Low nominal rates and the saver: a tale of two countries?

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Motivation

- Demographic aging and fiscal imbalances in the euro area have triggered notable changes in social security.
- Rising importance of private saving in retirement income.
- Shall we expect monetary stabilization policy to work as usual if the fiscal government recedes?
- The answer is a qualified no.

Data/Stylized facts

Cuts to retirement benefits – recent and going forward

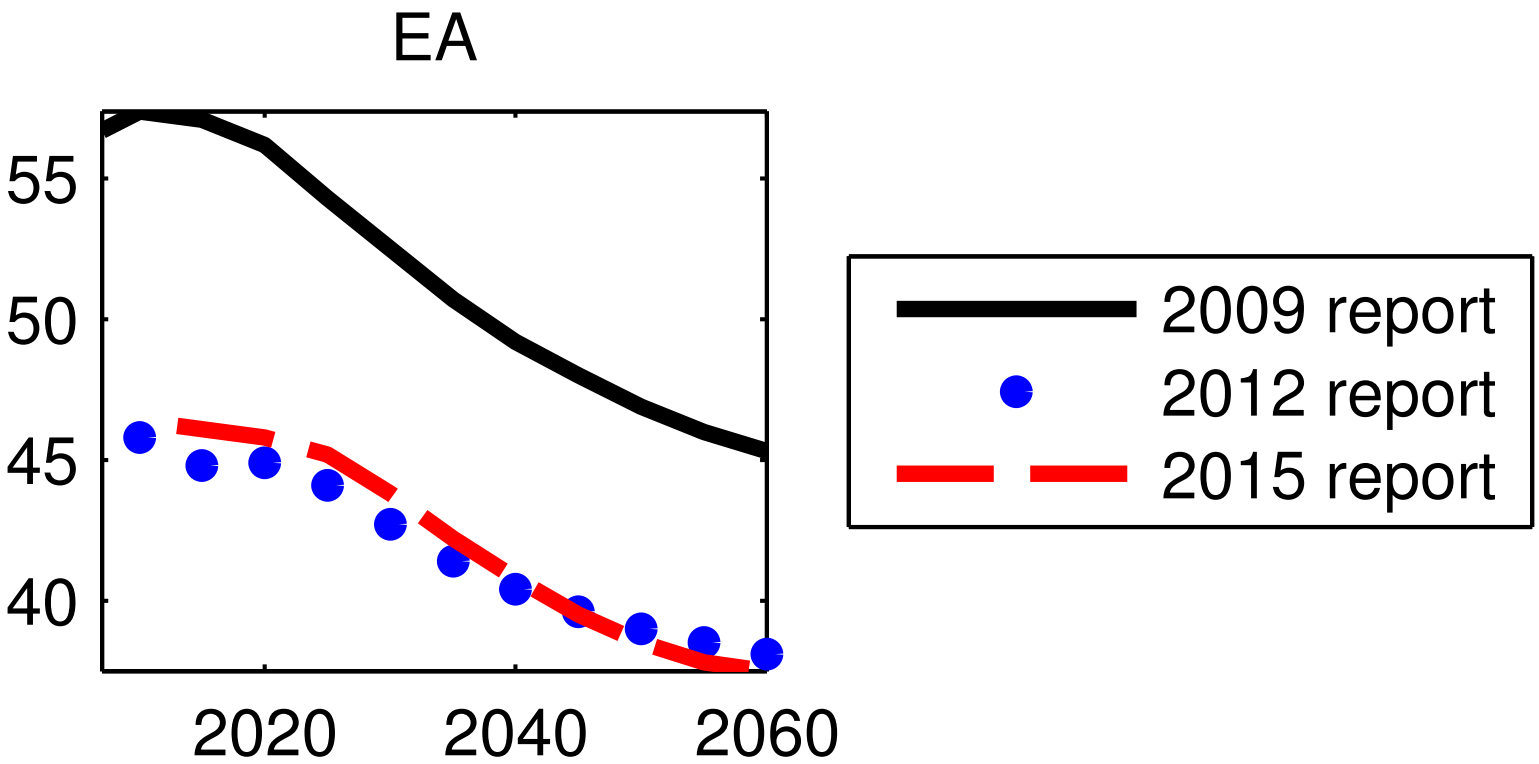
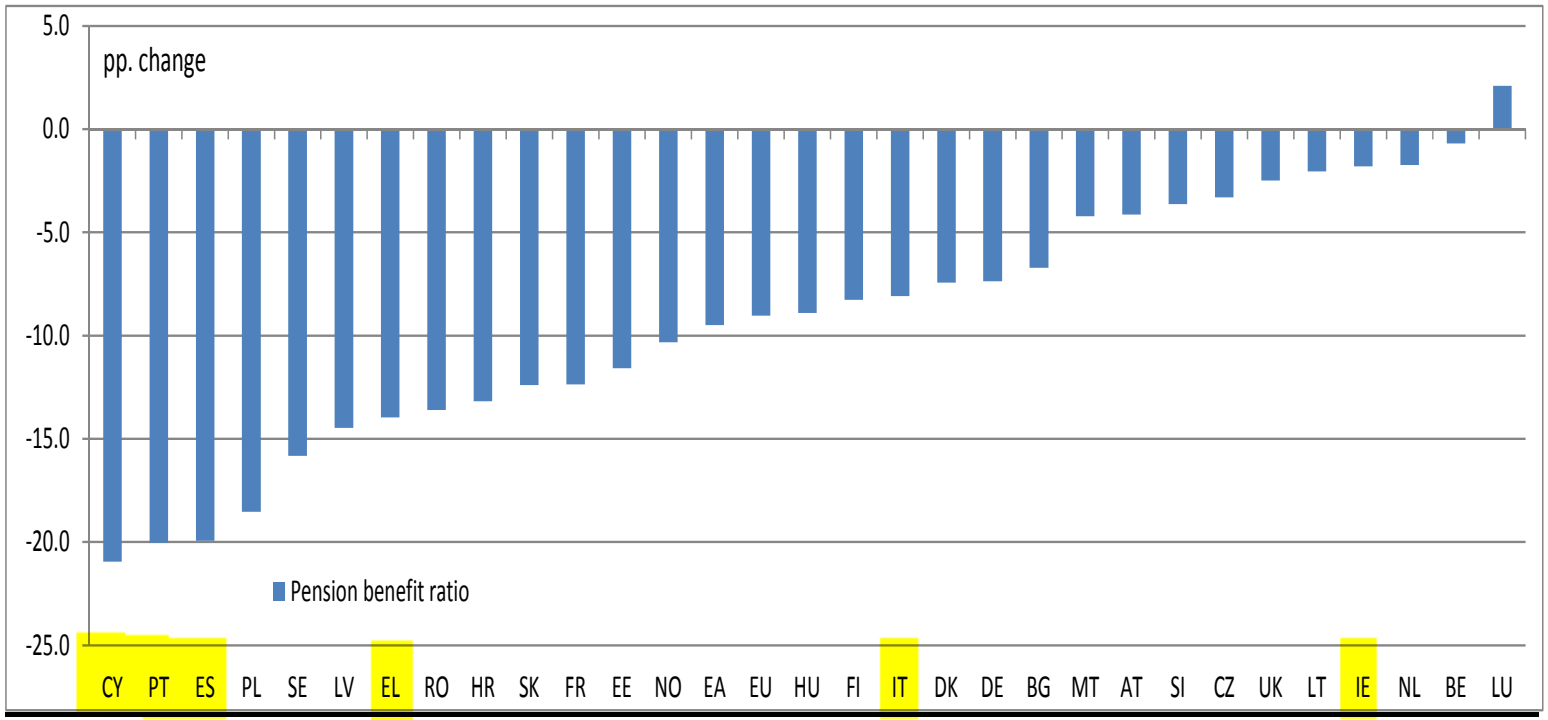


Figure: **Benefit ratio, projections in 2009, 2012, 2015.** The first observation is data (year 2007 for year 2009 projections, year 2010 for year 2012 projections, year 2013 for year 2015 projections). Source: European Commission Aging Reports 2009, 2012, and 2015. The benefit ratio is the average pension as a share of the average wage. The chart shows projections from the Ageing Reports of 2009 (black, solid line), 2012 (blue circles), and 2015 (red, dashed line) for the euro area countries.

Massive cuts – concentrated in the Periphery

Graph 4: **Public pension benefit ratio, change 2013-2060, pp. change**



Source: Commission services, EPC.

Figure: **Projected public pension benefit ratio.** Average pension relative to average wages. Projected change. Source: European Commission 2015 Aging Report.

In addition, sharp increase in retirement age.

Importance of private pension schemes

Table II.1.17: **Private (occupational and individual) pension schemes expenditure in 2013 and 2060**

	% GDP		% total pension expenditure	
Country	2013	2060	2013	2060
DK	4.6	5.8	30.8	44.7
EE	0.0	2.2	0.2	25.9
ES	0.7	0.8	5.3	6.9
HR	0.0	1.6	0.0	19.0
LV	0.0	2.2	0.0	32.2
LT	0.0	1.1	0.0	12.8
NL	5.2	6.5	43.2	45.5
PT	0.3	0.2	2.0	1.5
RO	0.0	0.8	0.0	9.3
SE	2.5	3.9	21.7	34.2

(1) The table only presents the countries which provided (non-zero) data for private (occupational and individual) pension schemes.
Source: Commission services, EPC

Figure: **Private pension schemes.** Source: European Commission 2015 Aging Report.

What this paper seeks to achieve

- Provide analytical insights as to transmission of monetary policy when pensions matter.
- 3-period OLG model.
- Highlight the importance of financial constraints (borrowing constraints).
- Corroborate the mechanism quantitatively (not yet, really).

Model

New Keynesian model with 3-period OLG structure

- Builds on [Eggertsson and Mehrotra(2014)].
- Describe the setup of the model.
- Then, examine how interest-rate changes by the central bank affect aggregate activity, and highlight the determinants.

Model setup

- Time is discrete, $t = 0, 1, 2, \ldots$.
- three generations of households, each of which with a unit mass: The young (y), the middle-aged (m), and the old (o).
- Households receive income and they can save and borrow at the risk-free nominal interest rate R_t (gross).
- We follow the cashless limit-assumption [Woodford(1998)].
- Inside debt is the only asset that can be used for saving.

Preferences

- Life-time utility for an individual born in period t:

$$E_t \left\{ \frac{(c_t^y)^{1-\sigma}}{1-\sigma} + \beta \left(\frac{(c_{t+1}^m)^{1-\sigma}}{1-\sigma} - \chi \frac{1}{1+\nu} (h_{t+1}^m)^{1+\nu} \right) + \beta^2 \frac{(c_{t+2}^o - \overline{c}_{t+2})^{1-\sigma}}{1-\sigma} \right\}.$$

- c_t^y consumption young, c_t^m consumption middle-aged, c_t^o old-age consumption.
- h_t^m are hours worked by the middle-aged.
- $0 < \beta < 1$ is the time-discount factor, $\sigma > 0$, $\nu \geq 0$, and $\chi > 0$.
- $\overline{c}_t > 0$: minimum consumption threshold when old. Can reflect, for example, out-of-pocket health expenditures, high expenses from living in a retirement home, or habits.
- can significantly reduce the intertemporal elasticity of substitution of households close to retirement.

Incomes and endowments I

- Each generation is endowed with home production $\omega_y \geq 0$, $\omega_m \geq 0$ and $\omega_o \geq 0$, respectively.
- Think of these as *after-tax* endowments. That is, ω_0 can be thought of as a state pension.
- Budget constraint for the young:

$$c_t^y \leq \omega_y + d_t^y .$$

- Here d_t^y is nominal borrowing by the young. We will assume that there is a borrowing limit $\overline{d}_t$, such that $d_t^y \leq \overline{d}_t$ always. The borrowing limit will be specified below. We will restrict ourselves to equilibria in which $d_t^y \geq 0$ so that the young are borrowers.

Incomes and endowments II

- budget constraint of the middle-aged. Having borrowed when young, households start saving for retirement:

$$c_t^m + b_t^m + d_{t-1}^y R_{t-1}/\Pi_t \leq \omega_m + h_t^m w_t + \Gamma_t.$$

  Expenditures: consumption and saving for old age, b_t^m. In addition, repay debts entered into when young. R_{t-1}/Π_t is the real interest rate due on this.

- Income: endowment ω_m. In addition, income from selling their labor-hours, h_t^m, on a perfectly competitive labor market. w_t is the competitive real wage. Last, each middle-aged household is endowed with equity of a one-period lived firm. The firm, to be specified further below, provides profits Γ_t.

Incomes and endowments III

- Budget constraint of the old

$$c_t^o \leq \omega_o + b_{t-1}^m R_{t-1}/\Pi_t$$

  The old consume their endowment/pension and their savings.
- For the mechanics of the model, the relative size of endowment and savings will matter.

Production I

- There is a unit mass of intermediate goods firms that produce differentiated goods.
- A representative producer of final goods purchases the intermediate goods in order to produce a homogenous consumption good according to a Dixit-Stiglitz CES production function. Intermediate goods firms and the goods that they produce are indexed by $j \in (0, 1)$.
- Intermediate goods producers are one-period-lived firms owned by the middle-aged. They produce using a production function that is linear in labor. Firm $j's$ output being

$$y_t(j) = z_t h_t(j),$$

where z_t marks labor productivity and $h_t(j)$ are the hours worked hired by firm j.

Production II

- Let $P_t(j)$ be the price of variety j, and let P_t be the aggregate price level.
- We assume that there are quadratic price adjustment costs as in [Rotemberg(1982)].
- Anticipating the production function of the representative final-goods producer, the demand function for good j is given by $y_t(j) = (P_t(j)/P_t)^{-\epsilon} y_t$. Here y_t is aggregate output and $\epsilon > 1$ marks the price elasticity of demand.

Production III

- The problem of producer j, then, is to

$$\max_{P_t(j)} \quad \left(\frac{P_t(j)}{P_t}\right)^{1-\epsilon} y_t - \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} y_t \frac{w_t}{z_t} - \frac{\phi_p}{2} y_t \left(\frac{P_t(j)}{P_{t-1}} - \overline{\Pi}\right)^2 - \frac{\phi_p}{2} y_t \beta E_t \left(\frac{P_{t+1}}{P_t(j)} - \overline{\Pi}\right)^2$$

- Above, parameter $\phi_p > 0$ indexes the price adjustment costs. $\overline{\Pi}$ marks the level of gross inflation to which prices are implicitly indexed. Later, we assume that this level coincides with the central bank's inflation target.

Production IV

- As is common with Rotemberg quadratic adjustment costs, in equilibrium all firms will set the same price. Anticipating this, the first-order condition for price setting by intermediate-goods firms takes the form

$$\Pi_t(\Pi_t - \overline{\Pi}) = \beta E_t \left\{\Pi_{t+1}(\Pi_{t+1} - \overline{\Pi})\right\} + \frac{\epsilon}{\phi_p}\left[\frac{w_t}{z_t} - \frac{\epsilon - 1}{\epsilon}\right].$$

Final goods

- Final consumption goods can be produced from intermediate goods according to

$$y_t = \left(\int_0^1 y_t(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}.$$

- From this, the demand function follows as does the elasticity of demand

$$P_t = \left(\int_0^1 P_t(j)^{1-\epsilon} dj \right)^{\frac{1}{1-\epsilon}}.$$

- Aggregate profits are given by

$$\Gamma_t = \int_0^1 \left[\frac{P_t(j) y_t(j)}{P_t} - w_t h_t(j) - \frac{\phi_p}{2} y_t \left(\frac{P_t(j)}{P_{t-1}} - \overline{\Pi} \right)^2 - \frac{\phi_p}{2} y_t \beta E_t \left(\frac{P_{t+1}}{P_t(j)} - \overline{\Pi} \right)^2 \right] dj.$$

Central bank

- The central bank controls the nominal rate of interest using a Taylor-type rule

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\phi_R} \cdot \left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\phi_\Pi(1-\phi_R)} \cdot \exp\{e_t^m\},\ \phi_R \in [0,1), \phi_\Pi > 1. \tag{1}$$

- This links deviations of the current gross interest R_t from its steady-state value R to past interest rates and deviations of inflation from target.
- Our focus is not on shifts in the natural rate, but the effect of deviations of central bank policy from the natural rate.

Market clearing

- Market clearing for final goods means that

$$y_t + (\omega_y + \omega_m + \omega_o) = c_t^y + c_t^m + c_t^o + y_t \frac{\phi_p}{2} \left[\left(\Pi_t - \overline{\Pi} \right)^2 + \beta E_t \left(\Pi_{t+1} - \overline{\Pi} \right)^2 \right],$$

  that is, output and the endowments of the three age groups are used for consumption by each of them and price-adjustment costs.

- Labor-market clearing and $y_t(j) = y_t$ implies

$$y_t = z_t h_t.$$

- Bond-market clearing means

$$d_t^y = b_t^m$$

Two cases

- Borrowing constraints for the young do not bind: economy responds to monetary easing just like the "standard" New Keynesian representative agent model.
- Borrowing constraints for the young bind.

The case with binding borrowing constraints I

- Assume $d_t^y = \overline{d}_t$ in all periods t.
- Look at dynamics around the deterministic state.

The case with binding borrowing constraints II

- For the young, $\tilde{d}_t^y = \widetilde{\overline{d}}_t$.
- Combining the consumption Euler equation of the middle-aged and the budget constraint for the old, we have

$$\tilde{c}_t^m = \frac{c^m}{c^o - \overline{c}} \left[\frac{R}{\Pi}\right] \tilde{\overline{d}}_t - c^m \left[\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}}\right] E_t \left\{\widehat{R}_t - \widehat{\Pi}_{t+1}\right\} - \frac{c^m}{c^o - \overline{c}} E_t \tilde{\overline{c}}_{t+1}.$$

- Consumption of the middle-aged will show a "conventional response" to lower real interest rates (that is, consumption will rise), whenever either a) such lower interest rates ease the borrowing constraint, the first term above, or b) if

$$\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}} > 0. \tag{2}$$

The case with binding borrowing constraints III

- $$\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}} > 0. \tag{3}$$
- first term: substitution effect, the last term wealth and income effect combined.
- middle-aged consumption will rise with lower real interest rates as long as households are sufficiently willing to substitute intertemporally ($1/\sigma$ large enough) and as long as wealth/income effect of interest change small.
- Note that the latter will be the case if the old-age endowment makes up a large enough share of old-age consumption after netting out the consumption threshold $\overline{c}$ or, equivalently, if savings are a small enough part of old-age consumption net of bare necessities.

The case with binding borrowing constraints IV

- $$\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}} > 0. \tag{4}$$
- Putting it differently: a conventional response of the middle-aged to monetary policy is by no means guaranteed.
- Rather, a lower real interest rate can have adverse effects on consumption if private saving for retirement is a sufficiently essential part of retirement consumption.

Aggregate Dynamics with binding borrowing constraint

- The above already is suggestive of the possibility that a cut in interest rates may have negative effects on aggregate demand (through a rising propensity to save by households close to retirement).
- Aggregate consumption is given by

$$\begin{aligned}\widetilde{c}_t &= \widetilde{c}_t^y + \widetilde{c}_t^m + \widetilde{c}_t^o \\ &= \underbrace{\widetilde{\overline{d}}_t}_{\widetilde{c}_t^y} + \widetilde{c}_t^m + \underbrace{\frac{R}{\Pi}\widetilde{\overline{d}}_{t-1} + \overline{d}\frac{R}{\Pi}\left[\widehat{R}_{t-1} - \widehat{\Pi}_t\right]}_{\widetilde{c}_t^o}\end{aligned}$$

- Output:

$$\begin{aligned}\tilde{y}_t = &\left[1 + \tfrac{c^m}{c^o - \overline{c}}\tfrac{R}{\Pi}\right]\widetilde{\overline{d}}_t - c^m\left[\tfrac{1}{\sigma} - \tfrac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}}\right]E_t\left\{\widehat{R}_t - \widehat{\Pi}_{t+1}\right\} \\ &- \tfrac{c^m}{c^o - \overline{c}}E_t\widetilde{\overline{c}}_{t+1} + \tfrac{R}{\Pi}\widetilde{\overline{d}}_{t-1} + \overline{d}\tfrac{R}{\Pi}\left[\widehat{R}_{t-1} - \widehat{\Pi}_t\right]\end{aligned} \tag{5}$$

Special case: perfectly rigid prices I

- Assume that prices are perfectly rigid ($\phi_p \Rightarrow \infty$). In that case, $\widehat{\Pi}_t = 0$ in all periods and the central bank, by steering the nominal interest rate, directly steers aggregate demand. In that case (5) implies

$$\begin{aligned} \tilde{y}_t &= \left[1 + \frac{c^m}{c^o - \overline{c}} \frac{R}{\Pi}\right] \tilde{\overline{d}}_t + \frac{R}{\Pi} \tilde{\overline{d}}_{t-1} - c^m \left[\frac{1}{\sigma} - \frac{\overline{d} \frac{R}{\Pi}}{c^o - \overline{c}}\right] \widehat{R}_t \\ &\quad + \overline{d} \frac{R}{\Pi} \widehat{R}_{t-1} - \frac{c^m}{c^o - \overline{c}} E_t \tilde{\overline{c}}_{t+1} \end{aligned} \tag{6}$$

Special case: perfectly rigid prices II

Proposition

Consider the three-period OLG model described above. Suppose that prices are perfectly rigid, $\phi_p \to \infty$, $\phi_R \in (0,1)$, *and the borrowing constraint of the young always binds. Further, suppose that borrowing constraints are constant* $\widetilde{\overline{d}}_t = 0$, *the subsistence level of consumption is constant* $\widetilde{\overline{c}}_t = 0$, *and so is productivity,* $\widehat{z}_t = 0$. *Suppose that the economy initially is in steady state. Consider the effect of a one-time monetary policy shock* ϵ_t^m *in* $t = 0$, *and no shocks afterwards. Then, up to first order, equilibrium output evolves according to*

$$\begin{aligned} \tilde{y}_0 &= -c^m \left[\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}}\right] \hat{\epsilon}_0^m, \\ \tilde{y}_t &= \phi_R^{t-1} \left[-c^m \left[\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}}\right] \phi_R + \overline{d}\frac{R}{\Pi}\right] \hat{\epsilon}_0^m, \ t = 1, 2, ... \end{aligned} \tag{7}$$

Special case: perfectly rigid prices III

a) On impact, a monetary easing $\epsilon_0^m < 0$ has a *contractionary* effect on output iff

$$\frac{1}{\sigma} - \frac{\overline{d}\frac{R}{\Pi}}{c^o - \overline{c}} < 0.$$

b) Suppose that the condition in item a) is true. Then, a monetary easing $\epsilon_0^m < 0$ will be *most contractionary* on output $\tilde{y}_t$ in $t = 1, 2, ...$ if the monetary easing is *persistent* (that is, if $\phi_R \to 1$).

c) Even if the monetary easing were expansionary on impact, in future periods it may not. The future old have a lower consumption (the direct effect of having lower returns on a fixed amount of real saving), whereas the stimulative effect of an interest-cut on the middle-aged vanishes ($0 < \phi_R < 1$).

Simulations

- Simulation results based on a rough numerical example.
- Illustrate that the mechanism highlighted above is borne out in a reasonably straightforward exercise.
- Take as first pass. More work to be done for truly quantitative assessment.

Parameters for simulations

Table: Parameters of 3-period OLG model

Par.	value	target	Par.	value	target
β	0.995	real rate of 1 percent	ϕ_p	367.4	Calvo stickiness of 0.85
ν	0.5	Frisch elasticity of 2	ϕ_R	0.85	interest rate persistence
ϵ	11	Markup of 10%	ϕ_Π	1.2	moderate response to inflatio
$\overline{c}$	0	arbitrary choice.	$\overline{\Pi}$	1	zero-inflation steady state
χ	4.1744	$h = 1$ (disut. of work)	$\overline{d}$	0.2627	borr. constr. hardly binds.
σ	2	risk aversion	z	1	steady-state output $y = 1$.
ω_y	0.2	some value			
ω_m	0	middle-aged inc. endog.			
ω_o	0.2	roughly 40% of old age c			

Notes: Parameters chosen for the calibration of the 3-period OLG model.

Steady state in simulations

Table: Steady State 3-period OLG model

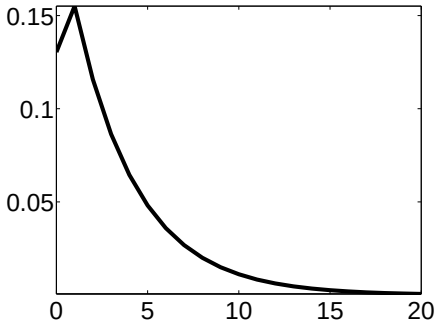
Variable	value	description	Variable	value	description
c^y	0.4651	consumption young	R	1.0117	nominal rate (gross)
c^m	0.4666	consumption middle-aged	Π	1	inflation (gross)
c^o	0.4682	consumption old	w	0.9091	wage rate
d^y	0.2651	borrowing young	h	1	hours worked
b^m	0.2651	saving middle-aged	y	1	variable output

Notes: steady state for the calibrated three-period OLG model. The steady state reported here refers to the case absent a borrowing constraint for the young.

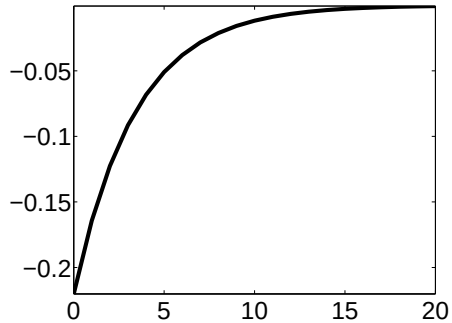
Steady state in the calibration with the borrowing constraint is virtually identical.

The effect of a monetary easing – no borrowing constraint

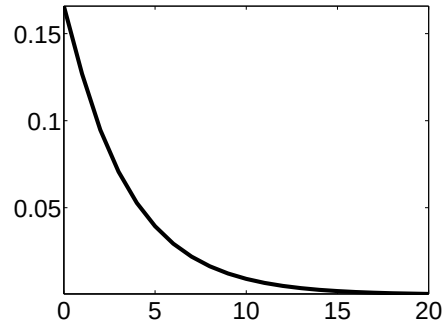
output, $\widehat{y}_t$



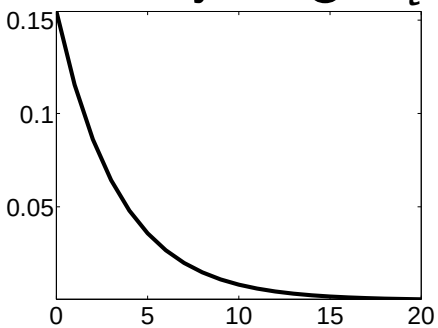
interest, $4\widehat{R}_t$



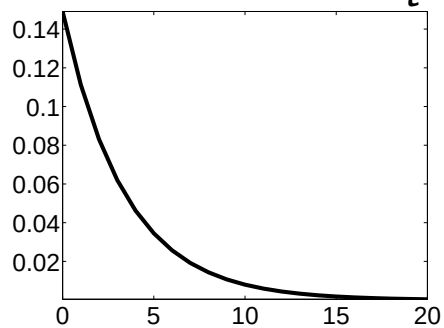
inflation, $4\widehat{\Pi}_t$



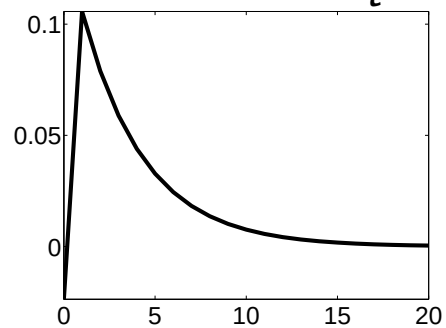
cons. young, $\widehat{c}_t^{\,y}$



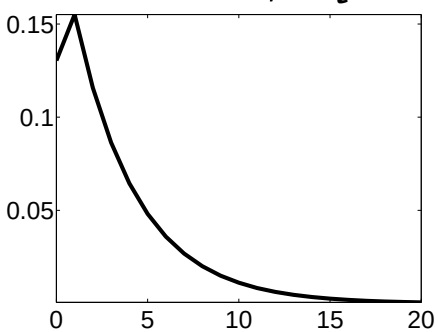
cons. middle, $\widehat{c}_t^{\,m}$



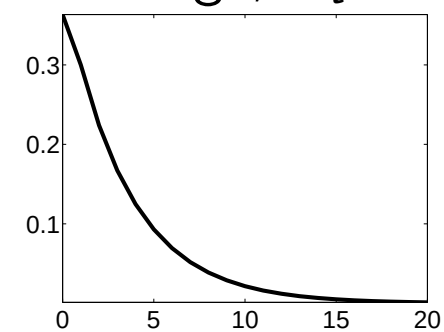
cons. old, $\widehat{c}_t^{\,o}$



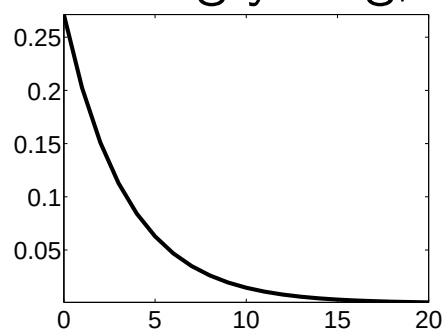
hours, $\widehat{h}_t$



wage, $\widehat{w}_t$

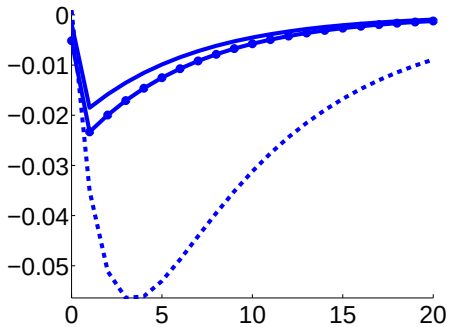


borrowing young, $\widehat{d}_t^{\,y}$

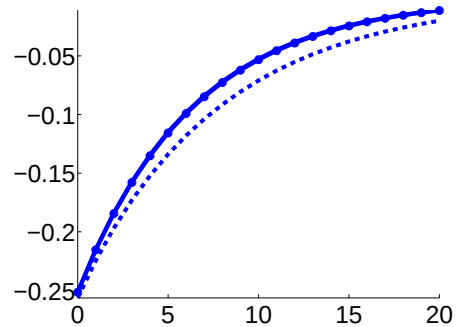


The effect of a monetary easing – borrowing constraint

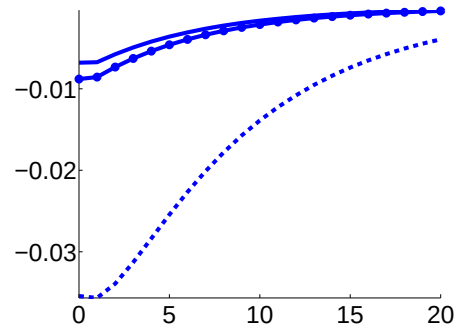
output, $\widehat{y}_t$



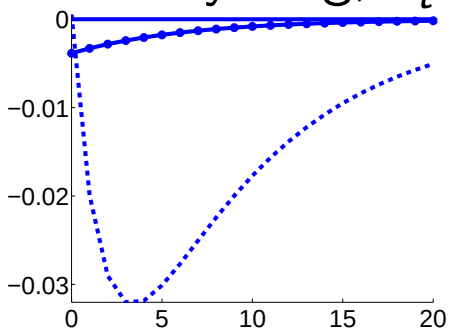
interest, $4\widehat{R}_t$



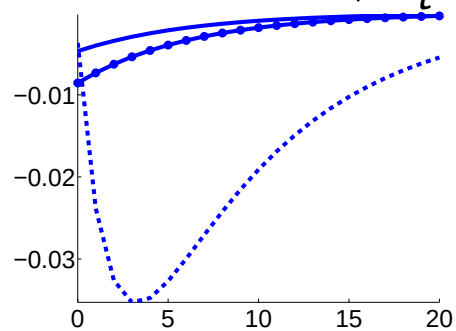
inflation, $4\widehat{\Pi}_t$



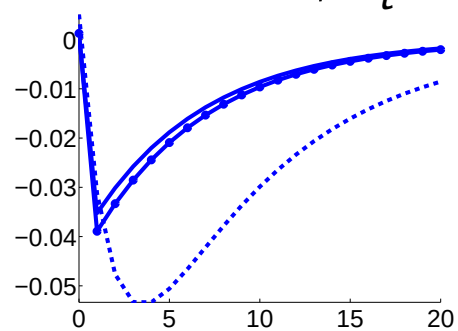
cons. young, $\widehat{c}_t^{\,y}$



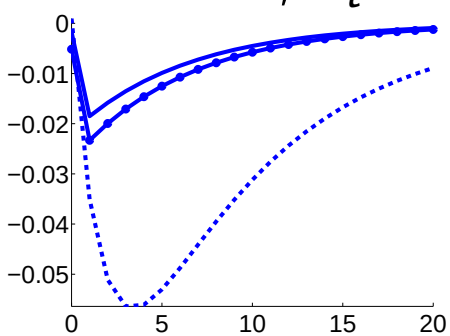
cons. middle, $\widehat{c}_t^{\,m}$



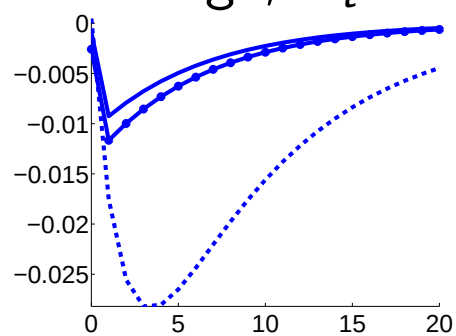
cons. old, $\widehat{c}_t^{\,o}$



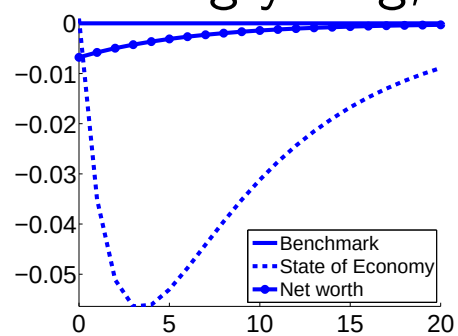
hours, $\widehat{h}_t$



wage, $\widehat{w}_t$



borrowing young, $\widehat{d}_t^{\,y}$



Conclusions I

- There is a perception in some parts of the euro area that low interest rates are counterproductive in stabilizing economic activity.
- This perception builds on a notion that low interest rates "hurt the saver."
- The current paper has formalized this notion in a simple New Keynesian three-period OLG setup.

Conclusions II

- If private savings provide substantial support to retirement consumption, and borrowing constraints bind, the increased desire by the middle-aged to save (and so, refrain from consumption) can render a monetary "easing" recessionary.
- Effect exacerbated if borrowing constraint binds.
- More work needed to corroborate the mechanism.

Policy Conclusions

- Monetary policy may not be a good tool to stabilize activity in such cases.
- Indeed, it may be *risky* to use. Note that the response of middle-aged consumption to monetary policy switches sign at some level of private saving.
- Risk of "doubling down" with a monetary easing: On the one side of that point, increases output more strongly
- On the other side, low interest rates plunge the economy ever deeper into recession ...

Retirement age

Graph I.2.1: **Impact of pension reforms (1) on the average effective retirement age from the labour force (2)**

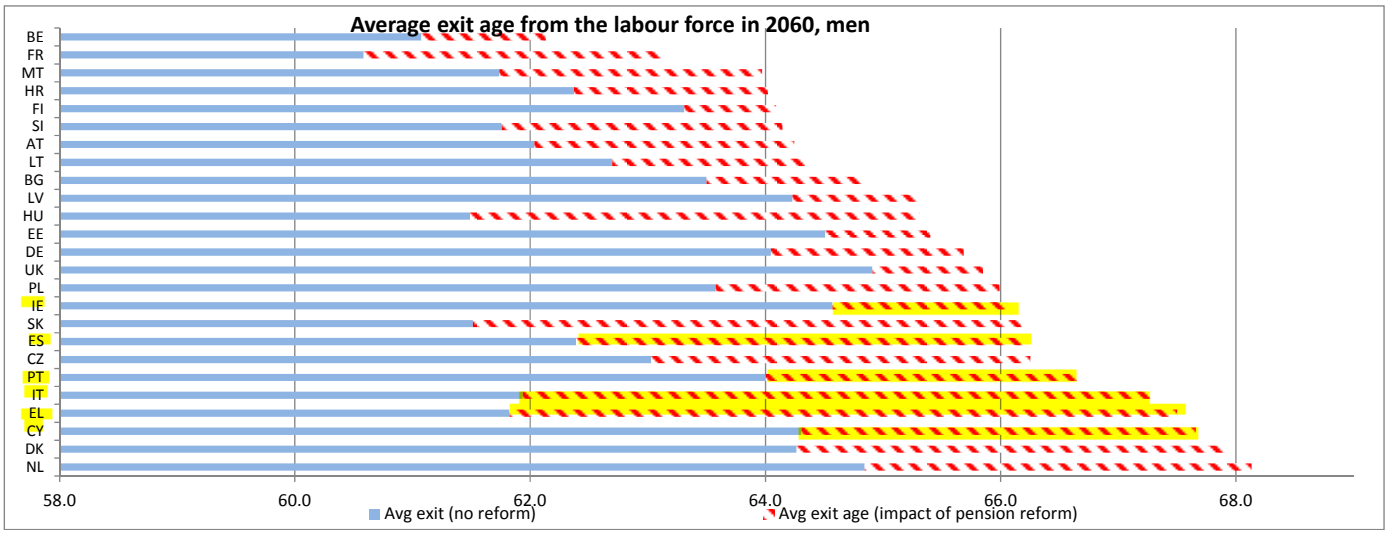


Figure: **Average effective retirement age – impact of pension reforms.** Projected average retirement age. Source: [European Commission(2015)].

Labor-force participation

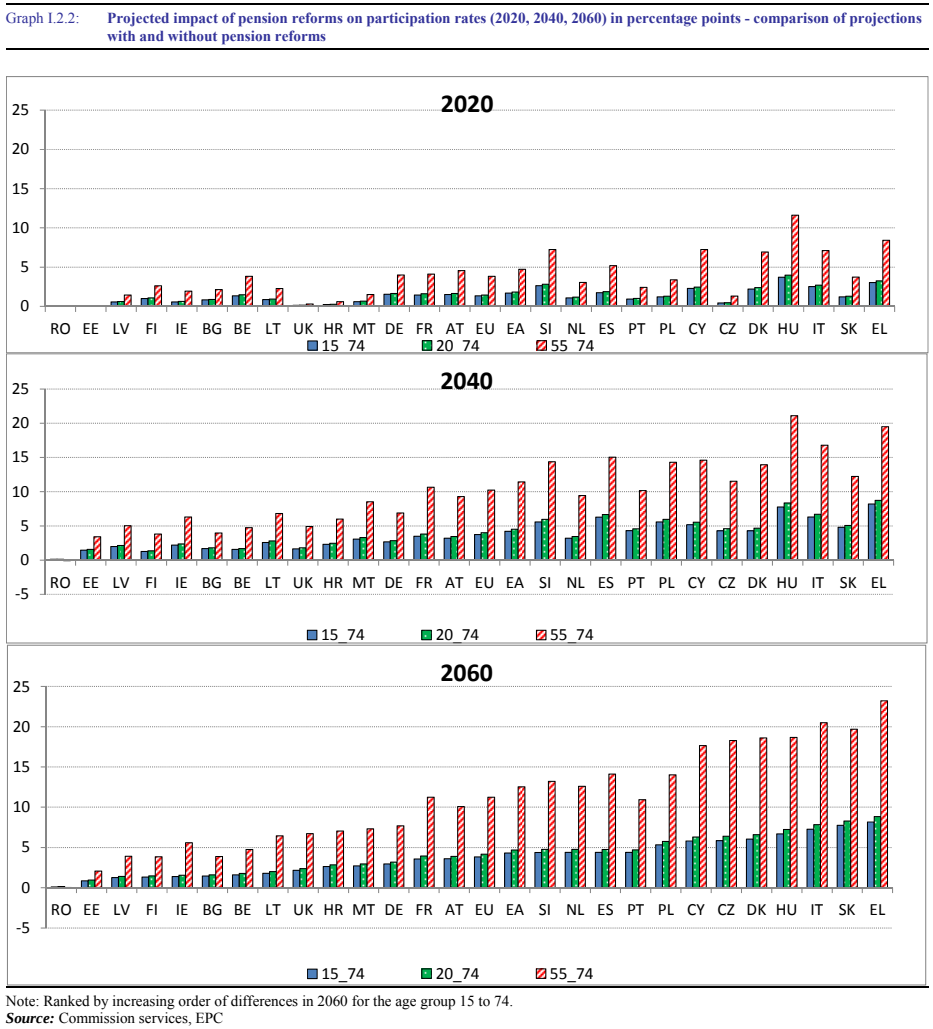


Figure: **Participation rate by age.** Projected participation rate. Source: [European Commission(2015)].

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