COVID-19 epidemic and generational welfare

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Motivation → consensus on some features of the pandemic's economic burden (especially its distribution):

- "**young**" people experience extremely *small mortality rates* due to COVID-19
- "**old**" people are dramatically hit, with heavy health consequences and *high mortality rates*
- Young generations are asked to bear **most of the costs** of the severe containment policies introduced in many countries while **enjoying small benefits** (represented by reduced health damages and saved lives)

Greenstone and Nigam (2020): around 90% of the monetized mortality benefits of social distancing accrue to people aged 50 or older (Value of a Statistical Life)

Current (macro)economic literature:

- Most of the theoretical macroeconomic contributions presented so far tend to disregard that COVID-19 affects different age cohorts in extremely different ways
- This pandemic's demographic feature is addressed by epidemiological SIR/SIER models, possibly enriched by an economic block
- In Macro-SIR models, however, the focus is on health-related issues with a limited role played by standard intertemporal allocation decisions related to macroeconomic fluctuations.

Our research topic:

- We **are not interested** in how the (current or expected) agent's health status affects its intra-temporal economic decisions or in epidemiological issues, but **we focus on**:

    - the intertemporal effects of a **differentiated shock to mortality rates** on different generations of agents within a microfounded macroeconomic scheme with life-cycle features;

    - the effects on macroeconomic variables & the generations' relative welfare of **lockdown/social restriction** policies and of **expansionary fiscal policies** in response to the pandemics entailing substantial increases in public debt.

To this aim, we use the framework of Gertler (1999) which extends the *Perpetual youth* model of Blanchard (1985) and Yaari (1965) by emphasizing life-cycle factors.

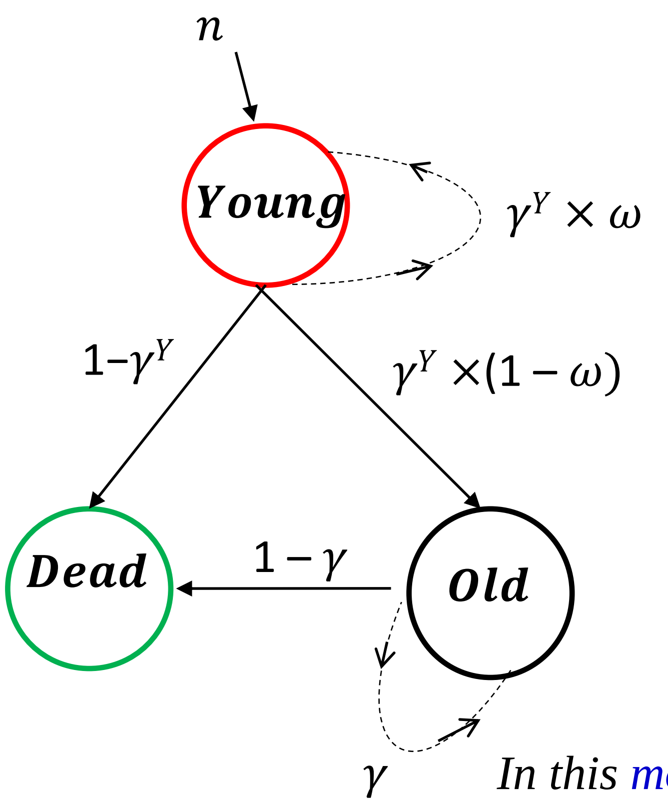
The model features *two classes of agents*:

- Young agents: consume, save, provide work services; they can become "old" with probability ω_t; they survive into the next period with prob. γ^y_t (=1, but for a «covid-shock»…);
- Old agents: consume, save, use resources from social security (are «retired»)… they can also provide (lower-productivity) labor services – they survive into the next period with prob. γ_t .

This model is well suited to study the impact of :

- **policies** (or other shocks) that redistribute resources between young workers and "retired" old agents
- **demographic changes**, in terms of population's growth rate and/or death probability

The model: *Population dynamics*



Young/workers $N_t^y = ((1-\gamma_t^y) + (1-\omega)\gamma_t^y + n_t)N_{t-1}^y + \gamma_t^y \omega N_{t-1}^y$

Newly-born young agents. Young (remaining)

Old and retired $N_t^o = (1-\omega)\gamma_t^y\, N_{t-1}^y + \gamma_t N_{t-1}^0$

«New» old agents. Old (surviving)

Population ratio $\frac{N_t^y}{N_t^o} = \psi_t = \gamma_t^y \frac{1-\omega}{1+n_t} + \gamma_t + \psi_{t-1}$

where: γ_t^y = young's prob. of surviving

γ_t = old's prob. of surviving

ω = prob. of becoming old

n = population growth rate

In this model the direct effect of COVID-19 is represented as a shock to the survival rates $\boldsymbol{\gamma_t^y}$ *and* $\boldsymbol{\gamma_t}$

The Model: *Old agent problem*

An agent born at s and entered into old age at $\tau < s$ chooses consumption C_t^o, labour l_t^o, and total assets A_t^o to maximize:

$$V_t^o(s,\tau) = \max\left\{\left[C_t^o(s,\tau)^q\left(1-l_t^o(s,\tau)\right)^{1-q}\right]^\rho + \beta\gamma_{t+1}\left(V_{t+1}^o(s,\tau)\right)^\rho\right\}^{\frac{1}{\rho}} \quad (1)$$

$$\text{s.t.} : C_t^o(s,\tau) + A_t^o(s,\tau) = \frac{R_{t.-1}A_{t-1}^o(s,\tau)}{\gamma_t} + E_t^o + W_t\eta l_t^o(s,\tau) - T_t^o \quad (2)$$

$$\text{where} : A_t^o(s,\tau) = K_t^o(s,\tau) + B_t^o(s,\tau)$$

where
$C_t^o(s,\tau)$: consumption;
$l_t^o(s,\tau)$: supply of work-time;
$K_t^o(s,\tau)$: next period capital stock;
$B_t^o(s,\tau)$: demand of government's bond;
E_t^o : social security transfer;
T_t^o : lump-sum taxes;
W_t : real wage rate;
R_t : bond's real interest factor, equal to the real return on capital (no-arbitrage holds);
$\eta \in (0,1)$: productivity of a unit of labor supplied by an old worker, relative to that of a young one;
β, q and ρ : agent's preference parameters.

The Model: *Young agent problem*

A young agent, born at time s chooses consumption C_t^y, labour l_t^y, and total assets A_t^y to maximize:

$$V_t^y(s) = \max \left\{ \begin{array}{c} \left[C_t^y(s)^q \left(1 - l_t^y(s)\right)^{1-q}\right]^\rho + \\ \beta\gamma_{t+1}^y \left[\omega_{t+1} V_{t+1}^y(s) + (1-\omega_{t+1}) V_{t+1}^o(s, t+1)\right]^\rho \end{array} \right\}^{\frac{1}{\rho}} \quad (3)$$

$$\text{s.t.} \quad : \quad C_t^y(s) + A_t^y(s) = \frac{1}{\gamma_t^y}\left(R_{t-1} A_{t-1}^y(s)\right) + W_t l_t^y(s) - T_t^y \quad (4)$$

$$\text{where} \quad : \quad A_t^y(s) = K_t^y(s) + B_t^y(s) \quad (5)$$

where l_t^y is the work supplied; T_t^y is the lump-sum tax paid.

The continuation value V_{t+1} is conditional on the agent remaining alive and young (with prob. ω_{t+1}) or old (prob. $1 - \omega_{t+1}$) .

The Model: *Individual consumption functions and m.p.c.*

Agents' problems are solved through a guess-and-verify strategy which allows to find closed form solutions for the agents' value functions.

Conjectures prescribe time-varying marginal propensities to consume (m.p.c.) ξ_t^o and ξ_t^y out of total wealth/resources:

$$C_t^o(s,\tau) = \xi_t^o \left[\frac{1}{\gamma_t} R_{t-1} A_{t-1}^o(s,\tau) + D_t^o + H_t^o\right] \quad ; \quad C_t^y(s) = \xi_t^y \left[\frac{1}{\gamma_t^y} R_{t-1} A_{t-1}^y(s) + H_t^y + D_t^y\right]$$

where D_t^o (D_t^y) and H_t^o (H_t^y) are, respectively, the discounted values of the stream of *social security* payments and the (net) *human wealth* for an old (young) agent.

The equilibrium dynamic laws of m.p.c. are:

$$\frac{1}{\xi_t^o} = 1+\gamma_{t+1}\left[\left(\frac{W_t}{W_{t+1}}\right)^{(1-q)\rho}\beta\right]^{\sigma}\frac{R_t^{\sigma-1}}{\xi_{t+1}^o}; \qquad \frac{1}{\xi_t^y} = 1+\gamma_{t+1}^y\left[\left(\frac{W_t}{W_{t+1}}\right)^{(1-q)\rho}\beta\right]^{\sigma}\frac{(R_t\Omega_{t+1})^{\sigma-1}}{\xi_{t+1}^y}$$

and the individual labor supply functions (with: $\varsigma = \frac{1-q}{q}$) are:

$$l_t^o(s,\tau) = 1 - \frac{\varsigma}{\eta W_t} C_t^o(s,\tau); \qquad l_t^y(s) = 1 - \frac{\varsigma}{W_t} C_t^y(s)$$

The Model: *aggregate variables*

Closed form solutions allow for a simple (linear) aggregation scheme:

Total consumption of old agents born at s and retired at $\tau \in [s, t]$ (whose number is $N_t^o(s,\tau)$) is equal to:

$$C_t^o(s) = \sum_{\tau=s}^{t} \int_0^{N_t^o(s,\tau)} C_t^o(s,\tau)\, di$$

Total consumption of all old agents at t is equal to the sum over all the birth dates s: $C_t^o = \sum_{s=-1}^{t} C_t^o(s)$.

The aggregate **consumption** function of of old agents is then:

$$C_t^o = \xi_t^o \left(R_{t-1} A_{t-1}^o + D_t + H_t\right) \tag{6}$$

The aggregate **labor supply** function of old agents is:

$$L_t^o = N_t^o - \frac{\varsigma}{W_t \eta} C_t^o \tag{7}$$

.... an analogous procedure can be adopted for young agents (and other aggregate variables).

The Model: *firms*

The representative firm operates in competitive markets and adopts a CES production function:

$$Y_t = \left[(1-\alpha) K_{t-1}^{\phi} + \vartheta_t \alpha (X_t L_t)^{\phi} \right]^{\frac{1}{\phi}}; \qquad (8)$$

Technology X_t evolves through time at a constant rate x: $X_t = (1+x) X_{t-1}$

Variable $\boldsymbol{\vartheta_t} \in (0;1]$ represents the impact of social distancing policies on production.

Profit maximization leads to the usual demand functions for the two inputs :

$$W_t = \alpha \vartheta_t X_t \left(\frac{Y_t}{X_t L_t} \right)^{1-\phi}; \qquad (9)$$

$$r_t^K = \left(\frac{Y_t}{K_{t-1}} \right)^{1-\phi} - \delta. \qquad (10)$$

The Model: *fiscal policy*

Fiscal policy is defined by the following equations:

$$\begin{aligned} e_t &= r_t^e y_t; \\ g_t &= \rho_g g_{t-1} + \left(1-\rho_g\right) r_t^g y_t; \\ \theta_t &= \rho_\theta \theta_{t-1} + (1-\rho_\theta)\left[r_t^\theta y_t + \delta_B\left(\frac{b_t}{y_t} - r^b\right)\right]. \end{aligned} \tag{11}$$

where e_t, g_t and θ_t represent the trend-stationary values of *social security*, *public expenditure* and lump-sum *(net) taxes.*

The exogenous processes of the ratios $r_t^g = \frac{g_t}{y_t}$, $r_t^e = \frac{e_t}{y_t}$, $r_t^\theta = \frac{\theta_t}{y_t}$ are set by the policy makers.

Ratios r_t^g and r_t^θ include a stationary, long-run component and a "temporary" one.

To ensure debt sustainability government adjusts lump sum taxes θ_t in response to deviations of the debt-to-GDP ratio from its stationary value r^b.

The government budget equation is:

$$(1+n)(1+x)\, b_t = g_t + e_t - (1 + a^o \psi_t)\, \theta_t + R_{t-1} b_{t-1} \tag{12}$$

The Model: *complete set of equations*

Equilibrium system of equations - with trend-stationary variables (e.g.: $z_t = Z_t/(X_t N_t^y)$):

$$
\begin{aligned}
\Omega_t &= \omega + (1-\omega)\,\chi\left(\frac{\xi_t^o}{\xi_t^y}\right)^{\frac{1}{1-\sigma}}; \quad (1+n)(1+x)\,k_t = y_t - c_t - g_t + (1-\delta)\,k_{t-1};\\
\frac{1}{\xi_t^y} &= 1 + \gamma_{t+1}^y\left[\left(\frac{w_t}{(1+x)\,w_{t+1}}\right)^{(1-q)\rho}\beta\right]^{\sigma}\frac{(R_t\Omega_{t+1})^{\sigma-1}}{\xi_{t+1}^y};\\
\frac{1}{\xi_t^o} &= 1 + \gamma_{t+1}\left[\left(\frac{w_t}{(1+x)\,w_{t+1}}\right)^{(1-q)\rho}\beta\right]^{\sigma}\frac{R_t^{\sigma-1}}{\xi_{t+1}^o};\\
a_t &= \frac{\omega\left[(1-\xi_t^o)\,R_{t-1}\lambda_{t-1}a_{t-1} + e_t + w_t\eta\widetilde{l}_t^o - a^o\psi_t\theta_t - \xi_t^o\,(h_t+d_t)\right]}{(1+n)(1+x)(\omega+\lambda_t-1)};
\end{aligned}
$$

$$
\begin{aligned}
a_t &= k_t + b_t; \qquad (1+n)(1+x)\,b_t = g_t + e_t - (1+a^o\psi_t)\,\theta_t + R_{t-1}b_{t-1};\\
d_t &= e_t + \frac{(1+x)\,\psi_t\gamma_{t+1}}{\psi_{t+1}R_t}d_{t+1}; \qquad \frac{1}{1+x}\bar{d}_t = \frac{\omega\gamma_{t+1}^y}{\Omega_{t+1}R_t}\bar{d}_{t+1} + \left(\frac{(\Omega_{t+1}-\omega)\,\gamma_{t+1}^y}{\psi_{t+1}\Omega_{t+1}R_t}\right)d_{t+1}\\
e_t &= r_t^e y_t; \quad g_t = \rho_g g_{t-1} + (1-\rho_g)\,r_t^g y_t; \qquad c_t = c_t^o + c_t^y\\
\theta_t &= \rho_\theta\theta_{t-1} + (1-\rho_\theta)\left[r_t^\theta y_t + \delta_B\left(\frac{b_t}{y_t} - r^b\right)\right];\\
c_t^y &= \xi_t^y\left[(1-\lambda_{t-1})\,R_{t-1}a_{t-1} + \bar{h}_t + \bar{d}_t\right]; \qquad c_t^o = \xi_t^o\,(\lambda_{t-1}R_{t-1}a_{t-1} + h_t + d_t).
\end{aligned}
$$

$$
\begin{aligned}
h_t &= w_t\eta\widetilde{l}_t^o - a^o\psi_t\theta_t + \frac{(1+x)\,\gamma_{t+1}\psi_t}{\psi_{t+1}R_t}h_{t+1};\\
\bar{h}_t &= w_t\widetilde{l}_t^y - \theta_t + \frac{(1+x)\,\omega}{\Omega_{t+1}R_t/\gamma_{t+1}^y}\bar{h}_{t+1} + \frac{(1+x)\,(\Omega_{t+1}-\omega_{t+1})}{\psi_{t+1}\Omega_{t+1}R_t//\gamma_{t+1}^y}h_{t+1};\\
\widetilde{l}_t &= \widetilde{l}_t^y + \eta\widetilde{l}_t^o; \qquad \widetilde{l}_t^y = 1 - \frac{\varsigma}{w_t}c_t^y; \qquad \widetilde{l}_t^o = \psi_t - \frac{\varsigma}{w_t\eta}c_t^o;\\
w_t &= \alpha\vartheta_t\left(\frac{y_t}{\widetilde{l}_t}\right)^{1-\phi}; \quad m_t^{RS} = \frac{\varsigma c_t^y}{1/\varphi_t - \widetilde{l}_t^y}; \quad y_t = \left[(1-\alpha)\,k_{t-1}^\phi + \vartheta_t\alpha\widetilde{l}_t^\phi\right]^{\frac{1}{\phi}};\\
w_t &= \frac{(1-\rho_w)(1-\rho_w\beta)}{1+\rho_w^2\beta}m_t^{RS} + \frac{\rho_w\beta}{1+\rho_w^2\beta}E_t w_{t+1} + \frac{\rho_w}{1+\rho_w^2\beta}w_{t-1};\\
R_t &= (1-\alpha)\left(\frac{y_{t+1}}{k_t}\right)^{1-\phi} + 1 - \delta; \quad (1+n)\,\psi_t = \gamma_t^y\,(1-\omega) + \gamma_t\psi_{t-1};
\end{aligned}
$$

(where $\lambda_t = A_t^o/A_t$ is the ratio of old agents' wealth over the total)

The Model: *Welfare indicator*

We choose a *relative welfare indicator* (of the two groups of agents) which:

- allows us to carry out the analysis out in terms of *commonly detrended variables*;
- includes the utility levels of all the old agents (V_t^o) and the utility levels of all the young agents (V_t^y) who exist at t;
- properly takes into account the demographic effect of a fall in γ_t and $\gamma^y{}_t$ on the population structure ψ_t .

We then compute:

$$V_t^o = \sum_{s=-1}^{t} \left[\int_0^{N_t^o(s,\tau)} V_t^o(s,\tau)\, di \right] = \left(\frac{\varsigma}{W_t \eta} \right)^{1-q} \Delta_t^o C_t^o$$

$$V_t^y = \sum_{s=-1}^{t} \left[\int_0^{N_t^y(s)} V_t^y(s)\, di \right] = \left(\frac{\varsigma}{W_t} \right)^{1-q} \Delta_t^y C_t^y$$

and form the relative welfare index:

$$v_t^{ratio} = \frac{V_t^y}{V_t^o} = \frac{1}{\chi} \left(\frac{\xi_t^y}{\xi_t^o} \right)^{\frac{\sigma}{1-\sigma}} \frac{c_t^y}{c_t^o}$$

where: $\chi = (1/\eta)^{1-q}$

We will focus on the evolution/response of v_t^{ratio} to the pandemic shock (and the fiscal variables)

Numerical analysis: baseline parameterization

To explore the model's prediction on the effects of pandemic and related policies, we specify a numerical version using empirical figures for the U.S. (parameters set at the model's stationary state)

Table 1 - Baseline parameterisation

$\alpha = 0.67$	$\beta = 0.998$	$\delta = 0.025$	$\sigma = 0.42$
$q = 0.4$	$\phi = -0.16$	$\eta = 0.72$	$\rho_w = 0.85$
$x = 0.02/4$	$n = 0.01/4$	$\gamma = 0.98214$	$\omega = 0.99444$
$r^g = \frac{g}{y} = 0.150$	$r^e = \frac{e}{y} = 0.0405$	$r^b = \frac{b}{y} = 0.983$	$a^o = 1$

preference and technological parameters

$(\alpha, \beta, \delta, \sigma, q, \eta, \phi) \rightarrow$ commonly adopted in the literature (e.g. Gertler (1999) and others)

demographic transistions probabilities:

ω: prob of retirement $\rightarrow$ 45 years of active life $\rightarrow \omega = 1 - \frac{1}{45 \times 4} = 0.99444$

γ: prob to survive (old) $\rightarrow$ 78.86 years, average U.S. life expectancy $\rightarrow \gamma = 0.98214$

γ^y: prob. to surives (young) $\rightarrow$ $\gamma^y = 1$ (with a temporary, Covid-related shock - see below)

fiscal policy ratios:

$r^{g,e,b,\theta} \rightarrow$ average ratios for 2009-2019:

Target value for Debt-to-GDP r^b $\rightarrow$ than g and e according to their ratios $\rightarrow$ then fiscal revenues θ to satisfy the budget equation

Numerical analysis: *Pandemic shock*

Two scenarios:

1. **Pure Pandemic (PP)** where – counterfactually – COVID-19 is not followed by social distancing policy
2. **Pandemic and Lockdown (PL)** with social distancing policy → mitigated effects on mortality rates

In 1 and 2 fiscal variables are anchored to their stationary ratios

1. Pure Pandemic (PP): Pandemic shock (u_t) hit the probabilities of survival (γ_t and γ_t^y)

$$\gamma_t = \gamma(u_t, \vartheta_t)\ ; \quad \gamma_t^y = \gamma^y(u_t, \vartheta_t) \quad \text{and } \vartheta_t = 1 \text{ i.e. no lockdown}$$

According to Goldstein and Lee (2020) pandemic would have caused 2,000,000 deaths **in the absence of social distancing policies**, bringing life expectancy down by **5.08 years**. We recover the implied value for the probability of survive (γ_t and γ_t^y) and set the series of shocks u_t accordingly

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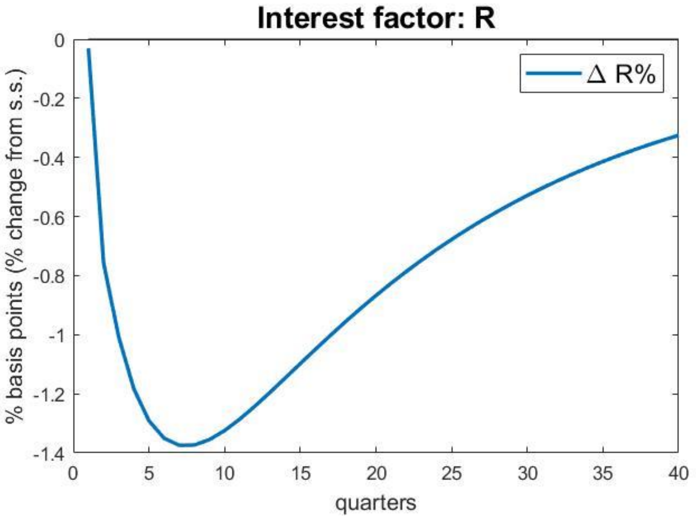
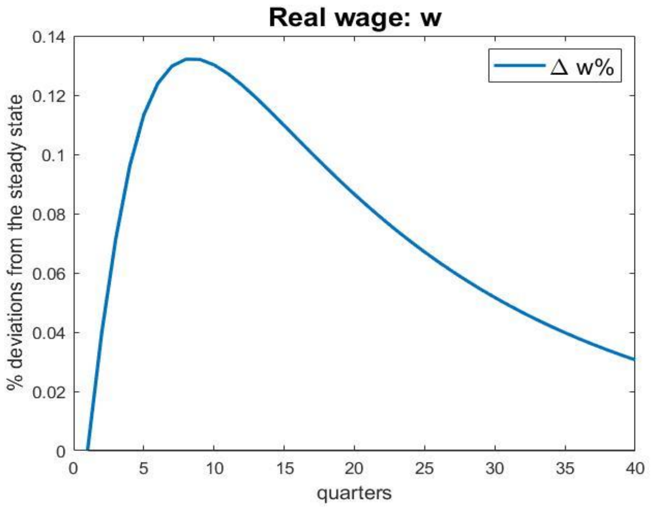
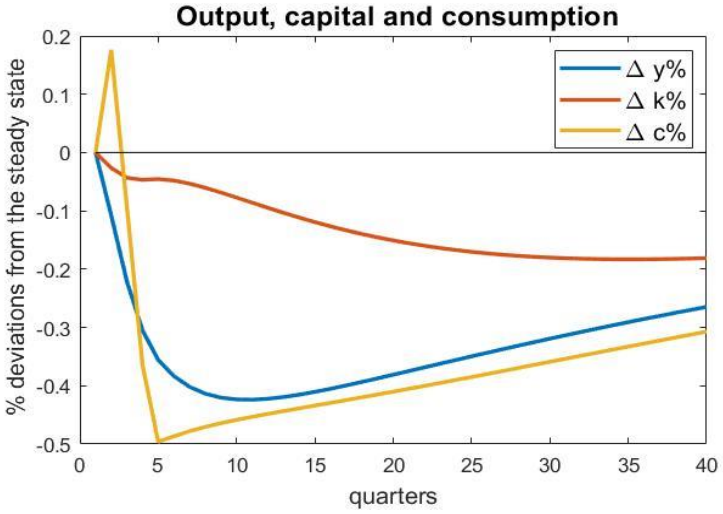
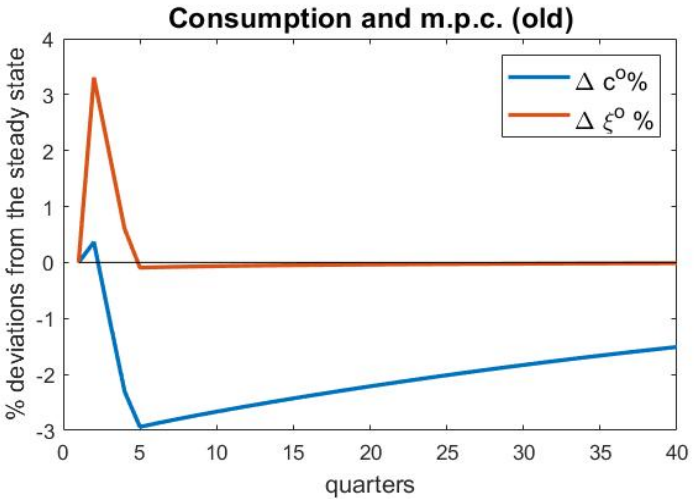
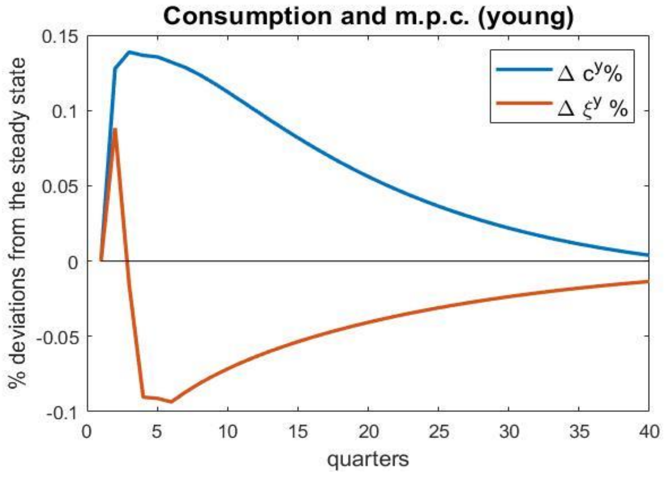
1. **Pure Pandemic (PP):** Dynamic responses











- *Demographic channel*: $\psi_t \downarrow$ starts a (mild) recession → y and c fall, driven by a fall in *total labor input* (not shown);

Real prices (R and w) response is coherent with the empirical evidence from historical pandemic episodes (Jordà et al 2020) - the rise of w is driven by the sharp fall in old agents L supply while old agents asset de-cumulation drives $R \downarrow$;

Differentiated effects : old consumption falls (young cons. rises, much less though). The demographic channel → λ falls, due to the stronger impact of $\gamma \downarrow$ on old agents' population (the fall in $\gamma^y \downarrow$ is comparatively much smaller). This results in a fall in aggregate consumption.

2. Pandemic and Lockdown (PL)

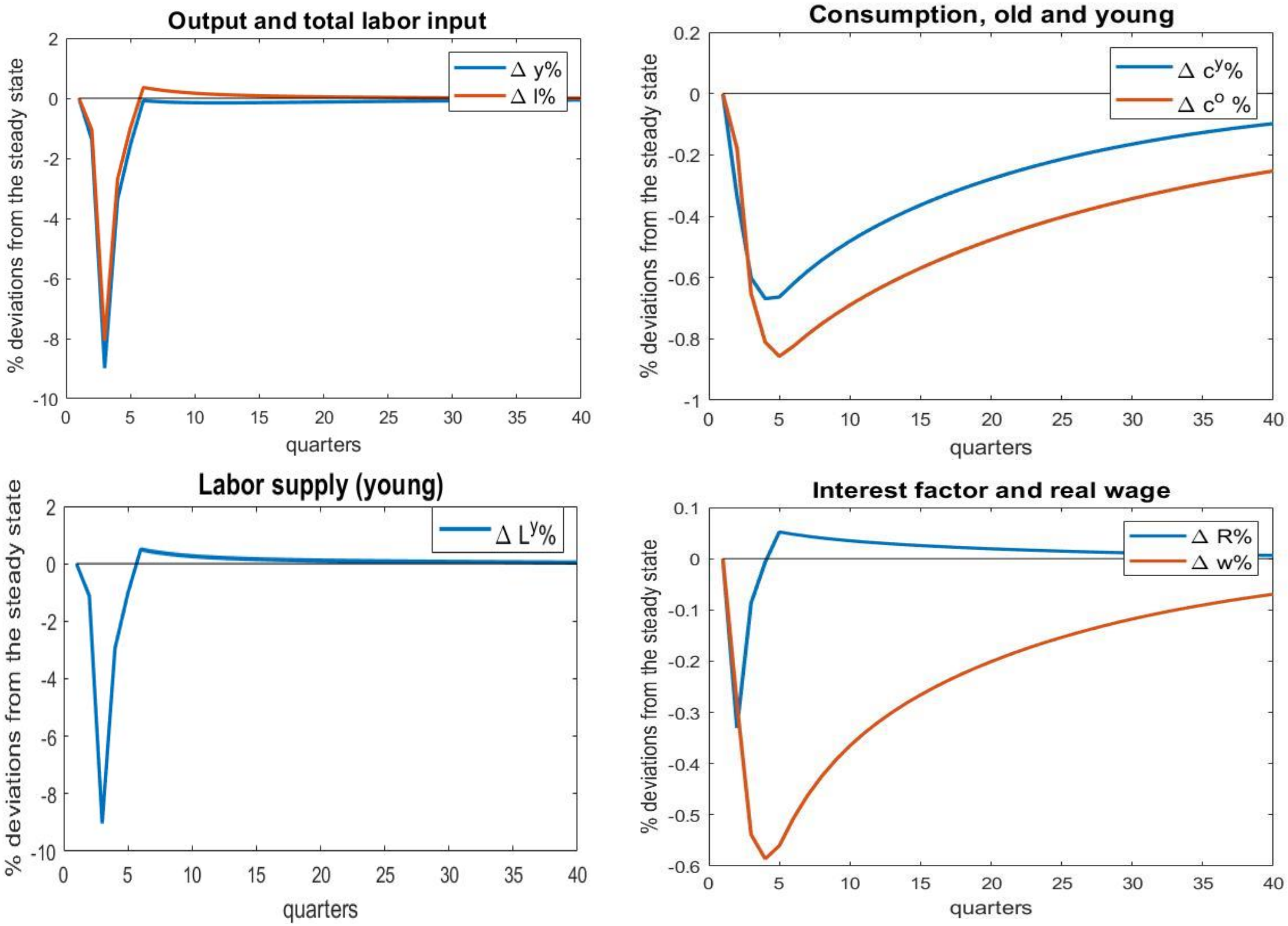
2. Pandemic and Lockdown (PL).

- **Shock to life expectancy**: the pandemic shock series u_t cause a fall in γ_t coherent with a reduction of **1.6 year** in life expectancy (*Health at a Glance 2021*. OECD 2021), while at the same time lockdown policies increases ϑ_t above 1 (the fall in γ_t^y is the same of that under PP – due to small effect).

- **Lockdown policies:** to set the numerical values of ϑ_t shocks, we follow a direct strategy: we target the U.S. real percapita output fall of 1.3% in Q1:2020; – 8.98% in Q2:2020; the strong rebound of 7.54% in Q3:2020; 1.12 in Q4:2020 and 1.53% in Q1:2021.

- **Fiscal variables** are (for now) kept anchored to their stationary ratios.

2. Pandemic and Lockdown (PL): Dynamic responses



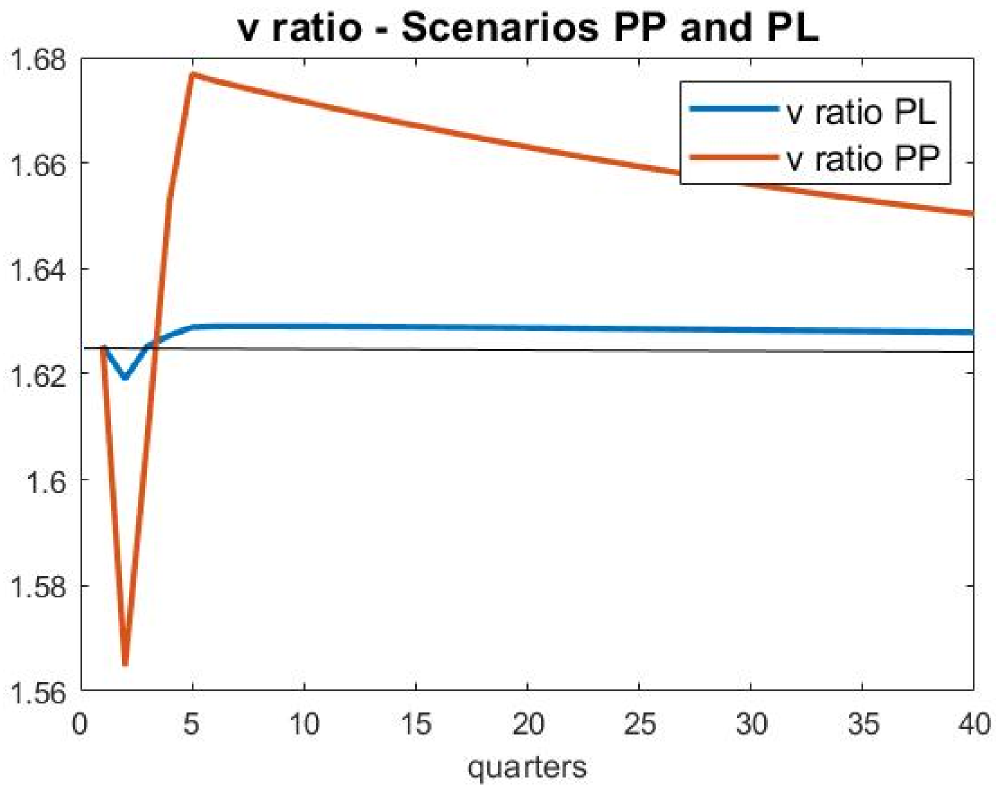
Social restriction channel: $\vartheta_t \downarrow$ ignites a **strong** recession → *y* and *c* fall, driven by a sharp fall in *young agents' labor input* (also the old ones' falls, but less) from the demand side;

The lockdown, on one side *reduces* the fall γ , and on the other side restricts production directly (*via* the production function); this completely overcomes the *demographic channel*;

Under PL (and contrary to the PP scenario), a transfer of wealth *from younger agents* (whose income loss is the greatest) *to old ones* takes place (while at same time total wealth a_t falls – not shown).

The Welfare ratio in PP and PL scenarios

The figure shows the impact of a fall of γ_t and γ_t^y due to the pandemic on the relative welfare index of the two groups v_t^{ratio} under PP and PL scenarios



- Under PL: both types of agents are forced to a *more uniform behavior* , because the impact of lockdown affects the economy on a global scale → the evolution of v_t^{ratio} is *strongly dampened under PL, as compared to the PP scenario*.
- Under PL: old agents experience a greater fall in the non-financial components of their wealth (h^o and d^o), but *young agents must bear a stronger decrease in their main income component* (labor);
- **Cost-shifting**:
  - Under PP: the cost of the pandemic is mainly sustained by older agents, (mainly due to the demographic channel/effect)
  - Under PL: the welfare/economic cost of lockdown or containment policies is shifted mainly to young agents (fall in labor income)
  - → "re-allocation" of economic welfare among age-groups: social restrictions affects all agents in a more symmetric way and tend to spread the welfare costs more homogeneously.
- The reallocation/equalization of welfare costs is paid with a *strong overall recession :* much less material resources available to all agents in the system.

The Fiscal Scenarios

Expansionary fiscal policy programs implemented in the wake of the pandemic and of the ensuing lockdown try to provide an immediate **support to aggregate demand and to households' and firms' income**. The ARP will provide 1.9 $ trillions to be allocated mainly in direct income support.

This implies an **increase in the level of public debt**, which can be repaid according to different schemes and time horizons. These *debt repayment schemes* imply different time evolutions of the *relative welfare index* v_t^{ratio} .

A) Expansionary fiscal programs

In the context of our model this type of intervention can be interpreted as a series of shocks to both the public expenditure (r^g) and net taxes (r^ϑ) ratios.

We target an increase in r_t^g of more than 9% in the quarters 7, 8 and 9 after the pandemic outbreak (from 14% to 24% of *g/y*, according to FRED estimates) and a decrease in r_t^ϑ (for 2,5 years) to capture the effects of direct financial supports.

The Fiscal Scenarios: different DRS

B) Public debt evolution

Our main goal is to evaluate the **impact on** $\boldsymbol{v_t^{ratio}}$ of **different** ***Debt Repayment Schemes*** (DRS), following the planned expansionary fiscal policies after the pandemic shock.

Different DRS are defined by setting a range of values of δ_B in equation: $\theta_t = \rho_\theta \theta_{t-1} + (1-\rho_\theta)\left[r_t^\theta y_t + \delta_B\left(\frac{b_t}{y_t} - r^b\right)\right]$

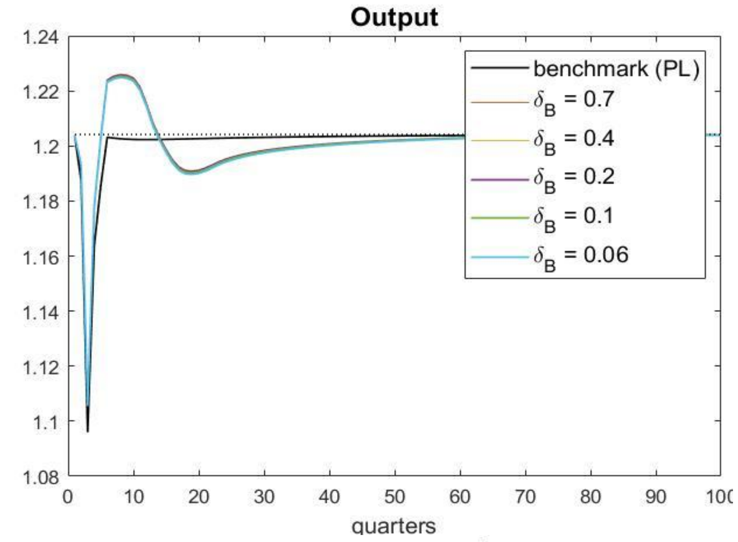
We choose the range:

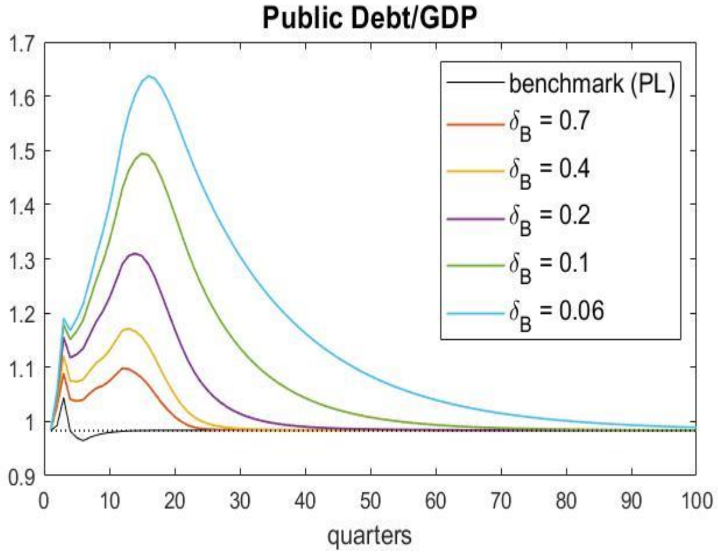
$$\delta_B = [0.7;\ 0.4;\ 0.2;\ 0.1;\ 0.06]$$

Extreme values represent a strongly delayed debt repayment (δ_B = 0.06) and a fast repayment scheme (δ_B = 0.7)

(the coefficient ρ_θ is set to 0)

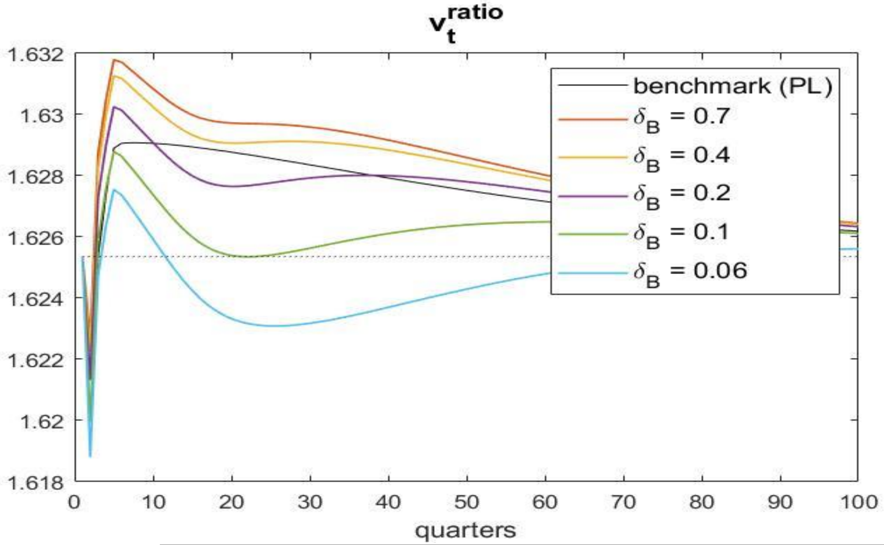
The Fiscal Scenarios: Dynamic responses





- DRS do not have a noticeable impact on the dynamic of GDP, but things are different for the Debt-to-GDP ratio and for the relative welfare index, $\boldsymbol{v_t^{ratio}}$.

- The more the repayment is postponed (i.e. low values for δ_B), the more the old agents are favored; With a rapid DRS, young agents can benefit in relative terms with respect to old ones.



- When the DRS is rapid, the burden of the repayment is shared more evenly between the age-groups, whereas a longer postponement of the repayment puts a greater share of the fiscal adjustment on the shoulders of the young agents

- Clearly, the more the DRS entails a substantial postponement, the more the Debt-to-GDP ratio grows, reaching a peak of more than 160%.

Conclusions

- We investigate the impact of the COVID-19 epidemics on the *relative economic welfare* of different age groups of the population, as well as the effects of the "lockdown" measures and of a debt-financed fiscal stimulus

- To this aim, we adapted the macroeconomic model with life-cycle of Gertler (1999), which partitions the population into "young" agents (active workers) and old agents or "retirees". Closed-form solutions allows us to define an appropriate relative welfare index given by the ratio between the aggregate utilities of the two groups at equilibrium.

We isolate **two main channels** through which the fall of life expectancy due to the COVID-19 and the restrictions imposed by lockdown policies impact the relative welfare index

In the absence of lockdown policies (PP scenario), only a **"demographic channel"** is active; the strong fall of old agents' life expectancy induces a relevant reduction of their share in the population. This implies a reduction of the overall labor supply that brings about an increase of the wage rate coupled with a fall of the real interest rate (due to asset decumulation by old agents). This tends to **penalize mainly the (welfare of) old agents**

Conclusions

When lockdown policies are active (PL scenario) a "social restriction channel" prevails on the demographic one. Lockdown policies contain the fall of old agents' life expectancy, but also induce a strong recessionary pull, much greater than the mild reduction taking place under PP.

The relative welfare index shows substantially smaller changes as compared to the hike (favoring the young agents) shown in the case of the demographic channel alone (PP). **Lockdown policies shifts a relevant part of the economic cost** of the pandemic **from older age-groups to younger ones**.

Debt-financed fiscal policy programs, implemented in the wake of the pandemic, do not produce a particularly strong reaction of total output (due to the RBC nature of the model), but different Debt Repayment Schemes (DRS) **have an impact on the time evolution of the relative welfare index**.

The postponement of the debt repayment tends to **favor the old agents**; on the opposite, a rapid repayment tend to advantage young agents **in terms of relative welfare**

We are currently updating the paper with more **recent data** and by adding the possibility that the Pandemic activates also a **preference shock giving rise to a voluntary postponement of consumption** and to an increase in savings.

Please contact one of the authors for questions, suggestions or replication materials

Thanks!