Comments by Rafael Repullo on

Monetary Easing, Investment and Financial Instability

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Purpose of paper

- Optimal monetary policy with financial stability concerns

- Specifically: Construct a model that explains three facts

    $\rightarrow$ Lax monetary policy

    $\rightarrow$ High payouts of firms to shareholders

    $\rightarrow$ Excessive risk-taking

Model overview (i)

- OLG model

    $\rightarrow$ 2-period lived workers and entrepreneurs

    $\rightarrow$ Monetary and fiscal authority

- Workers

    $\rightarrow$ Unit endowment of labor when young

    $\rightarrow$ Can supply labor to market or work in private production

    $\rightarrow$ Private production yields current output

    $\rightarrow$ Wages paid when young

    $\rightarrow$ Only interested in consumption when old

Model overview (ii)

- Entrepreneurs

    → Demand labor to produce future output

    → Utility depends on sum of current and future consumption

    → Need to borrow to pay wages + current consumption

- Monetary authority

    → Can set the <u>real</u> interest rate

    → Can resort to fiscal authority to balance its books

Main results (i)

- Characterize steady state equilibrium

- Analyze effects of increase in market supply of labor

    → With flexible wages: Central bank does nothing

    → With fixed wages: Central bank reduces the real rate

    → Increases borrowing by entrepreneurs

Main results (ii)

- To address implications for financial stability

    $\rightarrow$ Modified model with 3-period lived entrepreneurs

    $\rightarrow$ Output produced at $t + 2$, but wages paid at t

    $\rightarrow$ Borrowing has to be rolled over at $t + 1$

    $\rightarrow$ Exogenous probability of not being able to borrow at $t + 1$

- A reduction in real rate by central bank

    $\rightarrow$ Increases borrowing by entrepreneurs

    $\rightarrow$ Increases rollover risk: Financial instability

    $\rightarrow$ But central bank can act as lender of last resort

Main comments (i)

- Model assumes that central bank can set the <u>real</u> interest rate

    → Assumption is becoming popular in recent literature

    → But is nevertheless quite restrictive

    → Link between nominal and real rates may not be trivial

Main comments (ii)

- Entrepreneurs' preferences produce jumps in consumption

    → Entrepreneurs' consumption decision problem

    $$\max_{(c_0, c_1)} (c_0 + c_1) \text{ subject to } c_0 + \frac{1}{r} c_1 = y$$

    → Solution

    $$c_0(r) = \begin{cases} 0, & \text{if } r > 1 \\ y, & \text{if } r < 1 \end{cases}$$

- A reduction in r below 1 leads to jump in borrowing

    → Large effects of monetary policy on consumption

    → and on financial stability

Main comments (iii)

• Discussion on financial stability is pretty ad hoc

→ Based on exogenous probability of rollover

→ It would be desirable to have something more structural

What am I going to do?

- Present a slightly different version of the model

    $\rightarrow$ No OLG structure

    $\rightarrow$ No jumps in the consumption of entrepreneurs

    $\rightarrow$ Parametric specification of production and utility functions

- Focus on the working of monetary policy

    $\rightarrow$ Ignoring the discussion on financial stability

Part 1

Model with flexible wages

Model setup

- Two dates ($t = 0, 1$)

- Two consumption goods (at dates $t = 0, 1$) plus labor at $t = 0$

- Two types of private agents: workers and entrepreneurs

- Markets available at $t = 0$

  → Labor market with wage w (in terms of the good at $t = 0$)

  → Bond market with gross real rate r

Workers

- Continuum of workers characterized by

  $\rightarrow$ Unit labor endowment at $t = 0$

  $\rightarrow$ Fraction l supplied to market at wage w

  $\rightarrow$ Fraction $1 - l$ invested in private production

  $\rightarrow$ Production function $g(1 - l)$ of good at $t = 0$

  $\rightarrow$ Only interested in consumption at $t = 1$

$$c_w = r \max_l [wl + g(1 - l)]$$

Entrepreneurs

- Continuum of entrepreneurs characterized by

  → Production function $f(l)$ of good at $t = 1$

  → Utility function

  $$u(c_0, c_1) = \ln c_0 + \ln c_1$$

- Labor demand and consumption decisions

  $$\max_{(l, c_0, c_1)} \left[\ln c_0 + \ln c_1 \right]$$

  $$\text{subject to } \ c_0 + wl = \frac{1}{r}[f(l) - c_1]$$

Parametric assumptions

- Workers' production function

$$g(1-l) = \rho\sqrt{1-l}$$

→ where ρ is productivity parameter used to shock the model

- Entrepreneurs' production function

$$f(l) = 2\sqrt{l}$$

Workers' decision rules

- Labor supply function

$$l(w) = \arg\max_l [wl + g(1-l)] = 1 - \frac{\rho^2}{4w^2}$$

$\rightarrow$ Increasing in wage w

- Savings function

$$s(w) = \max_l [wl + g(1-l)] = w + \frac{\rho^2}{4w}$$

$\rightarrow$ Increasing in wage w (for $l(w) > 0$)

Entrepreneurs' decision rules (i)

- Labor demand function

$$l(w,r) = \arg\max_l \left[\frac{1}{r} f(l) - wl \right] = \frac{1}{(wr)^2}$$

→ Decreasing in wage w

→ Decreasing in real rate r

- Current consumption function

$$c_0(w,r) = \frac{1}{2}\left[\frac{1}{r} f(l) - wl \right] = \frac{1}{2wr^2}$$

→ Decreasing in wage w

→ Decreasing in real rate r

Entrepreneurs' decision rules (ii)

- Borrowing function

$$b(w,r) = c_0(w,r) + wl(w,r) = \frac{3}{2wr^2}$$

$\rightarrow$ Decreasing in wage w

$\rightarrow$ Decreasing in real rate r

Equilibrium conditions

- Labor market

$$l(w) = l(w, r)$$

- Bond market

$$s(w) = wl(w) + g(1 - l(w)) = wl(w, r) + c_0(w, r) = b(w, r)$$

$\rightarrow$ Using labor market equilibrium, this simplifies to

$$\underbrace{g(1 - l(w))}_{\substack{\text{Workers' output} \\ \text{at } t=0}} = \underbrace{c_0(w, r)}_{\substack{\text{Entrepreneurs'} \\ \text{consumption at } t=0}}$$

Equilibrium prices and quantities

- Wage: $w^* = \sqrt{5}\rho / 2$

- Real rate: $r^* = 1/\rho$

- Labor supplied to market: $l^* = 4/5$

- Workers' consumption (and utility): $c_w^* = u_w^* = 3/\sqrt{5}$

- Entrepreneurs' consumption at $t = 0$: $c_0^* = \rho/\sqrt{5}$

- Entrepreneurs' consumption at $t = 1$: $c_1^* = 1/\sqrt{5}$

- Entrepreneurs' utility: $u_e^* = \ln \rho - \ln 5$

Shock to the workers' production function

- Consider a negative shock to workers' production function

  $\rightarrow$ Going from $\rho = 1$ to $\rho = \frac{1}{2}$

- Comparison between the two equilibria

	w^*	r^*	l^*	u_w^*	c_0^*	c_1^*	u_e^*
$\rho = 1$	1.12	1	0.8	1.34	0.45	0.45	-1.61
$\rho = 1/2$	0.56	2	0.8	1.34	0.22	0.45	-2.30

Part 2

Model with fixed (real) wages

Fixed wages (i)

- Suppose that following the reduction in ρ wages do not fall

    $\rightarrow$ Excess supply of labor

    $\rightarrow$ No change in decision rules of entrepreneurs

    $\rightarrow$ Employment determined by labor demand $l(w^*, r)$

Fixed wages (ii)

- What will happen to the real rate?

  → Workers' output

$$\rho\sqrt{1-l(w^*,r)}$$

  → Equilibrium condition

$$\rho\sqrt{1-l(w^*,r)} = c_0(w^*,r)$$

  → For $\rho = \tfrac{1}{2}$ we have $r = 1.17$

Equilibrium with fixed wages

- Comparison between the three equilibria

  $\rightarrow$ Third row corresponds to equilibrium with fixed wages

	w^*	r^*	l^*	u_w^*	c_0^*	c_1^*	u_e^*
$\rho = 1$	1.12	1	0.8	1.34	0.45	0.45	-1.61
$\rho = 1/2$	0.56	2	0.8	1.34	0.22	0.45	-2.30
$\rho = 1/2$	1.12	1.17	0.58	1.14	0.32	0.38	-2.11

Monetary easing (i)

- Suppose now that central bank reduces real rate to $r = 1$

  $\rightarrow$ Fourth row corresponds to new equilibrium

	w^*	r^*	l^*	u_w^*	c_0^*	c_1^*	u_e^*
$\rho = 1$	1.12	1	0.8	1.34	0.45	0.45	-1.61
$\rho = 1/2$	0.56	2	0.8	1.34	0.22	0.45	-2.30
$\rho = 1/2$	1.12	1.17	0.58	1.14	0.32	0.38	-2.11
$\rho = 1/2$	1.12	1	0.8	1.12	0.45	0.45	-1.61

Summing up

• Monetary easing when wages are rigid downwards leads to

→ Increase in labor supplied to the market

→ Reduction in workers' consumption and utility

→ Increase in entrepreneur's consumption and utility

→ Hence, <u>not</u> Pareto improving

Part 3

Discussion

Discussion

- Two questions

  → How can the central bank reduce the real rate?

  → What are the implications for the real economy

How can central bank reduce the real rate?

- In the equilibrium with fixed wages the real rate is $r = 1.17$

  $\rightarrow$ To reduce the real rate to $r = 1$ bond market has to clear

  $\rightarrow$ But for $r = 1$ there is an excess demand for savings

  $\rightarrow$ Central bank has to act as a supplier of savings

- Recall that bond market equilibrium simplifies to

$$\underbrace{g(1-l(w^*,r))}_{\substack{\text{Workers' output} \\ \text{at } t=0}} = \underbrace{c_0(w^*,r)}_{\substack{\text{Entrepreneurs'} \\ \text{consumption at } t=0}}$$

Bond market equilibrium under fixed wages
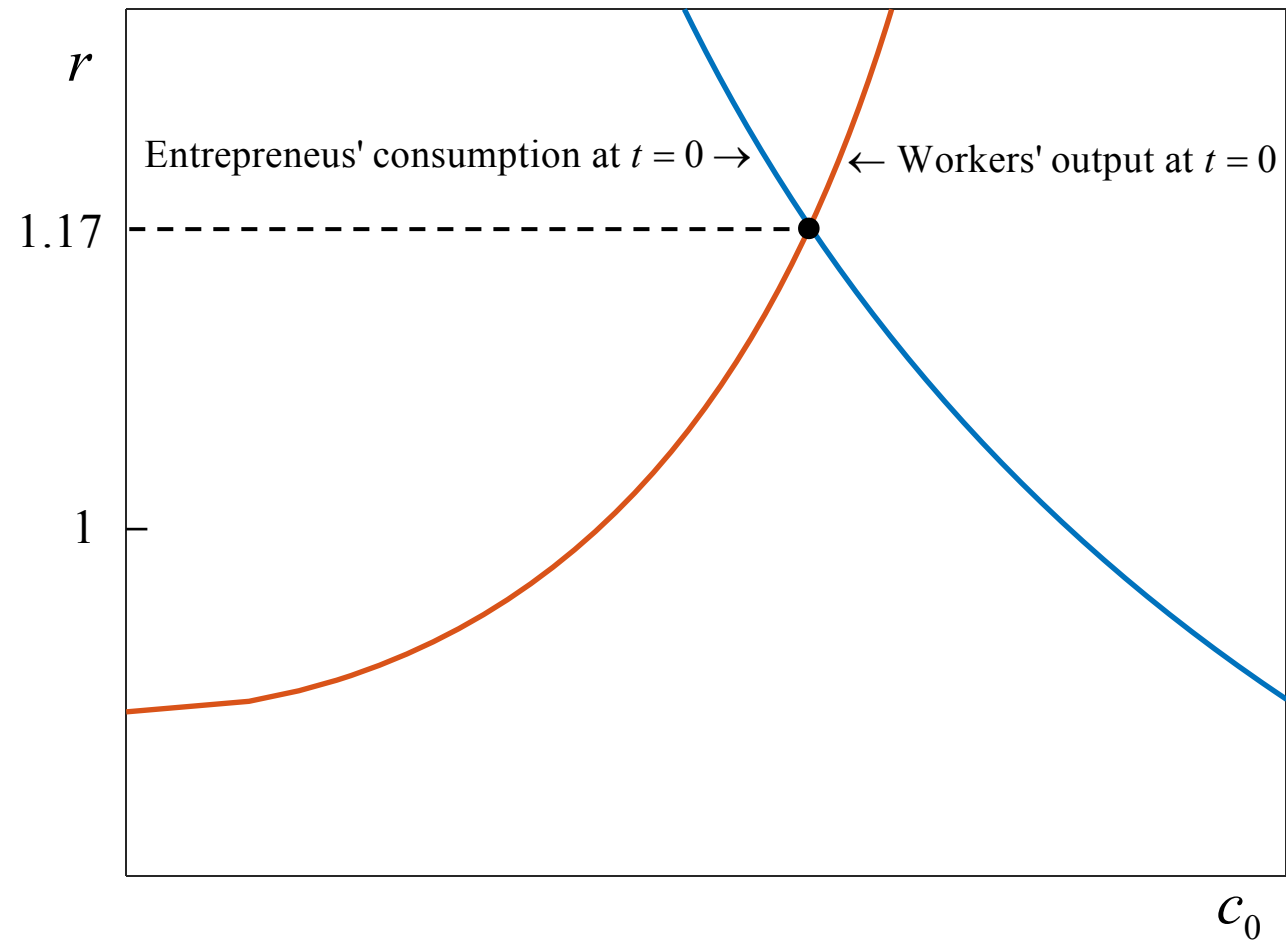
Bond market equilibrium under fixed wages
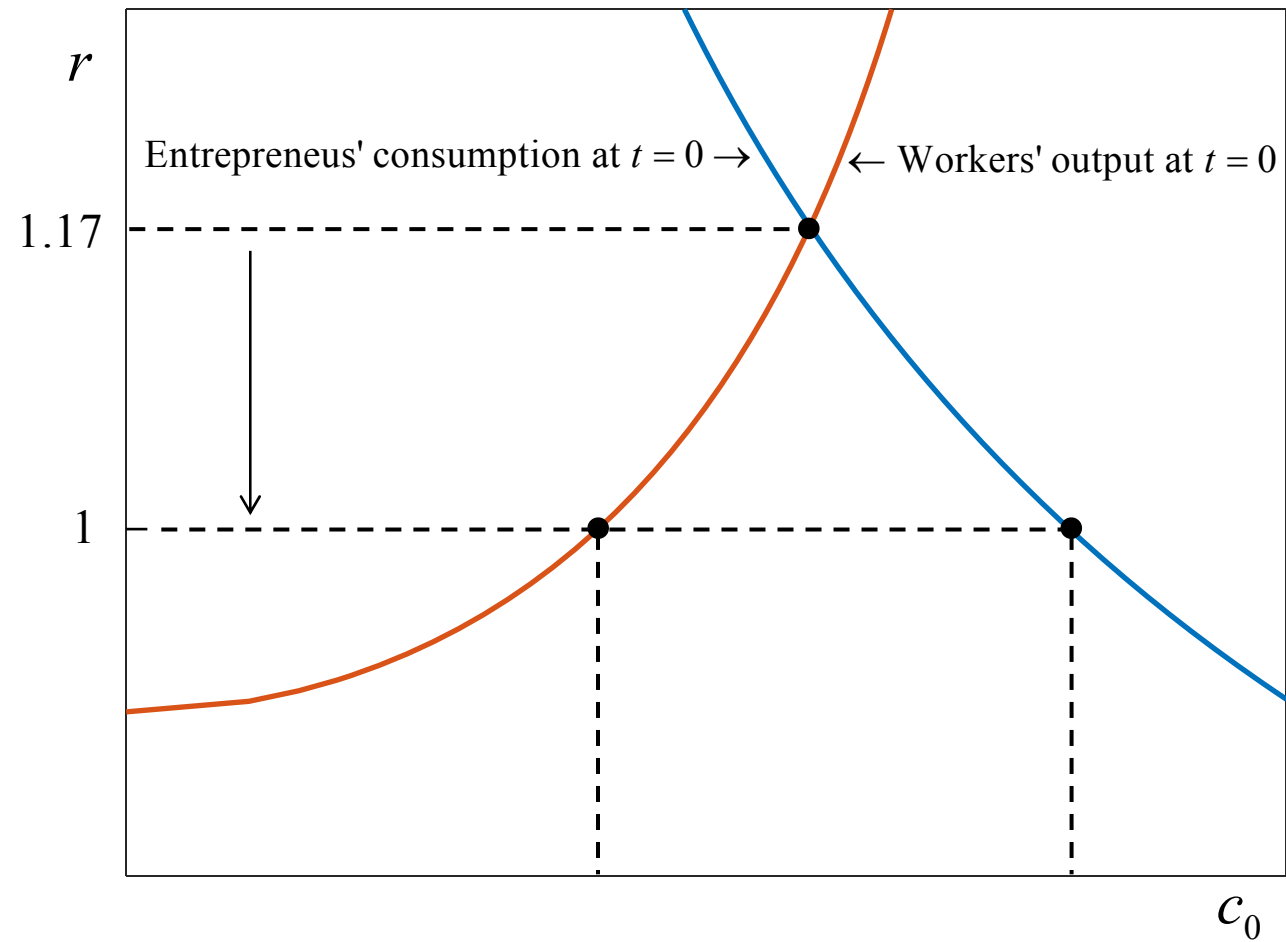
Bond market equilibrium under fixed wages
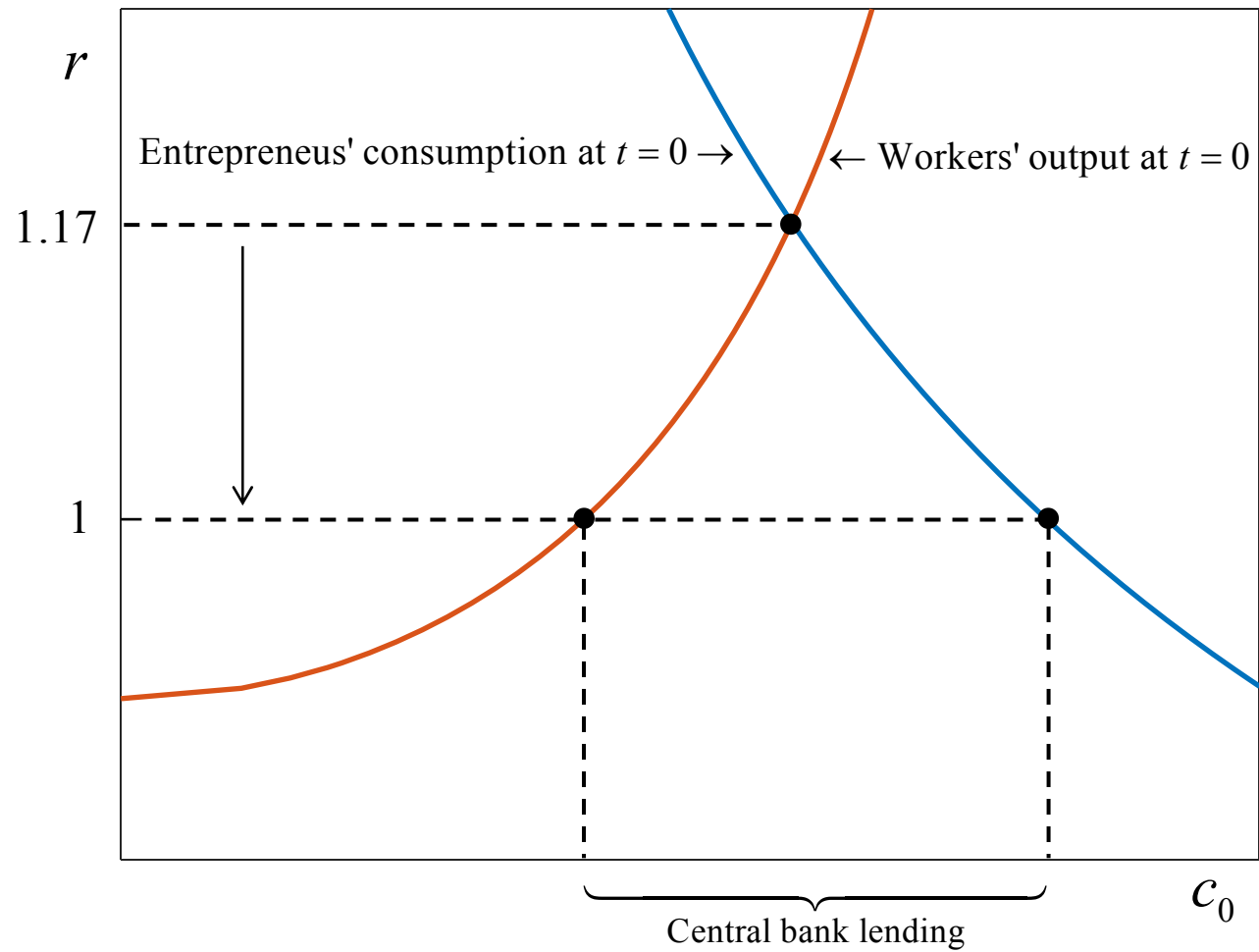
Implementing monetary easing (i)

- To implement the reduction in the real rate

    → Central bank has to be able to lend to the entrepreneurs

- Central bank is effectively a warehouse

    → that stores the consumption good

    → and lends it to the entrepreneurs

Implementing monetary easing (ii)

- Where do the goods in warehouse come from?

    → Taxing an initial generation of workers

- Central bank may get profits or losses (zero when $r = 1$)

    → Transferred to workers or entrepreneurs

- Connection between monetary and fiscal authorities

Implications for the real economy

- Construct the utility possibility frontier

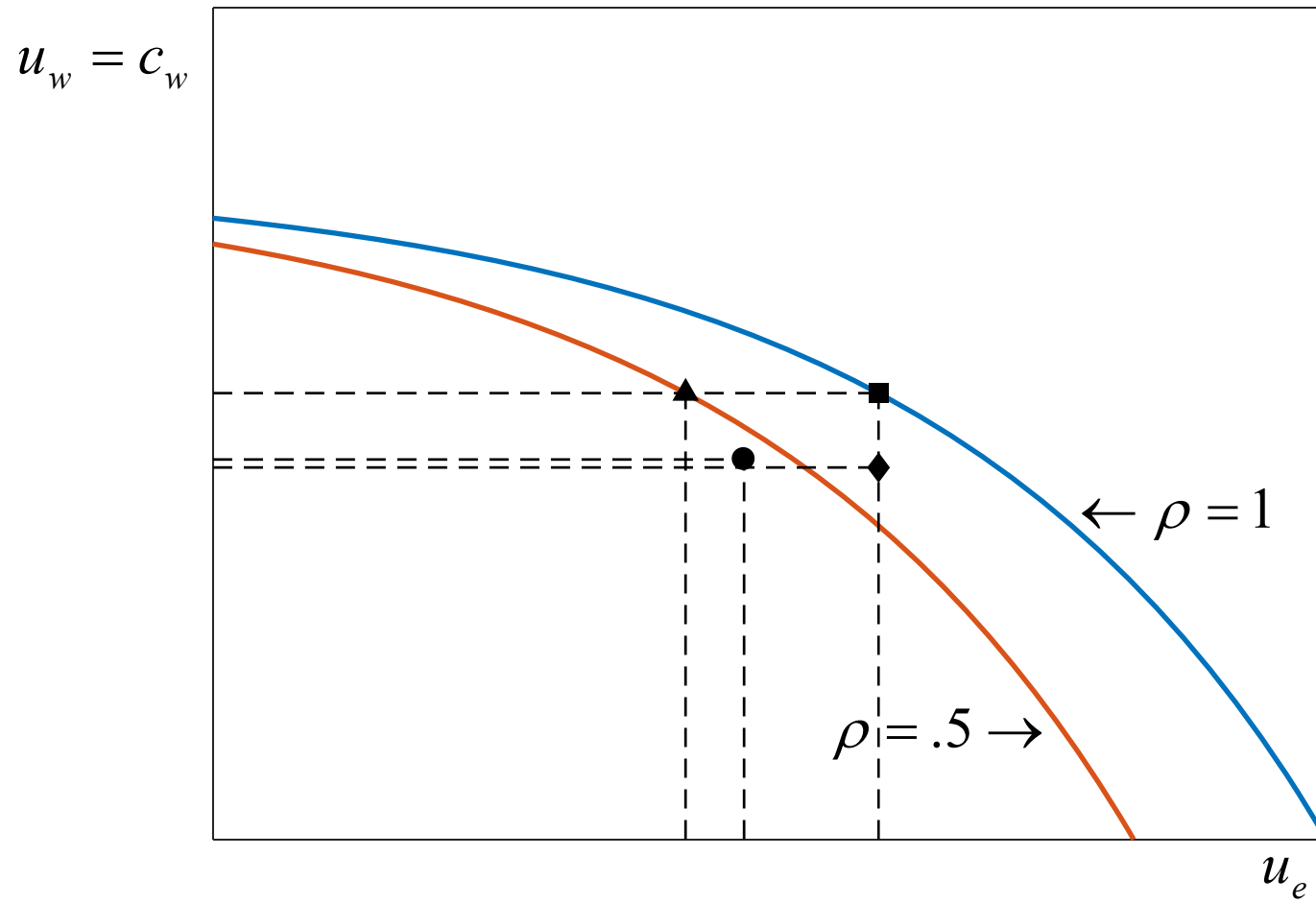$$\max c_w$$

$$\text{subject to:} \ \ c_w + c_1 = f(l)$$

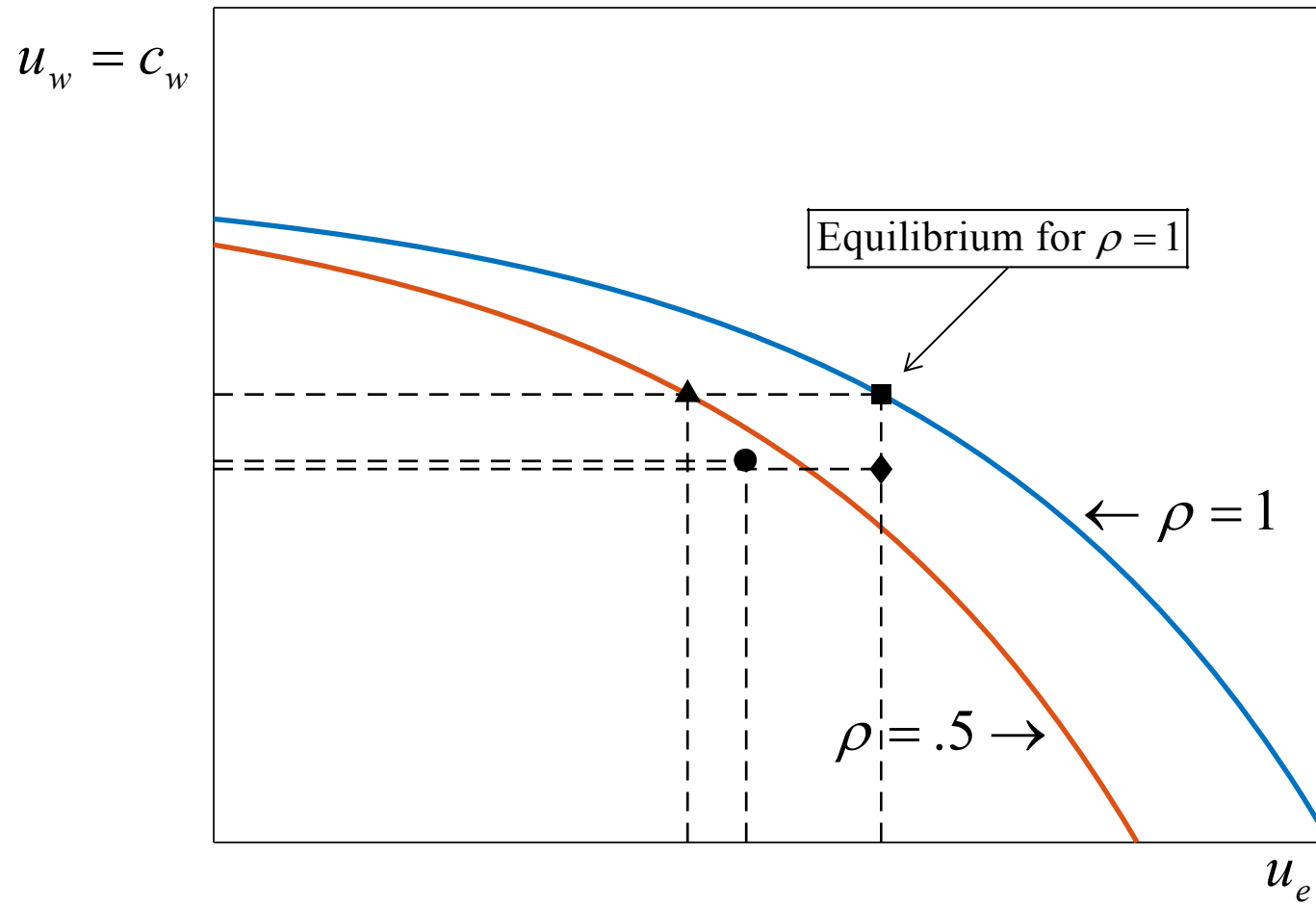$$c_0 = g(1-l)$$

$$\ln c_0 + \ln c_1 = u_e$$

- Plot frontiers for from $\rho = 1$ to $\rho = \frac{1}{2}$

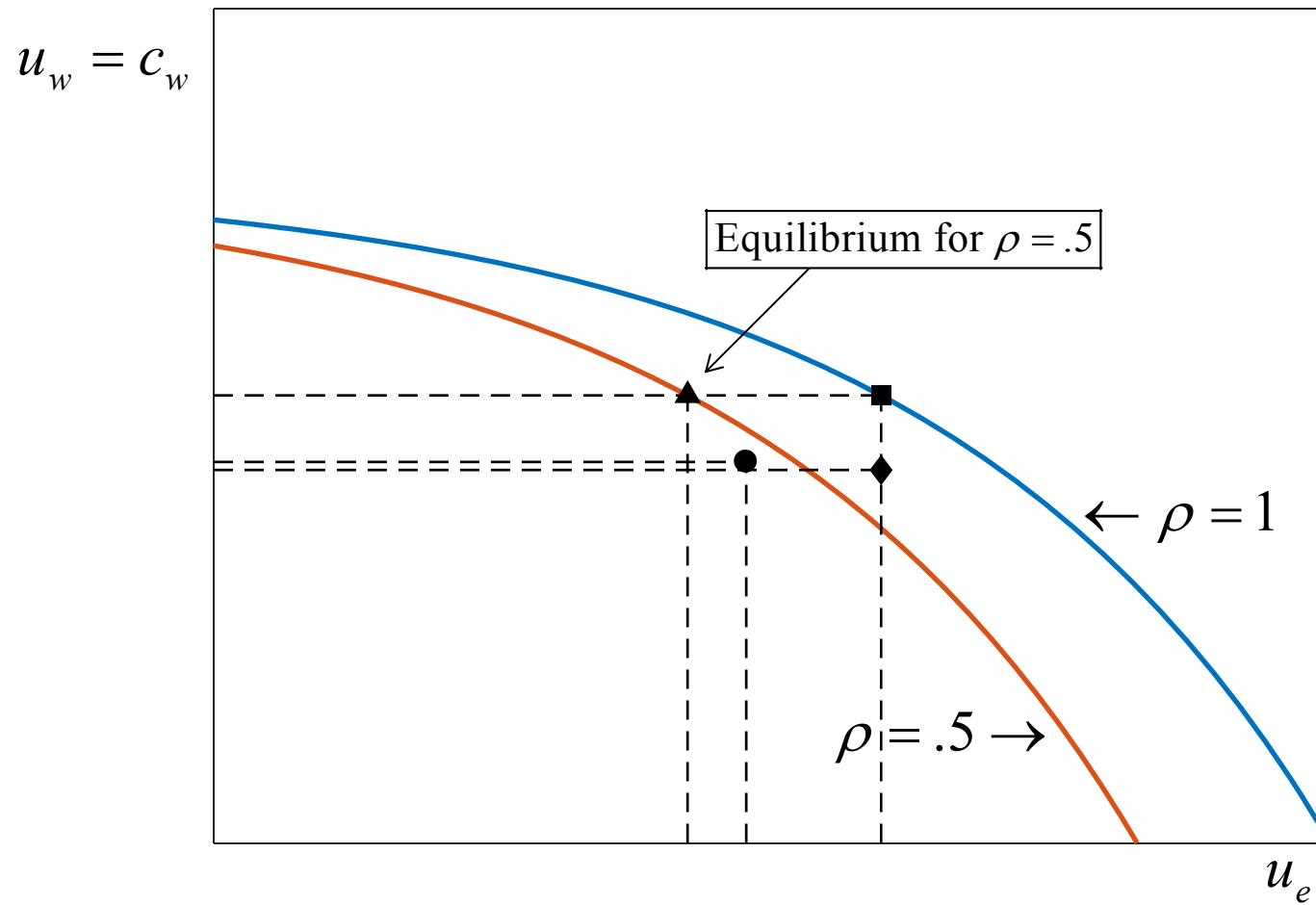$\rightarrow$ Locate the different equilibrium points in utility space

Utility possibility frontier

$u_w = c_w$

$\leftarrow \rho = 1$

$\rho = .5 \rightarrow$

u_e

Utility possibility frontier

Utility possibility frontier

$u_w = c_w$

Equilibrium for $\rho = .5$

$\leftarrow \rho = 1$

$\rho = .5 \rightarrow$

u_e

Utility possibility frontier

$u_w = c_w$

Equilibrium for $\rho = .5$ & fixed w

$\leftarrow \rho = 1$

$\rho = .5 \rightarrow$

u_e

Utility possibility frontier

Equilibrium for $\rho = .5$ & fixed w & $r = 1$

$u_w = c_w$

$\leftarrow \rho = 1$

$\rho = .5 \rightarrow$

u_e
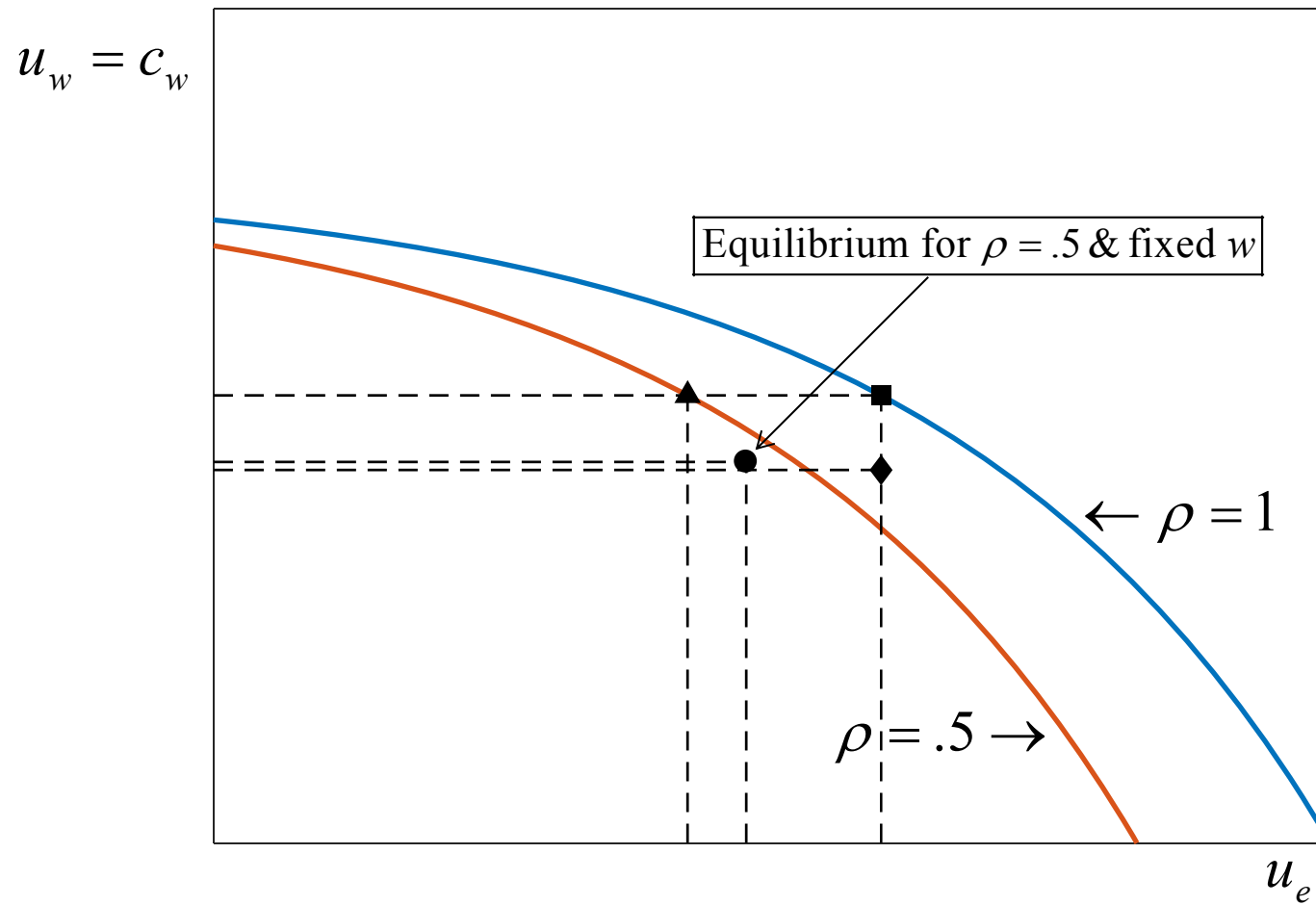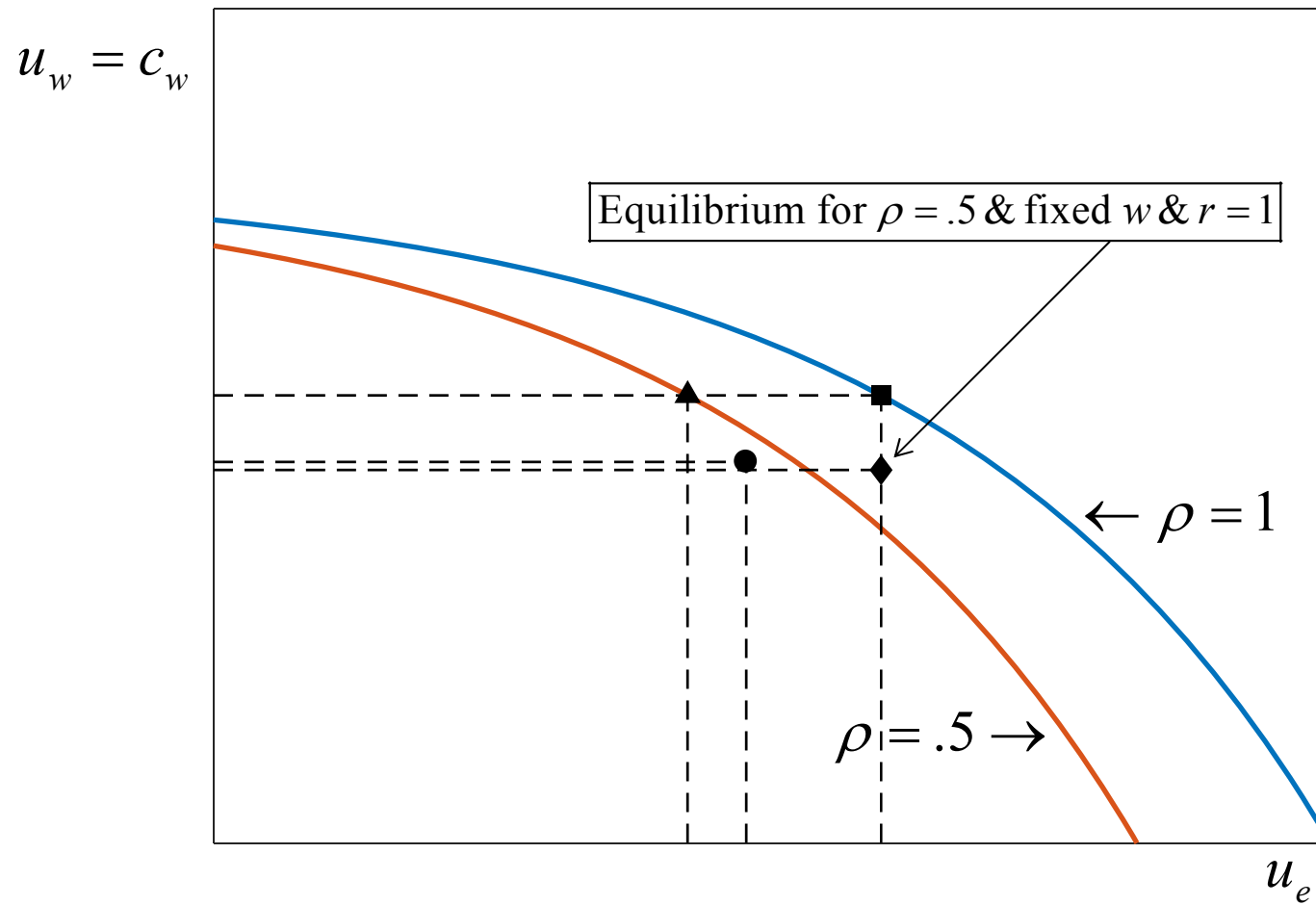
Summing up

- Equilibria with flexible wages are located on the frontiers

- Equilibrium with fixed wages is Pareto inefficient

- Equilibrium with monetary easing is <u>outside</u> the frontier

    → Central bank brings something that was not before

- Equilibrium with monetary easing is <u>not</u> Pareto improving

    → Distributional effects of monetary policy