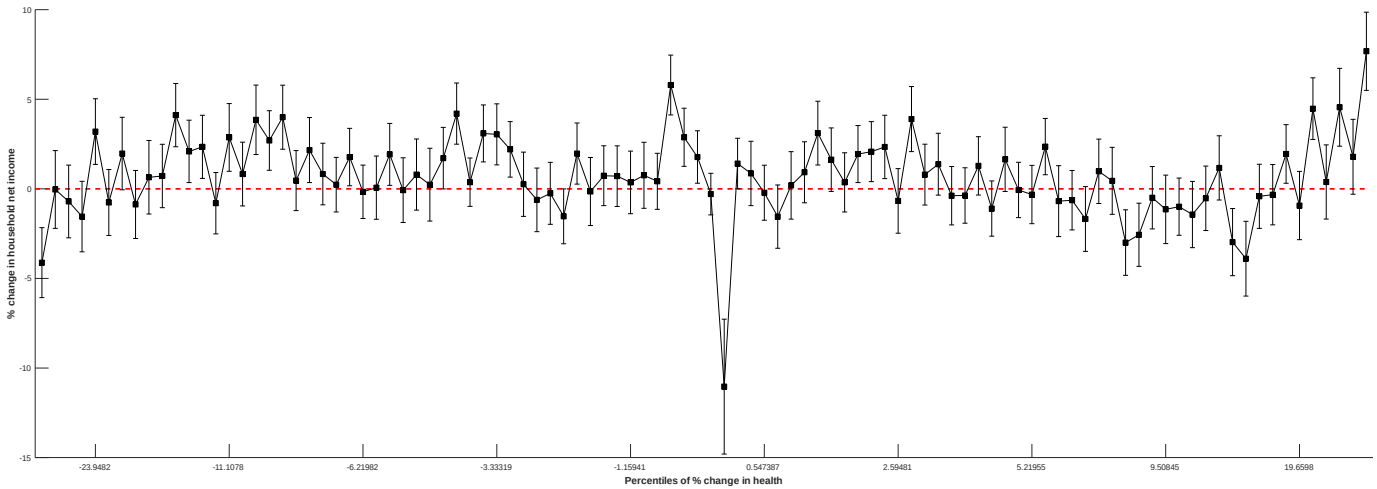
$t \setminus t+1$	Professional	Intermediate	Routine	Non-employed
Professional	**0.903**	0.083	0.008	0.006
Intermediate	0.034	**0.923**	0.029	0.014
Routine	0.009	0.0992	**0.858**	0.041
Non-employed	0.006	0.069	0.103	**0.822**

Transitions of households that have experienced a severe health event

$t \setminus t+1$	Professional	Intermediate	Routine	Non-employed
Professional	**0.903**	0.082	0.009	0.007
Intermediate	0.028	**0.915**	0.032	0.024
Routine	0.003	0.080	**0.856**	0.062
Non-employed	0.002	0.018	0.038	**0.942**

Note: Transitions are between UnSoc waves (wave to wave). Source: UnSoc Waves 1-9.

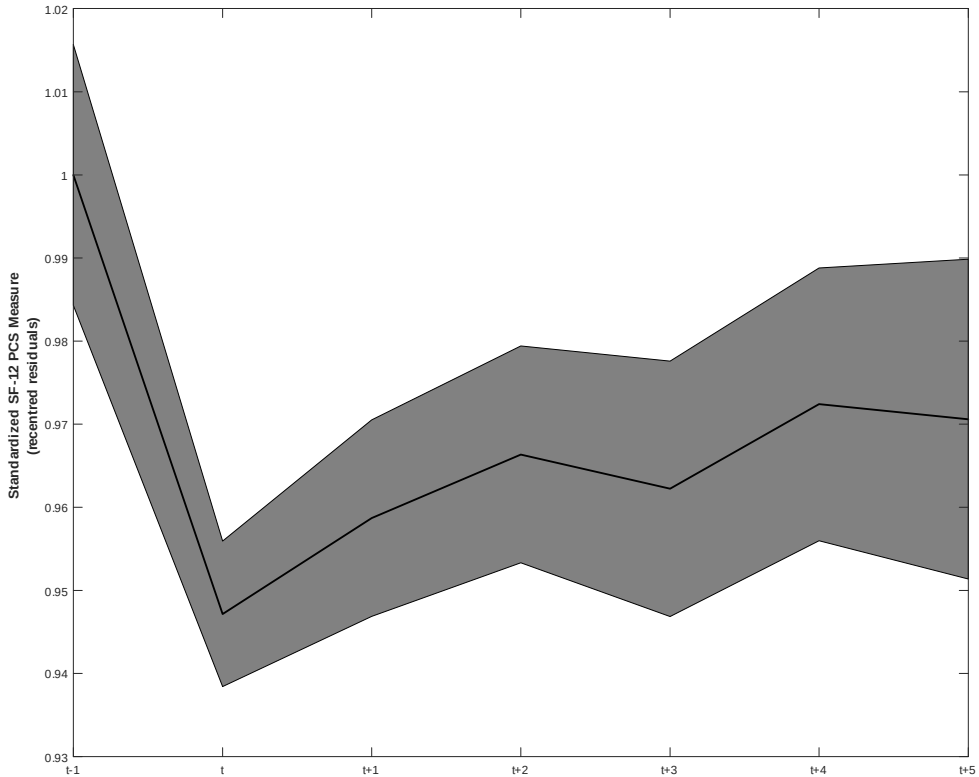
Modelling assumptions



Jones, Rice and Zantomio (2020); Using the USoc they show that severe shocks to health mostly imply increased probability to become inactive. There a 40% increase in this probability. They also show that severe health shock have also some effects on hours but these are small (and the effects on hours die out from t+2 i.e. no persistence).

Modelling assumptions

Relative change in the mincerian residuals of the SF-12 PCS measure following a severe health shock.



Source: Pooled Sample UnSoc Waves 1-9

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Calibration

$$u\left(c_t, h_{t+1}\right) = \frac{\left(c_t^{\phi} h_{t+1}^{1-\phi}\right)^{1-\sigma}}{1-\sigma},$$

$$m\left(x_t\right) = q x_t^{\gamma},$$

Calibration

Calibrated parameters

β	σ	$a^{\min}$	r	γ
0.96	1.6504	-0.0059	0.0056	0.5190

$\delta(s_t = \bar{s}_1)$	$\delta(s_t = \bar{s}_2)$	$\delta(s_t = \bar{s}_3)$	ϕ	q
0.9624	0.8128	0.9606	0.7687	0.1018

Note: For details on the calibration procedure, see Appendix D.

Calibration

Calibration fit

Target	Target Value	Outcome Value	Percentage Deviation
$\bar{h}_{t+1}(\bar{s}_1)$	0.688	0.689	0.176%
$\bar{h}_{t+1}(\bar{s}_2)$	0.577	0.578	0.162%
$\bar{h}_{t+1}(\bar{s}_3)$	0.603	0.602	-0.100%
$var(h_{t+1})$	0.014	0.014	-0.244%
$\frac{\sum x_t}{\sum c_t}$	0.089	0.089	0.042%
$\sum_{a_i<=0} i$	0.190	0.196	0.302%
$SSM = 2.1947e-05, (a^{\min}, q, \gamma, \phi, \delta(\bar{s}_2), \delta(\bar{s}_3))$			

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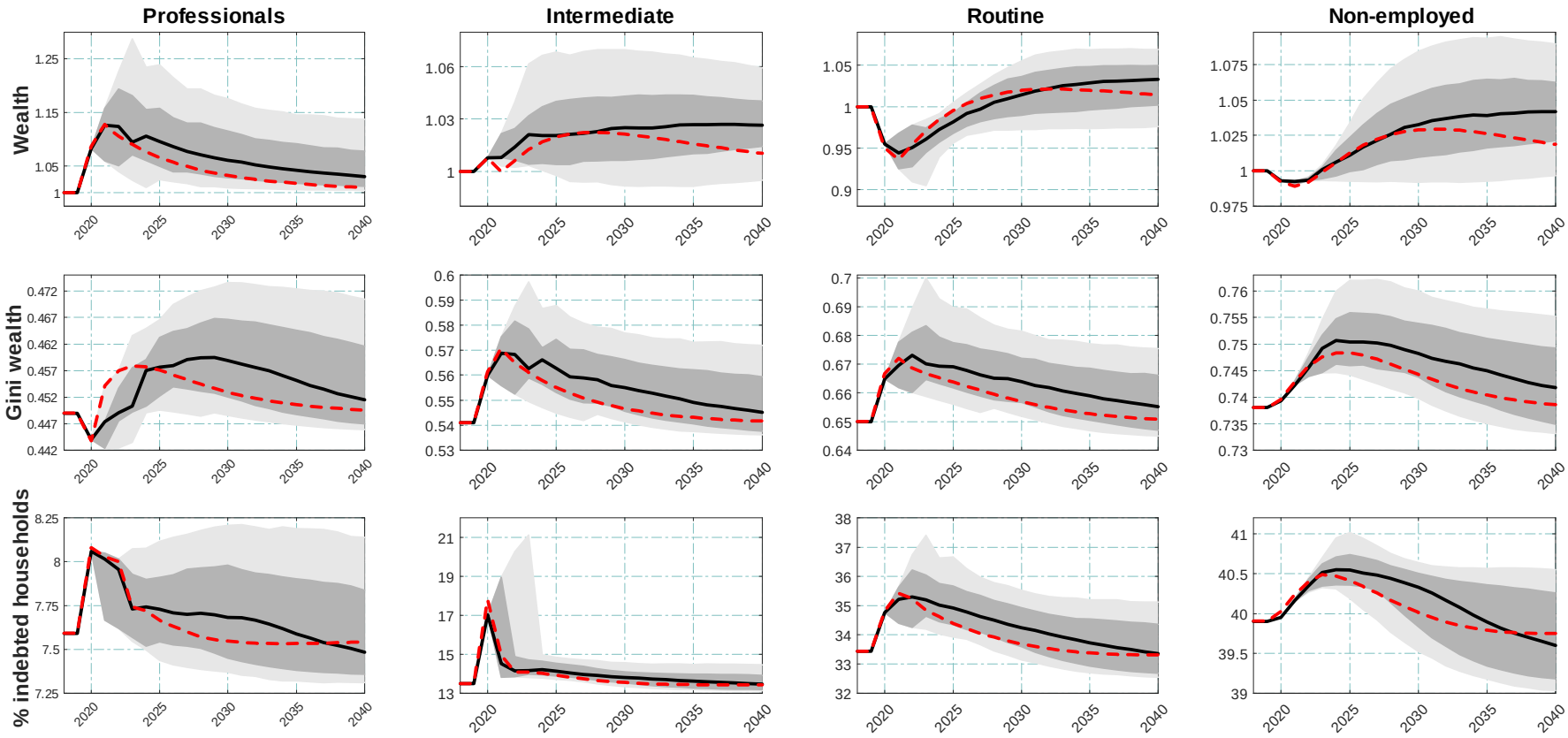
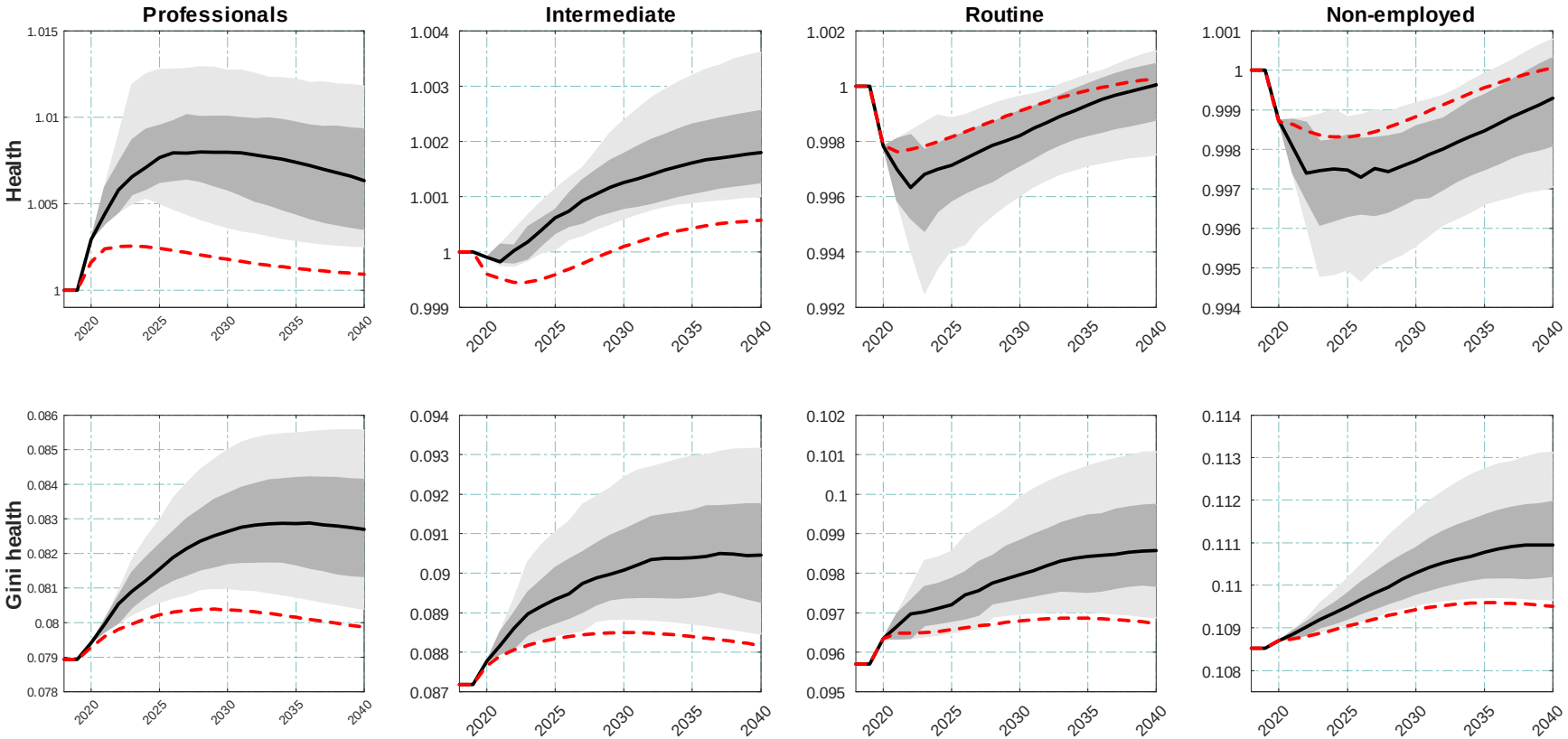
Results: Post-pandemic inequality by socioeconomic group



Results: Post-pandemic inequality by socioeconomic group



Insights on the Effects of pandemic-induced changes on choices

- A change in the aggregate-level process (z_t) in period t requires adjustments in health and wealth on the part of the household.
- Insights on how pandemic-induced changes affect household choices of wealth accumulation and improvement of the level of health can be obtained by theoretical analysis of the model.

Insights on the Effects of pandemic-induced changes on choices

Assuming *interior solutions* for health, optimality requires that the two Euler conditions are satisfied

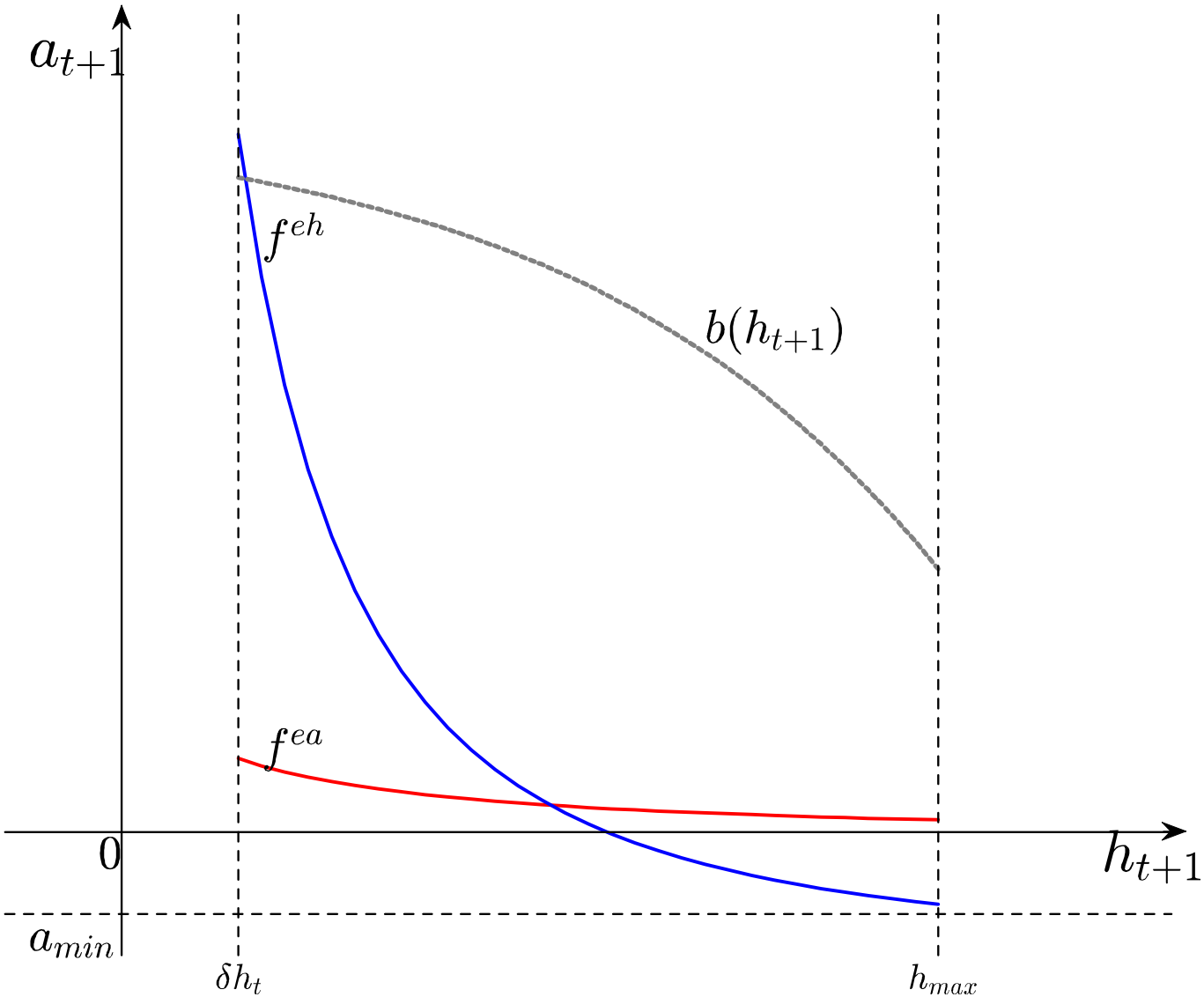
$$u_{c_t} = \beta E\left[u_{c_{t+1}}(1 + r(z_{t+1})\right]$$

$$u_{c_t} x_{h_{t+1}}(h_t, h_{t+1}) - u_{h_{t+1}} = \beta E\left[u_{c_{t+1}}\left(-x_{h_{t+1}}(h_{t+1}, h_{t+2})\right)\right]$$

where

$$x(h_t, h_{t+1}) = m^{-1}\left(h_{t+1} - \delta(e_t, z_t)h_t\right)$$

Example of loci of combinations of choices (Lemma 1)



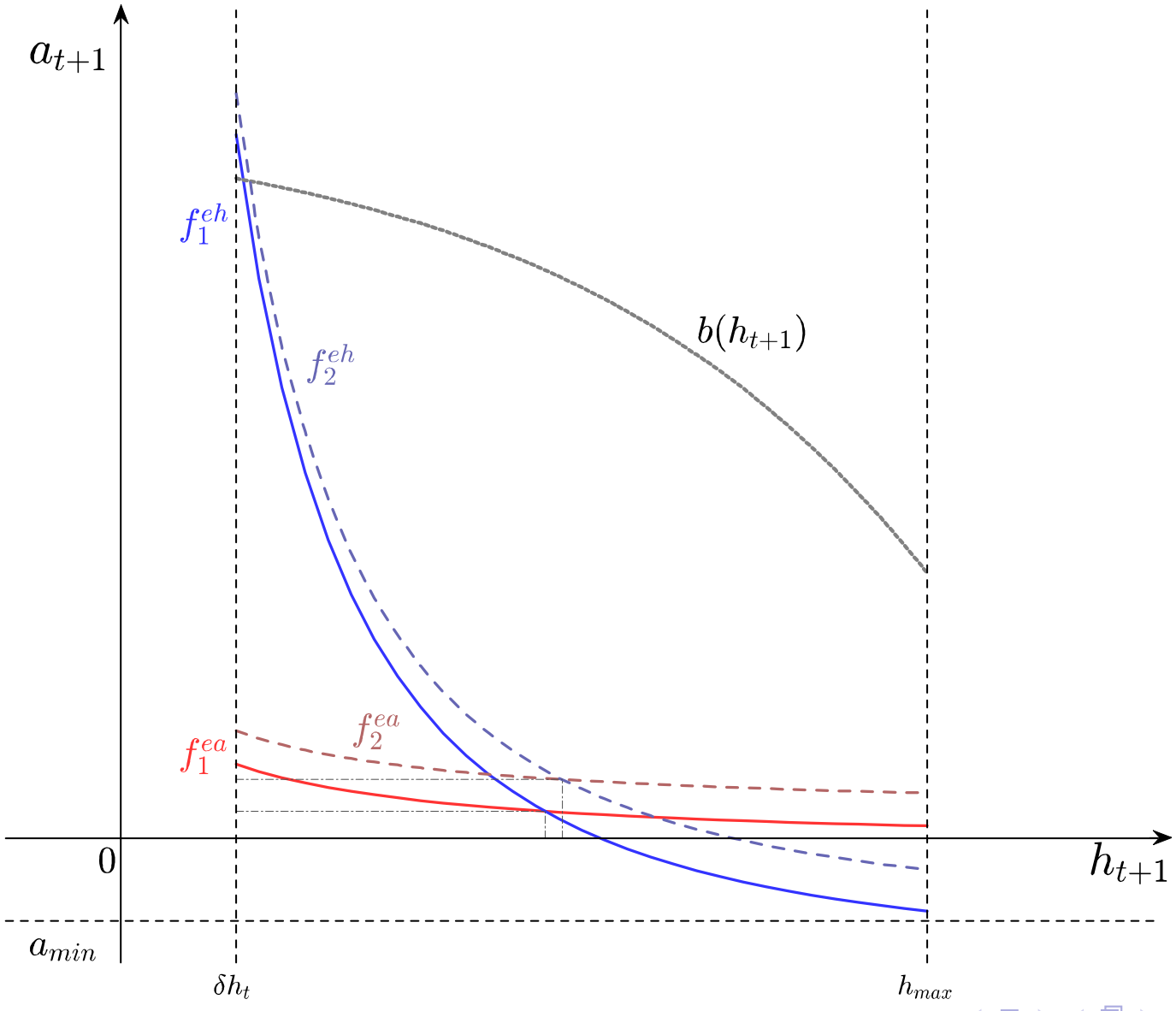
Pandemic-induced changes (Lemma 2)

Consider an aggregate-level stochastic process (z_t^p) which implies that in period t the *rhs* of the Euler equations are higher (lower) relative to the *lhs* compared with (z_t^s), conditional on $(a_t, a_{t+2}) \in A$, and $(h_t, h_{t+2}) \in \left(h^{\min}, h^{\max}\right)$. Then:

1. The downward slopping f^{ea} and f^{eh} shift outwards (inwards), and at least one of a_{t+1} and h_{t+1} increase (decrease) relative to (a_{t+1}^s, h_{t+1}^s).

2. The change in a_{t+1} relative to a_{t+1}^s is a negative function of the change h_{t+1} relative to relative to h_{t+1}^s, and vice versa.

An example of loci of combinations of choices (an increase in the *rhs* r.t.t lhs)



Proposition 1

Conditional on the levels of health wealth in period t and $t+2$:

i) *A surprise drop in labour or asset income in period t leads to a fall in at least one of a_{t+1} and h_{t+1}.*
(e.g. pandemic induced household income changes during the initial outbreak year –> consumption smoothing)

ii) *A surprise upper limit on consumption c^l in period t leads to an increase in at least one of a_{t+1} and h_{t+1} for the subset of households where $c_t > c^l$.*
(e.g. restrictions on consumption during the outbreak year –> "forced" investment in wealth or health)

Proposition 1

iii) *An increase in the probability of future drops in labour or asset income leads to an increase in at least one of* a_{t+1} *and* h_{t+1}*.*
(e.g. effects of post-pandemic outbreak risk on household income –> precautionary behaviour)

iv) *A positive probability for a future upper limit on consumption leads to a fall in at least one of* a_{t+1} *and* h_{t+1}*.*
(e.g. interplay between outbreak risk and restrictions on consumption –> form of consumption smoothing)

Substitutes in smoothing consumption

Having a portfolio of two assets, health and wealth, imply that:

- Consumption smoothing in this context **does not** necessarily imply reduction in both health and wealth, and precaution **does not** necessarily imply building buffer stocks of both health and wealth.
- A bigger change in one asset requires a smaller change in the same direction of the other asset (Lemma 2).
- The households view the two assets as **substitutes in smoothing consumption and in responding to changes in risk**.(Lemma 2)

Implications for inequality

- The different possibilities offered by the portfolio of assets for responses to shocks and risk (compared with a single-asset economy) implies more variation in the range of possible responses, because household responses to a pandemic-induced change refer to whether both assets change in the same direction, which asset changes more, and which asset increases/decreases, if assets change in different directions.

- Moreover, the inequality implications of a pandemic can be significantly dampened or amplified by the choices of households that are borrowing constrained.