Kiyotaki and Moore (1997)

ECON 70428: Advanced Macro: Financial Frictions

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Credit Cycles

Kiyotaki and Moore (1997, *JPE*) is the seminal paper on incorporating financial frictions via the so-called "limited enforcement" approach

Basic idea:

- Debt contracts are not perfectly enforceable – if borrower defaults, lender cannot force borrower to continue to work, have negative consumption, etc.
- The lender may be able to recover some of the borrower's assets, but because of limited enforceability, these assets are worth less to the lender than to the borrower
- The lender will restrict the amount of credit a borrower can access
- So we have a collateral constraint – amount borrower can borrow is a function of value of its assets

Financial Accelerator

With this kind of structure, durable assets play a dual role – factors of production and collateral on loans

Credit limits are affected by the price of collateralizable assets

Shocks which raise asset prices ease credit constraints, resulting in more investment and output, and further increases in prices

A similar “virtuous” cycle to the famed financial accelerator story of Bernanke, Gertler, and Gilchrist (1999)

Difference relative to CSV approach: there is no default/bankruptcy in equilibrium, and hence no risk spread

Basic Model

Two types of agents: farmers and gatherers (denoted with a $'$)

Farmers are impatient relative to gatherers ($\beta < \beta'$)

Farmer population is normalized to one, gatherers to m

Both are risk-neutral

One non-reproducible asset called land in fixed supply, $\bar{K}$. Land must be split between the two agents:

$$k_t + mk'_t = \bar{K}$$

Land trades in a competitive spot market at price q_t

Farmer: Preferences and Budget Constraint

Preferences are linear over consumption, x_{t+s}, and the future is discounted at β

Flow budget constraint:

$$q_t(k_t - k_{t-1}) + R_{t-1}b_{t-1} + x_t = (a+c)k_{t-1} + b_t$$

Output is:

$$y_t = (a+c)k_{t-1}$$

ck_{t-1} is non-tradeable: farmer has to consume it. ak_{t-1} is tradeable

Borrowing Constraint

Can only borrow up to what lender can claim in default:

$$R_t b_t \leq q_{t+1} k_t$$

When farmer borrows b_t, owes $R_t b_t$ back to lender

If farmer repudiates debt, lender can seize his land, which is worth $q_{t+1} k_t$, but can't force him to produce

If farmer owes more than the value of his land, $R_t b_t > q_{t+1} k_t$, he'd be better off not paying back

So lender will not allow debt obligations (inclusive of interest) to exceed the value of the his land

Farmer Problem

$$\max_{x_{t+s}, k_{t+s}, b_{t+s}} \sum_{s=0}^{\infty} \beta^s x_{t+s}$$

s.t.

$$q_t(k_t - k_{t-1}) + R_{t-1} b_{t-1} + x_t = (a + c) k_{t-1} + b_t$$

$$R_t b_t \leq q_{t+1} k_t$$

$$x_t \geq c k_{t-1}$$

Farmer Optimality Conditions

Let μ_t be the Lagrange multiplier on the borrowing constraint, and φ_t be the multiplier on the constraint that consumption must weakly exceed non-tradeable output

The FOC are:

$$1 + \varphi_t = \left[\beta(1 + \varphi_{t+1}) + \mu_t\right] R_t$$

$$q_t(1 + \varphi_t) + c\beta\varphi_{t+1} = \beta(1 + \varphi_{t+1})\left[a + c + q_{t+1}\right] + \mu_t q_{t+1}$$

Gatherer

Produces output according to:

$$y_t' = G(k_t')$$

Where $G'(\cdot) > 0$, $G''(\cdot) < 0$, and $G'(0) > 0$

Budget constraint is:

$$q_t(k_t' - k_{t-1}') + R_{t-1}b_{t-1}' + x_t' = G(k_{t-1}') + b_t'$$

Gatherer Optimality Conditions

FOC are standard asset pricing conditions:

$$1 = \beta' R_t$$

$$q_t = \beta' \left[G'(k_t') + q_{t+1} \right]$$

Because of risk neutrality, gross interest rate will be constant at $R = 1/\beta'$

Equilibrium

Market-clearing:

$$b_t + mb'_t = 0$$

$$k_t + mk'_t = \bar{K}$$

Farmer budget constraint:

$$q_t(k_t - k_{t-1}) + \frac{1}{\beta'} b_{t-1} + x_t = (a + c)k_{t-1} + b_t$$

Aggregate resource constraint (from combining the two budget constraints plus market-clearing):

$$x_t + mx'_t = (a + c)k_{t-1} + mG(k'_{t-1}) = Y_t$$

Functional Form and Steady State

Assume:

$$G(k_t') = \left(z + k_t'\right)^{\alpha}$$

Need z sufficiently small so that condition (5) of the paper holds (which ensures both farmers and gatherers produce in region of the steady state)

Will have $\mu > 0$ so long as $\beta' > \beta$ (borrowing constraint binds in steady state)

Will have $\varphi > 0$ so long as $\beta c > (1 - \beta)a$ (ensures farmer only consumes non-tradeable output)

Efficient Allocation

A planner would choose k_t and k_t' to maximize $t+1$ output (can't determine split of consumption across types given linearity of preferences):

$$\max_{k_t^e} \; (a+c)k_t^e + mG\left(\frac{\bar{K}-k_t^e}{m}\right)$$

FOC equates MPKs between farmers and gatherers:

$$a+c = G'\left(\frac{\bar{K}-k_t^e}{m}\right)$$

Also: optimal k_t^e is **constant** (even if we added a productivity shock) $\Rightarrow$ no interesting dynamics in planner's solution

Calibration and Productivity Shock

Introduce **iid and mean-zero** productivity shock to both farmers and gatherers:

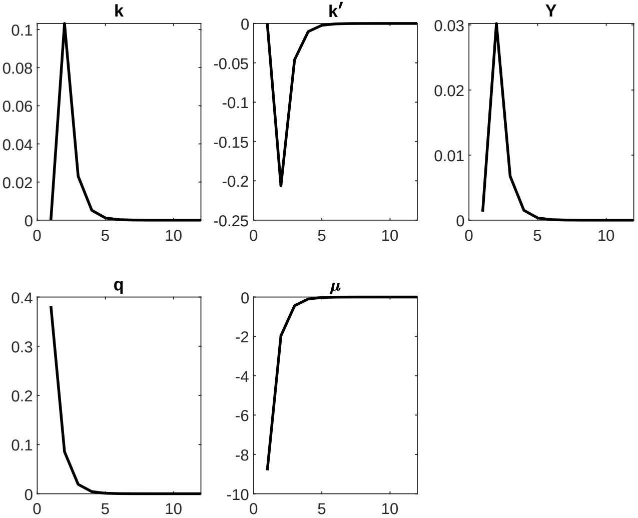
$$y_t = (1+\varepsilon_t)(a+c)k_{t-1}$$
$$y'_t = (1+\varepsilon_t)G(k'_{t-1})$$

Parameterize model: $\beta = 0.98$, $\beta' = 0.99$, $m = 0.5$, $\bar{K} = 1$, $a = 0.7$, $c = 0.3$, $\alpha = 1/3$, $z = 0.01$

Note with this parameterization, steady state capital allocated to farmers is $k = 0.84$, but planner's allocation would be $k^e = 0.91$

Because of borrowing constraint, too little capital is allocated to farmer

Impulse Responses to ε_t



Intuition

Increase in ε_t raises value of land, q_t

But this eases the borrowing constraint faced by the farmer

This allows them to purchase more land from the gatherers (i.e. get closer to efficient solution)

Them having more land in $t+1$ further increases price of land

Even though the productivity shock is "gone" by $t+1$, the fact they have more land in $t+1$ further eases the constraint and the shock persists

Borrowing constraint generates **persistence** through a **reallocation** channel – more land gets temporarily allocated to the higher marginal product agents

Would see no persistence in the efficient allocation