# The dark side of low(ering) interest rates

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# Introduction

# Motivation: Benefits under pressure

**Pension deficits reach a record £459bn as interest rate cut bites**

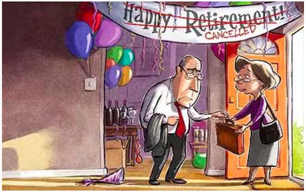
share


Generous defined benefit schemes have seen their funding shortfalls worsen CREDIT: ROSEMARY CALVERT

Your retirement on NBCNEWS.com

## Low interest rates squeezing pension funds

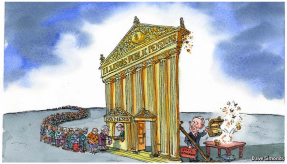
**Public, private plans scramble to make up widening shortfalls**




Public pensions

## America's Greece?

*Illinois risks default if it fails to tackle its public-pension crisis*



# Motivation: Retirement savings under pressure

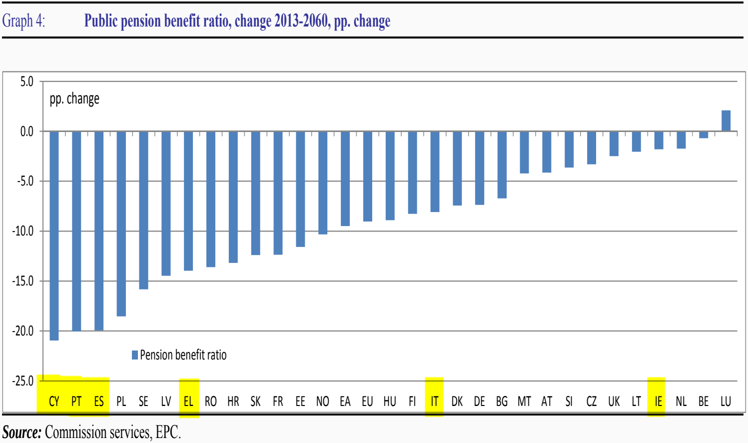



**Figure 1: Projected public pension benefit ratio.** Average pension relative to average wages. Projected change. Source: European Commission 2015 Aging Report.

# Motivation I

- Stylized facts
  - falling social security,
  - rising importance of private saving in retirement income,
- We ask what the implications are for monetary policy.

# Research questions

- Do we have to rethink monetary policy making?
- The answer is a yes, to some extent.
- "Will expansionary monetary policy" remain "expansionary" if the fiscal government recedes?
- Will price stability-oriented monetary policy be able to anchor the price level and real activity?
- The answer is a qualified no. Monetary policy may need to react *more strongly* to inflation

# The channel we emphasize

- The "standard" New Keynesian model emphasizes substitution effects for monetary transmission:
  - When prices are rigid, lower nominal interest rates mean lower real rates.
  - Households substitute intertemporally, wish to save less: current demand rises, output expands.
- Our paper adds to this a wealth view:
  - households save for retirement.
  - lower real rates mean a negative wealth effect.
  - if social security recedes, private saving will cover a bigger part of retirement consumption.
  - the role of the wealth effect rises.

# What we do

- Aggregate demand, then, depends on reaction of borrowers: if they do not expand consumption sufficiently, aggregate demand falls.
- Potential for Keynesian "paradox of thrift."
- This paper *is not* about secular stagnation.
- Analyze how monetary policy works when private savings for retirement matter.
- Toward this end, use OLG model with
  1. Nominal frictions,
  2. Inside debt,
  3. Financial frictions (borrowing constraints),
  4. Hump-shaped income profile.
- Partially done: provide a quantitative analysis.

# Literature

- Secular stagnation: Eggertsson and Mehrotra, Guerron- Quintana and Jinnai, Summers.
- Monetary policy: CEE, Woodford.
- OLG - Lifecycle: Samuelson, Blanchard, Bullard et al.
- Paradoxes in NK or OK models: Gali‘s bubble paper, Hall‘s missing deflation, Del Negro‘s forward looking puzzle, Keynes‘ paradox of thrift.

# Model

# Main ingredients

- Parsimonious OLG model to illustrate mechanism.
- We build on Eggertsson and Mehrotra (2014)
- Time is discrete $t = 0, 1, 2,$
- Three generations of households, each with unit mass:
  Young ($y$), middle-aged ($m$), and old ($o$).
- Households get income, work; save and borrow at rate $R_t$.
- Inside debt only instrument used for savings.

# Preferences

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

$$E_t \left\{ u\left(c_t^y, \overline{c}^y, h_t^y\right) + \beta \cdot u\left(c_{t+1}^m, \overline{c}^m, h_{t+1}^m\right) + \beta^2 \cdot u\left(c_{t+2}^o, \overline{c}^o, h_{t+2}^o\right) \right\}.$$

- $c_t^y$ consumption young, $c_t^m$ consumption middle-aged, $c_t^o$ old-age consumption.
- $\overline{c}^y$, $\overline{c}^m$, and $\overline{c}^o$ exogenous minimum consumption threshold.
- $h_t^y$, $h_t^m$, $h_t^o$ are hours worked.

# Incomes and endowments I

- Consumers purchase homogenous goods.
- Produced in the same period, or endowments.
- Tradable between households, but not storable over time.
- Each generation is endowed with home production $\omega_y \geq 0$, $\omega_m \geq 0$ and $\omega_o \geq 0$, respectively.
- Social security tax $\tau_t^y$, $\tau_t^m$, and $\tau_t^o$, lump-sum, positive or negative.
- Households borrow when young, save when middle-aged, and dissave in old age.

# Incomes and endowments II

- budget constraint for the young

$$c_t^y = d_t^y + \omega_y - \tau_t^y + w_t h_t^y.$$

- On the income side, the young borrow, have an endowment $\omega_y$, pay social security taxes $\tau_t^y$, derive labor labor income (with $w_t$ being the competitive real wage).
- We will assume that there is a borrowing limit $\overline{d}_t$, such that $d_t^y \leq \overline{d}_t$ always.

# Incomes and endowments III

- <u>budget constraint for the middle-aged</u>

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

- Expenditure side: consumption in middle age and saving for retirement + repaying debts incurred when young.
- Income side: endowment $\omega_m$, social security taxes $\tau_t^m$, and income from working.
- Last, each middle-aged household is endowed with equity of a portfolio of one-period lived firms.

# Incomes and endowments IV

- budget constraint of the old

$$c_t^o \leq \omega_o - \tau_t^o + w_t h_t^o + b_{t-1}^m \frac{R_{t-1}}{\Pi_t}$$

- The old consume their endowment after taxes, any income they may have from working, and their savings.

# Production I

- Two types of firms: final goods and intermediate goods.
- respresentative final goods producer purchases intermediate goods, produce homogenous consumption good.
- Dixit-Stiglitz production function

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

- demand function for good $j$ is $y_t(j) = (P_t(j)/P_t)^{-\theta} y_t$.
- Aggregate price level being $P_t = \left( \int_0^1 P_t(j)^{1-\theta} dj \right)^{\frac{1}{1-\theta}}$.

# Production II

- Intermediate goods produced by unit mass of intermediate goods firms, indexed by $j \in (0, 1)$.
- Production function $y_t(j) = zh_t(j)$, $z$ labor productivity and $h_t(j)$ hours worked hired by firm $j$.
- sells output in a monopolistically competitive market, subject to Rotemberg quadratic price adjustment costs.
- the problem of intermediate goods producer $j$

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

Parameter $\phi_p > 0$ indexes the price adjustment costs.

# Production III

- the first-order condition for price setting by intermediate-goods firms takes the form

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

- Aggregate profits are given by

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

# Monetary policy

- Central bank controls nominal interest rate. Taylor rule

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

- 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.
- Throughout the paper: steady-state natural rate accounted for; abstract from ZLB.
- Two questions:
  - Transmission of monetary shock $e_t$?
  - Does $\phi_\Pi > 1$ ensure determinacy?

# Fiscal policy

- The social security system runs a balanced budget

$$\tau_t^y + \tau_t^m + \tau_t^o = 0.$$

# Equilibrium and market clearing

- Symmetry: $P_t(j) = P_t$ for all firms $j$.

$$y_t(j) = y_t,\ h_t(j) = h_t.$$

- Market clearing for final goods, then, means that

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

- The labor market clears if

$$h_t = h_t^y + h_t^m + h_t^o.$$

- Bond-market clearing requires

$$d_t^y = b_t^m.$$

# Analytics

# Preferences I

- For CRRA preferences,

$$u(c, \overline{c}, h) = \frac{(c - \overline{c})^{1-\sigma} - 1}{1 - \sigma} - \psi \frac{h^{1+\nu}}{1 + \nu},$$

- Consumption Euler equations

$$\tilde{c}_t^m = \frac{c^m - \overline{c}^m}{c^o - \overline{c}^o} E_t \tilde{c}_{t+1}^o - \frac{1}{\sigma}(c^m - \overline{c}^m) E_t \{\widehat{R}_t - E_t \widehat{\Pi}_{t+1}\},$$

- the labor supply FOC is given by

$$\widehat{w}_t = \frac{\nu}{h^m} \tilde{h}_t^m + \frac{\sigma}{c^m - \overline{c}^m} \tilde{c}_t^m.$$

# Preview

- Focus on two cases: private retirement savings small or retirement savings matter for retirement.
- retirement savings small:
  - business as usual for monetary authority.
  - standard response to monetary easing.
- retirement savings matter:
  - Taylor principle does not ensure unique equilibrium.
  - Even if equilibrium is unique: Output and inflation may *fall* after a monetary "easing"!

# Simplifying assumptions

- To derive tractable results, unless noted otherwise, assume that only the middle-aged supply labor.

- This means $h_y = 0$ and $h_o = 0$, so that the income of young and old does not depend on the response of the wage.

# Binding borrowing constraint

# Binding borrowing constraint I

- $\widetilde{d}_t^y = \overline{\widetilde{d}}_t$.
- Euler equation of the young not binding.
- What matters is behavior of middle-aged
- Combine the budget constraint old, and consumption Euler equation of middle-aged:

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

# Consumption by middle-aged I

- Consumption of the middle-aged will show a "conventional response" to lower real interest rates (that is, consumption of the middle-aged will rise) if

$$A := \frac{1}{\sigma} - \frac{b^m \frac{R}{\Pi}}{c^o - \overline{c}^o} > 0.$$

- Term $1/\sigma$ substitution effect, unambiguously positive.
- The last term shows the income and wealth effect combined. Unambiguously positive.
- $A's$ sign depends on the importance of private saving in effective retirement consumption.

# Aggregate output I

- Use production function $\tilde{h}_t^m = \frac{1}{z}\tilde{y}_t$, and steady-state Phillips curve, $w = (\theta - 1)/\theta z$.

- Labor supply FOC, Euler conditions, and resource constraints so that output evolves as

$$\begin{aligned}
\widetilde{y}_t \quad = \quad & \left[1 + \frac{c^m - c_h^m}{c^o - \bar{c}^o}\frac{R}{\Pi}\right]\widetilde{\overline{d}}_t + \frac{R}{\Pi}\widetilde{\overline{d}}_{t-1} \\
& -(c^m - c_h^m)\left[\frac{1}{\sigma} - \frac{b_m \frac{R}{\Pi}}{c^o - \bar{c}^o}\right] E_t\left\{\widehat{R}_t - \widehat{\Pi}_{t+1}\right\} \\
& + b^m \frac{R}{\Pi}\left[\widehat{R}_{t-1} - \widehat{\Pi}_t\right] \\
& - \tilde{\tau}_t^y - \tilde{\tau}_t^o.
\end{aligned}$$

- the aggregate stimulus derived off a reduction in the real rate of interest all else equal is decreasing in the extent to which households rely on own savings ($b_m$) for old-age consumption.

# Two limiting cases

Highlight implications analytically for two limiting cases:

- perfectly rigid prices,
- and perfectly elastic labor supply.

# A special case: perfectly rigid prices I

- For now, focus only on transmission of shock.
- Follow Werning (2015) and highlight implications of a change in the real interest rate.
- Central bank perfectly controls the real interest rate.
- More formally, assume that prices are perfectly rigid ($\phi_p \to \infty$). In that case, $\Pi_t = 1$ (and $\widehat{\Pi}_t = 0$) in all periods.

# A special case: perfectly rigid prices II

- The central bank, by steering the nominal interest rate, directly steers aggregate demand.

$$
\begin{aligned}
\widetilde{y}_t \;\; = \;\; & \left[1 + \frac{c^m - c_h^m}{c^o - \overline{c}^o}\frac{R}{\Pi}\right]\widetilde{\overline{d}}_t + \frac{R}{\Pi}\widetilde{\overline{d}}_{t-1} \\
& - (c^m - c_h^m)\left[\frac{1}{\sigma} - \frac{b_m \frac{R}{\Pi}}{c^o - \overline{c}^o}\right]\widehat{R}_t + b^m \frac{R}{\Pi}\widehat{R}_{t-1} \\
& - \tilde{\tau}_t^y - \tilde{\tau}_t^o .
\end{aligned}
$$

# A special case: perfectly rigid prices III

## 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* $\widetilde{\overline{d}}_t = 0$ *and that that the economy initially is in its steady state. Consider the effect of a one-time monetary policy shock* $e_t$ *in* $t = 0$*, and no shocks afterwards. Then, up to first order, equilibrium output evolves according to*

$$\widetilde{y}_0 = -(c^m - c_h^m)\left[\frac{1}{\sigma} - \frac{b^m R}{c^o - \overline{c}^o}\right] \cdot \hat{R}_0,$$

$$\widetilde{y}_t = \phi_R^{t-1}\left[-(c^m - c_h^m)\left[\frac{1}{\sigma} - \frac{b^m R}{c^o - \overline{c}^o}\right]\phi_R + b^m R\right] \cdot \hat{R}_0, \; t = 1, 2, \ldots$$

# A special case: perfectly rigid prices IV

**Corollary**

*Consider a persistent "monetary easing" $\widehat{R}_0 < 0$.*

a) *A monetary easing will stimulate output the less, the more private saving $b_m R$ there is for old age.*

b) *On impact, in $t = 0$, a monetary easing has an expansionary effect on output if $A > 0$. Otherwise, output will fall.*

c) *Suppose $A < 0$. A monetary easing will be the more contractionary for output $\widetilde{y}_t$ in $t = 1, 2, ...$ the more persistent the easing is (the larger $\phi_R$).*

- The more households rely on own savings for retirement, the less expansionary the effect of a monetary easing on output.
- Up to the point, indeed, that a "monetary easing" becomes contractionary altogether.

# Second special case: perfectly elastic labor supply I

- let prices be less than perfectly rigid $0 < \phi_p < \infty$ but assume that labor supply is perfectly elastic ($\nu \to 0$).

- to see the implications for local determinacy, recall linearized New Keynesian Phillips curve, wage $\widehat{w}_t$ is driving term.

- Combining the labor-supply first-order condition and the production function for intermediate goods, we have that

$$\widehat{w}_t = \frac{\nu}{y}\tilde{y}_t + \frac{\sigma}{c^m - \overline{c}^m}\tilde{c}_t^m.$$

# Second special case: perfectly elastic labor supply II

- Since we will focus here on the case $\nu \to 0$, we will consider CRRA preferences only.

- Then,

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

- Standard New Keynesian model: as long as $\phi_\Pi > 1$ (the Taylor principle) – inflation and output are uniquely determined. Self-fulfilling expectations cannot form.

# Second special case: perfectly elastic labor supply III

- Key to this: interaction of central bank's reaction and the response of marginal costs. Non-fundamental belief of higher inflation would meet with central bank that raises real rate.
- Consumers substitute so as to save more and consume less, the wage falls – and with it marginal costs. This invalidates non-fundamental inflationary beliefs.
- Requires negative response of marginal costs to monetary tightening.
- Cannot be taken for granted.

# Second special case: perfectly elastic labor supply IV

- Whenever $A < 0$, that is, the wealth/income effect of an interest-rate change is strong enough, there could be scope for indeterminacy even if central bank obeys Taylor principle.
- Indeterminacy will be both nominal and real.
- Main message: in order to anchor inflation expectations when the government recedes from providing pensions, central bank may need to respond more strongly to inflation.

# Proposition on indeterminacy

## Proposition

*$\nu \to 0$ and CRRA preferences. Suppose that $\phi_R = 0$. Borrowing constraints are constant. Let $\kappa := (\theta - 1)/\phi_p$.*

a) *If $A > 0$, a response of $\phi_\Pi > 1$ (the Taylor principle) will ensure determinacy. Smaller responses may as well.*

b) *If $A < 0$ and $\beta + \kappa\sigma A > 0$, there is determinacy for any $\phi_\Pi > 0$, except if*

$$1 + \frac{1-\beta}{-\kappa\sigma A} < \phi_\Pi < -1 + \frac{1+\beta}{-\kappa\sigma A}.$$

*The lower threshold is larger than unity.*

c) *If $A < 0$ and $\beta + \kappa\sigma A < 0$, then there will be determinacy for any $\phi_\Pi > 0$, except if*

$$-1 + \frac{1+\beta}{-\kappa\sigma A} < \phi_\Pi < 1 + \frac{1-\beta}{-\kappa\sigma A}.$$

*Note that the upper threshold is larger than unity.*

# (In)determinacy – the mechanism I

- If income effect sufficiently strong, so that $A < 0$, Taylor principle no longer holds.
- If retirement savings are large-enough part of retirement consumption, real wage may *rise* with higher real rates.
- An example: Suppose households form non-fundamental beliefs of mean-reverting, but perhaps persistent, high inflation.
- Suppose the central bank raises the nominal interest rate sufficiently so that the real interest rate rises (the Taylor principle).
- When real rates are high, middle-aged households will want to work less (and consume more) since saving for retirement is provided for easily. The wage rises.

# (In)determinacy – the mechanism II

- Thus, what can happen if the central bank reacts to a non-fundamental belief of inflation by raising the real rate of interest, is that precisely this validates these very beliefs.
- In other words, the Taylor principle may no longer guarantee a unique stable rational expectations equilibrium.

# (In)determinacy – the mechanism III

- Two ways to anchor inflation expectations: the central bank could more strongly respond to inflation than the Taylor principle suggests, or by less

# (In)determinacy – the mechanism IV

- For sure, as $\phi_\Pi \to \infty$, the central bank would anchor inflation expectations and real activity.
- The underlying rationale differs from that of the conventional New Keynesian model, however.
- As the central bank embarks on a strong response to inflation, it makes sure that whenever non-fundamental inflation expectations form, there will be no *bounded* level of these expectations.
- If such beliefs formed, the central bank would strongly raise the real rate of interest, wages would strongly rise, and so would marginal costs,and so forth.

# (In)determinacy – the mechanism V

- Another avenue for ensuring determinacy: any response to inflation that is small (!).
- Any reaction of the central bank with $\phi_\Pi$ *smaller (!)* than unity will ensure determinacy, including the case of constant interest rates, $\phi_\Pi = 0$, a sharp reversal of the conventional wisdom; for example, Sargent and Wallace (1975).

# (In)determinacy – the mechanism VI

- When retirement savings are important ($A < 0$), inflationary beliefs can be self-regulating amid constant interest rates.
- Suppose inflationary beliefs formed and that the nominal interest rate were held constant. Then, the real interest rate would fall.
- The wealth effect being important, the middle-aged would want to work more, reducing the wage and marginal costs, in turn contradicting the beliefs of high inflation.
- If the wage falls just enough, self-fulfilling expectations are ruled out.

# (In)determinacy – the mechanism VII

- Item c) of the proposition shows that the constant interest-rate case is not fool-proof, however, whereas a strong response to inflation is.

# Monetary transmission I

- The next proposition summarizes the response of inflation and output to a persistent monetary easing, provided that there is determinacy.

# Monetary transmission II

## Proposition

*A monetary shock $e_t$ that follows an AR(1) process with autocorrelation $\rho \in (0,1)$. The fundamental solution for inflation is given by $\widehat{\Pi}_t = a\epsilon_t^m$, with $a = -\kappa\sigma A/(1-\beta\rho+\kappa\sigma A(\phi_\Pi-\rho))$.*

a) **Response of inflation**. *If $A > 0$ and the Taylor principle holds, the response of inflation will be conventional ($a < 0$).*

b) *If $A < 0$ and $\beta + \kappa\sigma A > 0$, responses of $\phi_\Pi$ below the lower threshold given in the previous Proposition item b) will show an unconventional response of inflation, $a > 0$, whereas response coefficients of $\phi_\Pi$ larger than the upper threshold ensures a conventional response.*

d) **Response of output**. *Consider the case the $\rho = 0$. Suppose that price rigidities are sufficiently large, such that $c^m > \overline{d}\frac{R}{\Pi}\kappa\sigma$. Suppose that there is determinacy. Output will rise following a monetary easing if $A > 0$. If $A < 0$, output rises only if $\phi_\Pi > \frac{1}{-\kappa A\sigma}$. Otherwise, the monetary easing is contractionary.*

# Slack borrowing constraints

# Slack borrowing constraint I

- Next, we discuss the case when borrowing constraints on the young are slack.
- In order to be able to derive tractable analytical results, we continue to focus on the case in which only the middle-aged supply work.
- In addition, we set $\beta = 1$. We focus on a parameterization in which the effective endowment of young and old households is identical, namely, $\omega^y - \tau^y - \overline{c}^y = \omega^o - \tau^o - \overline{c}^o$. We also focus on a zero-inflation steady state.
- For the case of perfectly rigid prices, we have

# Slack borrowing constraint II

## Proposition

*Consider the three-period OLG model described above. Suppose that prices are perfectly rigid, and the borrowing constraint of the young never binds. Consider the effect of a persistent monetary policy shock $e_t$ in $t = 0$. Then, up to first order, saving evolves according to*

$$\widetilde{b}_t^m \quad = \quad -\tfrac{1}{1-\phi_R}(c^y - \overline{c}^y)\left[\tfrac{1}{\sigma}(1+\phi_R) - \tfrac{b^m}{c_o - \overline{c}^o}\phi_R\right]\widehat{R}_t.$$

*In addition, we have that*

$$\tilde{y}_0 = -(c^y - \overline{c}^y)\left[\frac{1}{\sigma}(3+\phi_R) - \frac{b^m}{c_o - \overline{c}^o}(1+\phi_R)\right]\frac{1}{1-\phi_R}\widehat{R}_0$$

*and*

$$\tilde{y}_0 = -(c^y - \overline{c}^y)\left[\frac{1}{\sigma}(1+4\phi_R+\phi_R^2) - \frac{b^m}{c_o - \overline{c}^o}(1+\phi_R+\phi_R^2)\right]\frac{1}{1-\phi_R}\widehat{R}_t, \;\; t \geq 1$$

# Slack borrowing constraint III

## Corollary

*Consider a "monetary easing"* $\widehat{R}_0 < 0$.

a) *A monetary easing will stimulate output the less, the more of a role private saving* $b_m$ *play in financing old-age.*

b) *On impact, in* $t = 0$, *a monetary easing has an expansionary effect on output if*

$$\frac{1}{\sigma}(3 + \phi_R) - \frac{b^m}{c_o - \overline{c}^o}(1 + \phi_R) > 0.$$

*Otherwise, output will fall.*

d) *Suppose that the steady state with and without borrowing constraints on the young is the same.*

   i) *whenever impact response is expansionary with borrowing constraints, the impact response is expansionary without a borrowing constraint on the young. The reverse is not true.*

## Slack borrowing constraint IV

- Also without a binding borrowing constraint on the young, we have that a monetary "easing" can be contractionary.
- Such an outcome is less likely when the borrowing constraints of the young do not bind.

# Summary: analytical results

- When the government retreats from social security, monetary policy may need to focus more on price-stability, so as to anchor inflation and economic activity.
- A monetary "easing" need no longer be expansionary.
- Additional demand for savings by the middle-aged needs to be absorbed by additional demand for credit by the young.

# Simulations

# Simulations

- Lets uncover full dynamics based on a rough parametrization (more realistic model coming).
- It will help visualize the models mechanism.

# Parameters for simulations

**Table 1:** Parameters of 3-period OLG model

| Par. | value | target | Par. | value | target |
|---|---|---|---|---|---|
| $\beta$ | 0.995 | real rate of 1 percent | $\phi_p$ | 367.4 | Calvo stickiness of 0.85 |
| $\nu$ | 0.5 | Frisch elasticity of 2 | $\phi_R$ | 0.85 | interest rate persistence |
| $\epsilon$ | 11 | Markup of 10% | $\phi_\Pi$ | 1.2 | moderate response to inflation |
| $\overline{c}$ | 0 | arbitrary choice. | $\overline{\Pi}$ | 1 | zero-inflation steady state |
| $\chi$ | 4.1744 | $h = 1$ (disut. of work) | $\overline{d}$ | 0.2627 | borr. constr. hardly binds. |
| $\sigma$ | 2 | risk aversion | $z$ | 1 | steady-state output $y = 1$. |
| $\omega_y$ | 0.2 | some value | | | |
| $\omega_m$ | 0 | middle-aged inc. endog. | | | |
| $\omega_o$ | 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 2:** 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 | $\Pi$ | 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.

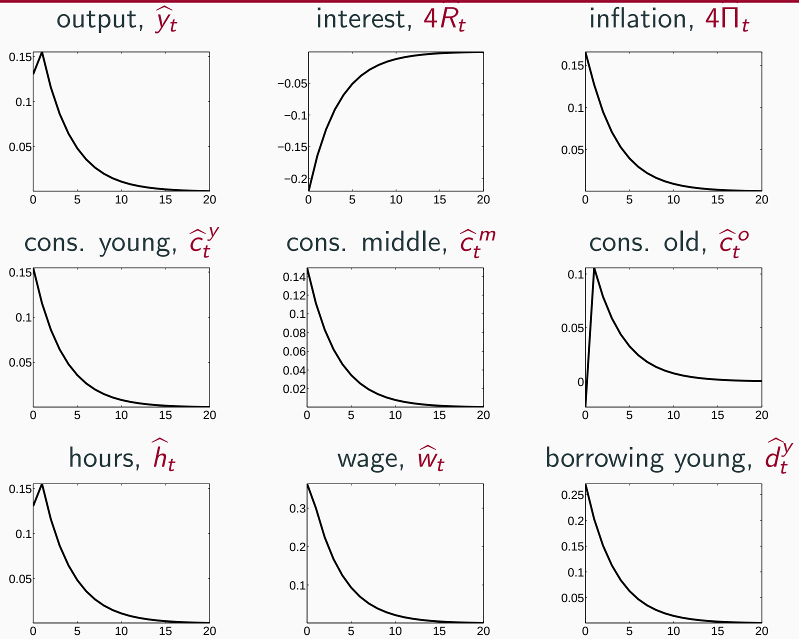
# The (no B's and C's)

$$A = -0.0676$$

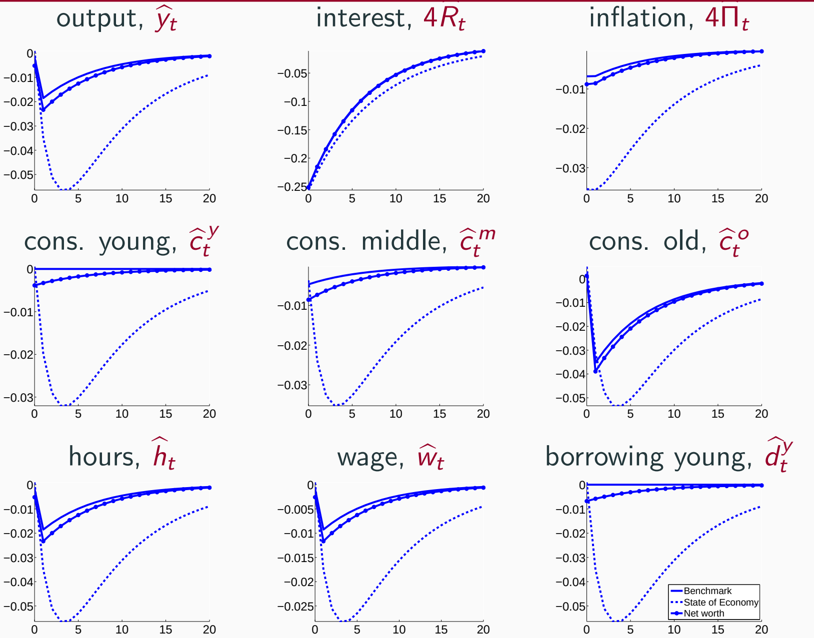
# The effect of a monetary easing

- no borrowing constraint (the young take up the slack).
- young borrowing constrained.
  - what if borrowing constrained endogenous?

# Monetary easing – no borrowing constraint



# Monetary easing – borrowing constraint



# Conclusions

# What is next?

- Model is simple in many dimensions:
  - To start with, it is a 3-period model.
  - Young do not enter with debt.
  - Old have MPC of 1.
  - Labor supply of young (or old).
  - Other savings vehicles.
  - Does result survive in more complex scenarios?
- More precisely, what ingredients deliver adverse effects of low interest rates?

# Conclusions

- Perception in some parts of the world 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.
- If private savings provide substantial support to retirement consumption, the increased desire by the middle-aged to save can render a monetary "easing" recessionary.
- Effect exacerbated if borrowing constraint binds.

# 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 ...

Woodford, M. (1998), 'Doing Without Money: Controlling Inflation in a Post-Monetary World,' *Review of Economic Dynamics*, 1(1), pp. 173–219.