Credit Cycles

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1 Introduction

How do shock to technology and wealth distribution generate large fluctuations in aggregate output and asset prices?

propagation

persistence

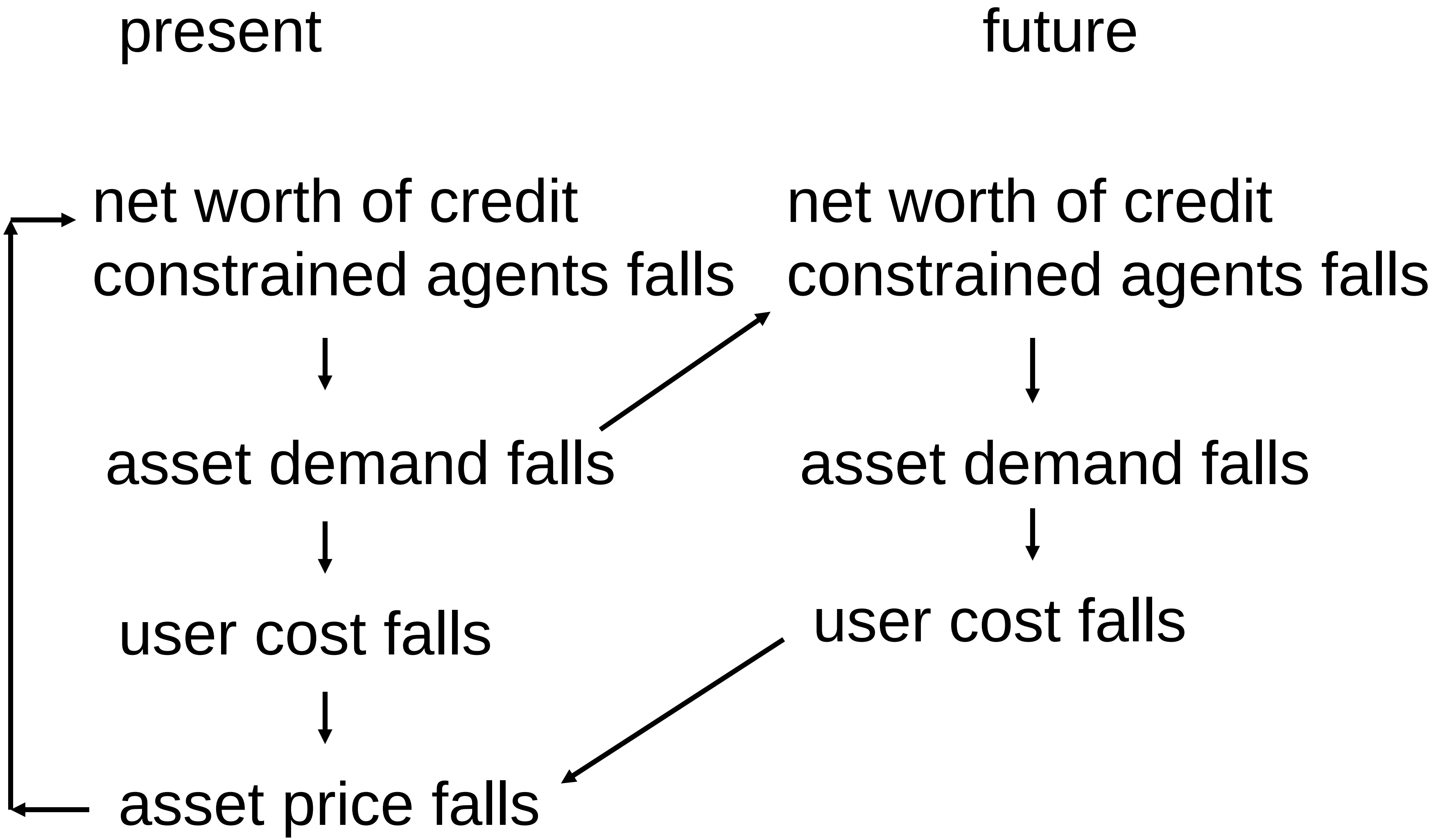
co-movement between output and asset value

co-movement across sectors

co-movement between output and productivity

Problem of real business cycle theory: lack of powerful propagation

Propagation in credit constrained economy



2 Model

One homogeneous goods and land (fixed supply of $\overline{K}$)

Farmers and gatherers with population size $1 : m$

Preference

$$\begin{aligned} \text{farmer} &: E_0\left[\sum_{t=0}^{\infty} \beta^t x_t\right] \\ \text{gatherer} &: E_0\left[\sum_{t=0}^{\infty} R^{-t}\, x'_t\right], \quad 1 < R < \frac{1}{\beta} \end{aligned} \tag{1}$$

Output of farmer

$$\begin{aligned} y_{t+1} &= F(k_t) = (a+c)k_t, \text{ where} \\ c &> \left(\frac{1}{\beta} - 1\right) a : \text{ nontradeable} \end{aligned} \tag{2}$$

Limited commitment:

only farmer who starts the production can get full output

farmer cannot precommit to finish $\longrightarrow$ credit constraint

$$Rb_t \leq q_{t+1}k_t \tag{3}$$

Flow-of-funds

$$q_t(k_t - k_{t-1}) + Rb_{t-1} + x_t - ck_{t-1} = ak_{t-1} + b_t \tag{4}$$

Gather's production

$$
\begin{aligned}
y'_{t+1} &= G(k'_t), \text{ where} \\
G'(k) &> 0, G''(k) < 0, G'(0) > aR > G'\left(\frac{\overline{K}}{m}\right)
\end{aligned}
\tag{5}
$$

flow-of-funds

$$q_t(k'_t - k'_{t-1}) + Rb'_{t-1} + x'_t = G(k'_{t-1}) + b'_t$$

Market equilibrium

$$K_t = \frac{1}{q_t - \frac{1}{R}q_{t+1}} \left[(a + q_t)K_{t-1} - RB_{t-1}\right] \tag{6}$$

$$B_t = \frac{1}{R}q_{t+1}K_t \tag{7}$$

$$u_t = q_t - \frac{1}{R}q_{t+1} = \frac{1}{R}G'\left[\frac{1}{m}\left(\overline{K} - K_t\right)\right] \equiv u(K_t) \tag{8}$$

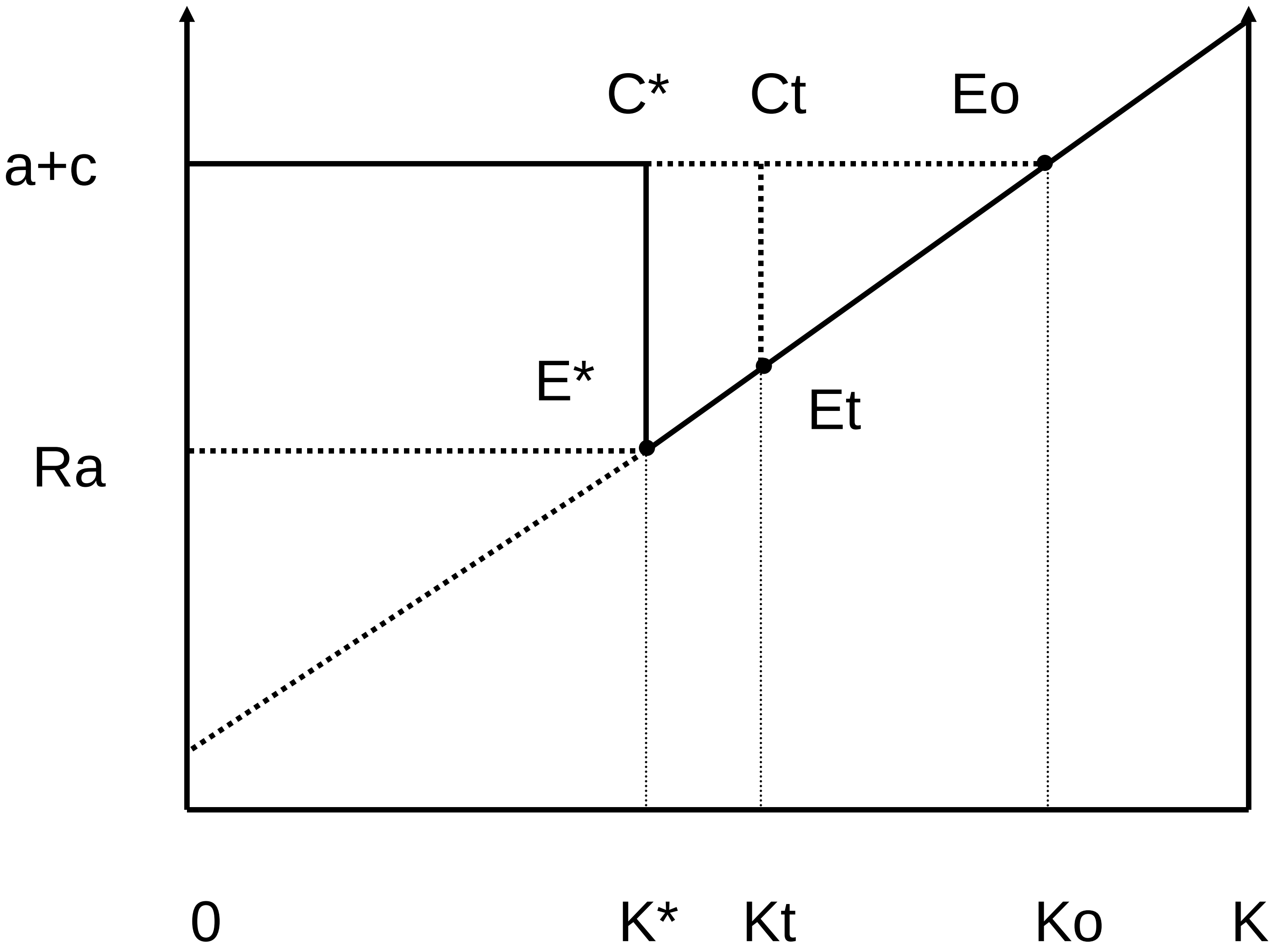
$$\underset{s\longrightarrow\infty}{Lim} E_t\left(R^{-s}\ q_{t+s}\right) = 0. \tag{9}$$

Steady state

$$\frac{R-1}{R}q^* = u^* = a$$

$$\frac{1}{R}G'\left[\frac{1}{m}\left(\overline{K} - K^*\right)\right] \equiv u^*$$

$$B^* = \frac{1}{R}q^* K^*$$



a+c
Ra
C*
Ct
Eo
E*
Et
0
K*
Kt
Ko
K

Economy was at the steady state at date t-1

Unanticipatedly, at date t, $a_t = (1 + \Delta)a$, once for all

$$u(K_t)K_t = [(1 + \Delta)a + q_t - q^*]K^* \tag{10}$$

$$u(K_{t+s})K_{t+s} = aK_{t+s-1} \text{ for } s \geq 1 \tag{11}$$

$$q_t = \sum_{s=0}^{\infty} R^{-s}\, u(K_{t+s}) \tag{12}$$

Linear approximation: $\widehat{X}_t \equiv (X_t - X^*)/X^*$, $\frac{1}{\eta} \equiv \frac{d\ \log\ u(K)}{d\ \log\ K}$

$$\left(1+\frac{1}{\eta}\right)\widehat{K}_t \;=\; \Delta + \frac{R}{R-1}\hat{q}_t \tag{13}$$

$$\left(1+\frac{1}{\eta}\right)\widehat{K}_{t+s} \;=\; \widehat{K}_{t+s-1} \tag{14}$$

$$\hat{q}_t \;=\; \frac{R-1}{R}\sum_{s=0}^{\infty} R^{-s}\frac{1}{\eta}\widehat{K}_{t+s}, \quad \longrightarrow \tag{15}$$

$$\hat{q}_t \;=\; \frac{1}{\eta}\Delta$$

$$\widehat{K}_t \;=\; \frac{1}{1+\frac{1}{\eta}}\left(1+\frac{R}{R-1}\frac{1}{\eta}\right)\Delta$$

$$\widehat{Y}_{t+s} = \frac{a+c-Ra}{a+c}\,\frac{(a+c)\,K^*}{Y^*}\widehat{K}_{t+s-1} \tag{16}$$

Asset demand of credit constrained firm depends upon the net worth $\longrightarrow$ history dependent $\longrightarrow$ persistence

Asset market is forward looking $\longrightarrow$ anticipating persistent effect of the shock, the asset price moves significantly

$\longrightarrow$ persistence and amplification re-enforce each other

$+$ Balance sheet of the constrained firms has leverage

$\longrightarrow$ large propagation

3 Heterogeneous Farmers

Farmer's production technology

$$\left.\begin{array}{r} k_t \text{ land} \\ k_t \text{ trees} \end{array}\right\} \longrightarrow \left\{\begin{array}{c} ak_t \text{ tradeable output} \\ ck_t \text{ nontradeable output} \\ k_t \text{ land} \\ \lambda k_t \text{ trees} \end{array}\right. \quad \text{in the next period}$$

Farmer has opportunity to plant new trees only with probability π each period:

$$\phi i_t \text{ goods} \;\longrightarrow\; i_t \text{ new trees within the period}$$

Farmer's flow-of-fund

$$\begin{aligned} q_t(k_t\text{-}k_{t-1}) + \phi(k_t\text{-}\lambda k_{t-1}) + Rb_{t-1} + x_t\text{-}ck_{t-1} &= ak_{t-1} + b_t \\ Rb_t &\leq q_{t+1}k_t \end{aligned}$$

Aggregate land and debt of farmers:

$$
\begin{aligned}
K_t \;=\; & (1-\pi)\lambda K_{t-1} \\
& + \frac{\pi}{\phi + q_t - \frac{1}{R} q_{t+1}} \left[(a + q_t + \lambda q_t) K_{t-1} - R B_{t-1} \right]
\end{aligned}
$$

$$B_t = R B_{t-1} + q_t (K_t - K_{t-1}) + \phi (K_t - \lambda K_{t-1}) - a K_{t-1}$$

In this economy, a productivity shock generates a damped oscillation

$$\begin{pmatrix} K_t \\ B_t \end{pmatrix} = \begin{pmatrix} + & - \\ + & ? \end{pmatrix} \begin{pmatrix} K_{t-1} \\ B_{t-1} \end{pmatrix}$$