



Credit Cycles

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1997

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Motivation

- How credit constraints interact with aggregate economic activity over the business cycle.
- Sector specific shocks can be contagious and get amplified through time
- Constructing a model of dynamic economy
 - mechanism of dynamic interaction between credit limits and asset prices

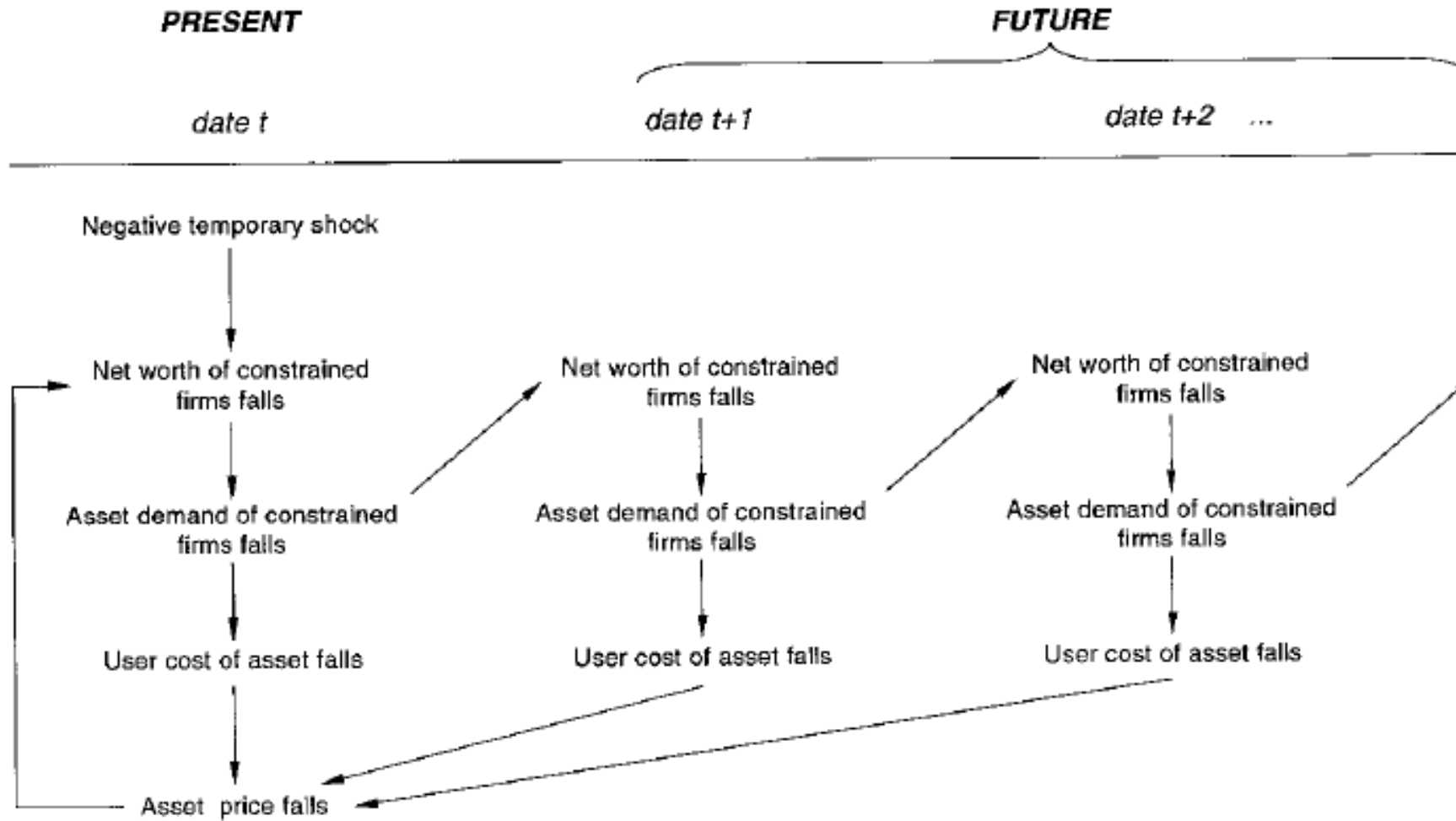


Results

- **Interaction between credit limits and asset prices** is a powerful mechanism by which the effects of shocks persist, amplify and spread out
- Durable asset (land) : - factor of production
- collateral for loan



Results

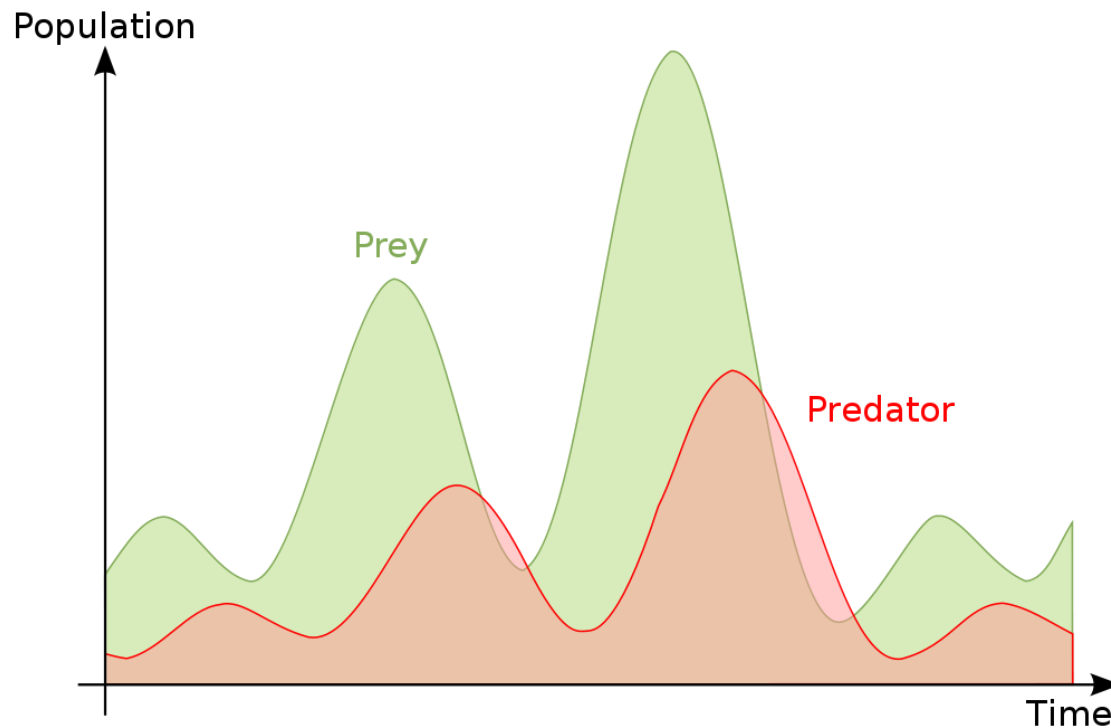




Results

■ Predator-prey model :

$$\begin{bmatrix} prey_t \\ predator_t \end{bmatrix} = \begin{bmatrix} * & - \\ + & * \end{bmatrix} \begin{bmatrix} prey_{t-1} \\ predator_{t-1} \end{bmatrix}$$



→ Predator : Debts of credit-constrained firms

→ Prey: Collateralized assets



The Basic Model : Amplification and Persistence

- Durable asset : land = \bar{K}
- Nondurable commodity : fruit
- Farmers : population = 1
- Gatherers : population = m
- Land price : q_t (fruit is taken as the numeraire)
- Land market
- Credit market : 1 fruit at date t \longrightarrow R fruit at date t+1



The Basic Model : Amplification and Persistence

- Farmers at date t :

Maximize expected utility :
$$E_t \sum_{s=0}^{\infty} \beta^s x_{t+s}$$

s.t :

production function :
$$y_{t+1} = F(k_t) = (a + c)k_t$$

borrowing constraint :
$$Rb_t \leq q_{t+1}k_t$$

flow of funds constraint :
$$q_t(k_t - k_{t-1}) + Rb_{t-1} + x_t - ck_{t-1} = ak_{t-1} + b_t$$



The Basic Model : Amplification and Persistence

- Gatherers at date t :

$$\text{Maximize expected utility : } E_t \sum_{s=0}^{\infty} \beta'^s x'_{t+s} \quad \beta < \beta'$$

s.t. :

$$\text{production function : } y'_{t+1} = G(k'_t) \quad G' > 0 \quad G'' < 0$$

$$\text{budget constraint : } q_t (k'_t - k'_{t-1}) + Rb'_{t-1} + x'_t = G(k'_{t-1}) + b'_t$$



The Basic Model : Amplification and Persistence

- Results :

$$x_t = ck_{t-1} \quad b_t = \frac{q_{t+1}k_t}{R} \quad k_t = \frac{[(a + q_t)k_{t-1} - Rb_{t-1}]}{q_t - \frac{1}{R}q_{t+1}}$$

$$\frac{G'(k'_t)}{R} = q_t - \frac{1}{R}q_{t+1} = u_t$$

- u_t = opportunity cost of holding land



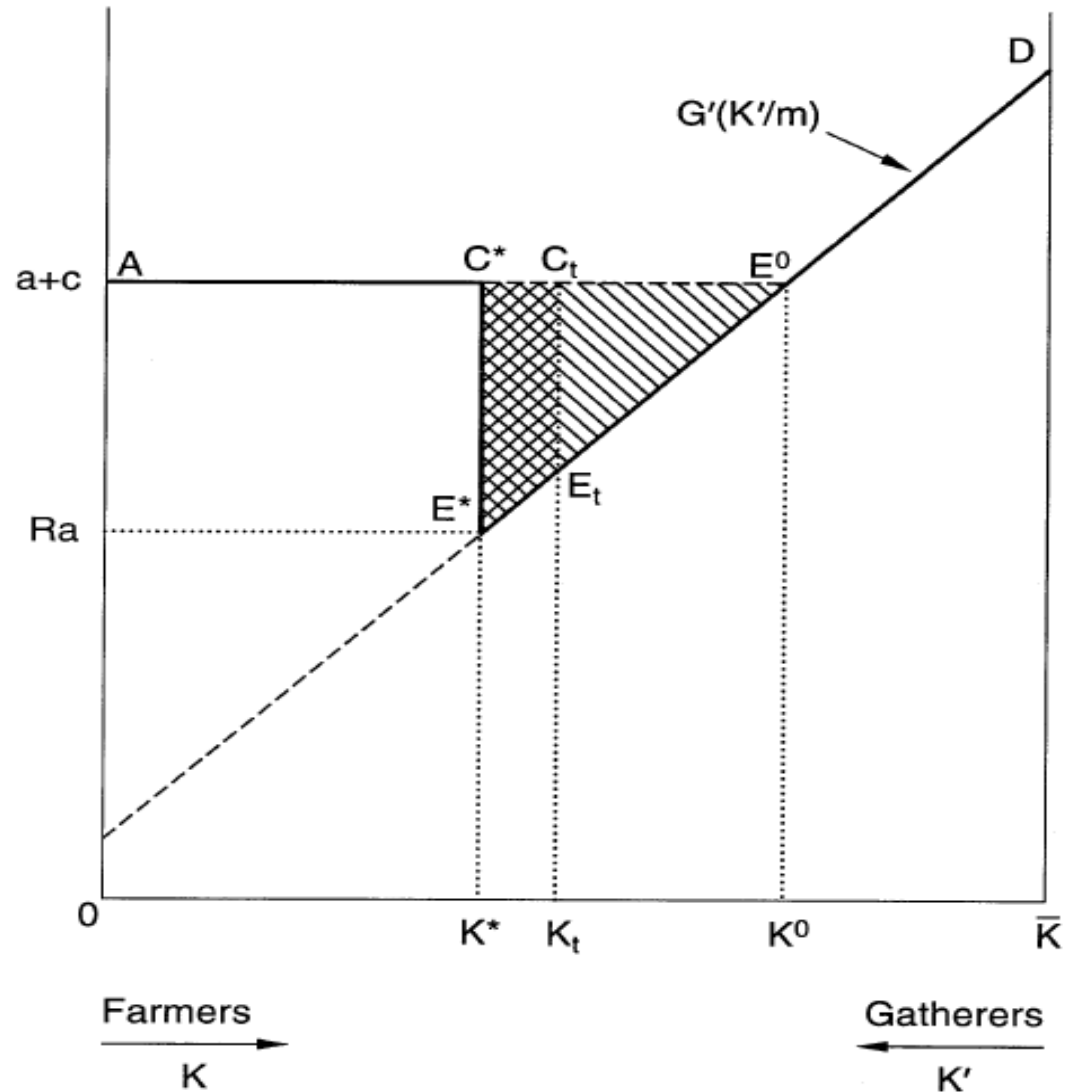
The Basic Model : Amplification and Persistence

- Steady state:

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

$$\frac{1}{R} G' \left[\frac{1}{m} (\bar{k} - k^*) \right] = u^*$$

$$B^* = \frac{a}{R-1} k^*$$





The Basic Model : Amplification and Persistence

- Temporary productivity shock :

Both farmers' and gatherers' production at date t are $1 + \Delta$ times their expected levels.

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

$$\hat{k}_t = \frac{1}{1 + \frac{1}{\eta}} \left(1 + \frac{R}{R-1} \frac{1}{\eta} \right) \Delta$$

$$\eta = \frac{d \log k}{d \log u(k)} \Big|_{k=k^*}$$

- Persistency:
$$\left(1 + \frac{1}{\eta} \right) \hat{k}_{t+s} = \hat{k}_{t+s-1} \quad s \geq 1$$



The Basic Model : Amplification and Persistence

- Static multiplier :

$$\hat{q}_t \Big|_{q_{t+1}=q^*} = \frac{R-1}{R} \frac{1}{\eta} \Delta$$

$$\hat{k}_t \Big|_{q_{t+1}=q^*} = \Delta$$

→ Dynamic multiplier effect > Static multiplier effect



The Basic Model : Amplification and Persistence

- Unanticipated debt-reduction (one-time) :

$$\frac{RB^*}{ak^*} = \frac{R}{R-1}$$

→ Reduction of $\frac{R-1}{R}$ percent in debt = 1 percent productivity shock



The Basic Model : Amplification and Persistence

■ Basic Model results:

- credit constrained firms \rightarrow output loss
- credit constrained firms \rightarrow effects of shocks persist and amplify



The Full Model : Investment and Cycles

- **First change** : Reproducible capital \longrightarrow trees (depreciation rate = $1-\lambda$)
 - Trees are not tradable
 - Increase cultivated land from λk_{t-1} to k_t the farmer must plant $\phi(k_t - \lambda k_{t-1})$ fruit and acquire $k_t - k_{t-1}$ more land
- \rightarrow Contemporaneous responses are damped by ϕ and The effects are more persistent



The Full Model : Investment and Cycles

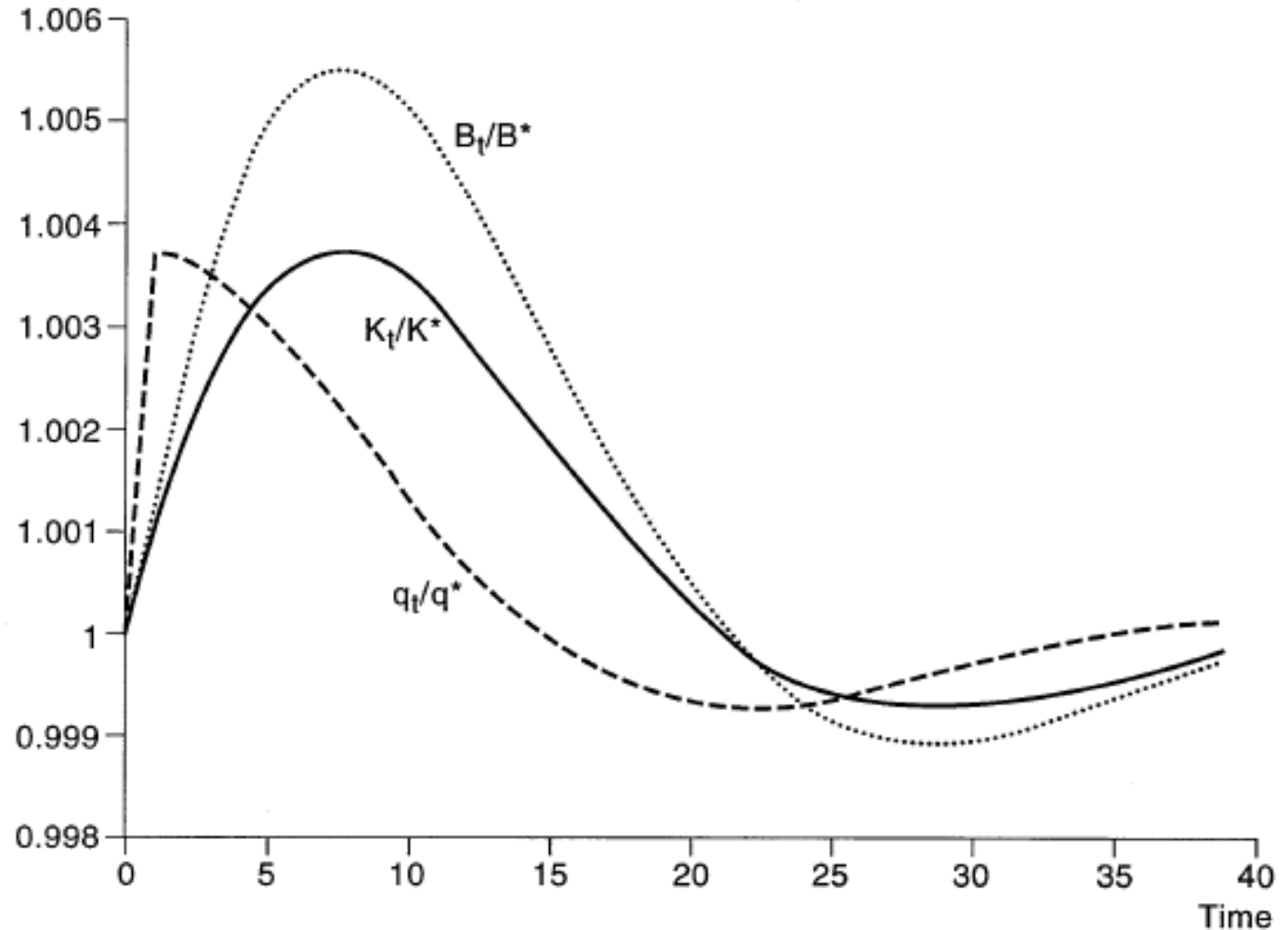
- **Second change** : In each period only a fraction of farmers have an investment (plant fruit) opportunity
 - Other farmers use their revenues to pay their debts
 - Investment opportunity to plant fruit arises with probability π
- Contemporaneous responses are damped by π and the effects of the shock can continue to build up



The Full Model : Investment and Cycles

- Simulation :
positive productivity shock

Debt : Predator
Landholding : Prey





The Full Model : Investment and Cycles

- **Full Model results:**

- sunk cost → Contemporaneous effect of shocks are damped and the effects are more persistent
- lumpy investment → Contemporaneous effect of shocks are damped and the effects are more persistent



Spillovers

- Impulse response to a sector-specific technology shock :
 - There are two symmetric farming sectors
 - Unanticipated increase in output of sector 1 (productivity shock)

- Direct impact on farmers in sector 1: increase in the demand of land by farmers in sector 1 → increase in land price



Spillovers

- **Positive spillover:** jump in land price is enjoyed by the farmers in sector 2 and increases their demand of land
- **Spillover Model result:**
 - The initial increase in land demand of two sectors persists and the two sectors commove after shock , at least for a time



Summary

- In a credit constrained economy responses to a shock persist and amplify through time
- The effects of a shock can be built up through time
- Sector specific shocks can be contagious and persist through time