Kiyotaki & Moore (1997) - Credit Cycles

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Motivation

▶ There is a range of empirical micro evidence that the balance sheet of firms is important to their spending decisions.

▶ The idea that credit-constraints can play an important role in macroeconomic fluctuations has been formalized in Bernanke & Gertler (1989).

▶ Schleifer & Vishny (1992) argue that there is also a two-way feedback between borrowing limits and asset prices. Namely, if a firm is experiencing hard times, the potential buyers for its assets are other firms in the same sector which may also be experiencing hard times, thereby depressing asset prices and further credit-constraining them.

▶ Furthermore this lowering of sector-level activity may also depress future asset prices adding a dynamic aspect to the feedback.
Borrowing Limits

- Production by borrowers will involve the use of their own labour/human capital which they will not be able to precommit to provide.
- This production is idiosyncratic & the human capital inalienable, in that only their human capital can be used in the production process and not that of others.
- As a result, they will be constrained to being able to borrow only against their physical assets. They will be unable to borrow against the value of their production that comes from the use of their own human capital.
- The asset price of their physical assets will also vary, creating the feedback mechanism.
The Model

- A continuum of infinitely lived agents.
- They are of two types, farmers and gatherers, with population sizes one & \( m \) respectively.
- Two goods/assets: land \((k)\), which is in fixed supply, and fruit \((y)\) which is produced.
- Both types can own land, and produce & eat fruit.
- They have different discount rates, \( \beta < \beta' \) (prime symbolizes gatherers)
- All prices will be denominated in units of fruit.
At each date $t$ there is a competitive spot market in which land is exchanged for fruit at price $q_t$.

The only other market is a one-period credit market in which one unit of fruit is exchanged for a claim to $R_t$ units of fruit at $t+1$.

In equilibrium, we will get $R_t = R = 1/\beta'$. 
Farmers

- Maximize $E_t\left(\sum_{s=0}^{\infty} \beta^s x_{t+s}\right)$
- CRS production function: $y_{t+1} = F(k_t) = (a + c)k_t$
- Only fraction $ak_t$ is tradable.
- Fraction $ck_t$ is nontradable bruised fruit and so will always be consumed by farmer.
- Making the assumption $c > (1/\beta - 1)a$, the farmer will never consume more than $ck_t$. 
We assume that the farmers technology is idiosyncratic in the sense that only his labour can be used & further that a farmer always has the freedom to withdraw his labour; he cannot precommit to work. In the language of Hart & Moore (1994), the farmer’s human capital is inalienable.

The implication of this is that he faces a borrowing limit: 
\[ Rb_t \leq q_{t+1}k_t. \]

This borrowing limit says that his flow of payments (LHS) must be fully collateralized (RHS).

The farmer’s flow-of-funds constraint is thus
\[ q_t(k_t - k_{t-1}) + Rb_{t-1} + (x_t - ck_{t-1}) = ak_{t-1} + b_t \]
Gatherers

- Maximize $E_t\left(\sum_{s=0}^{\infty} \beta^s x_{t+s}'\right)$
- DRS production function: $y_{t+1}' = G(k_t')$
- Assume $G'(0) > aR > G'(\bar{K}/m)$, so that in equilibrium there will always be both farmers & gatherers producing (ie. with land) in the neighbourhood of the SS equilibrium.
- Gatherers’ production does not require any specific skill; nor do they produce any nontradable output. As a result no gatherer is credit constrained.
- Budget constraint is thus
  $$q_t(k_t' - k_{t-1}') + Rb_{t-1}' + x_t' = G(k_{t-1}') + b_t'$$
- In eqm, $b_t'$ & $b_{t-1}'$ are actually negative, reflecting the fact that gatherers are creditors to the farmers.
Market Equilibrium

Market eqm is defined as a seq of land prices and allocations of land, debt, & consumption of farmers and gatherers \( \{q_t, k_t, k'_t, b_t, b'_t, x_t, x'_t\} \), such that each farmer is maximizing his discounted utility subject to his production fn, borrowing constraint, & flow-of-funds constraint; each gatherer is maximizing her expected discounted utility subject to her production fn & budget constraint; and the markets for land, fruit & debt clear.
Farmers in Eqm

- Farmers choose to borrow up to the maximum & invest in land, consuming no more than their current output of nontradable fruit. So that \( x_t = ck_{t-1} \), \( b_t = q_{t+1}k_t/R \), and

\[
k_t = \frac{1}{q_{t-1/Rq_{t+1}}[(a + q_t)k_{t-1} - Rb_{t-1}]}\]

- Notice that contents of square brackets is the net worth of the farmer at the beginning of period \( t \).

- Also, \( q_t \) is the price of land, & \( 1/Rq_{t+1} \) is the amount that can be borrowed against land. Thus \( u_t = q_t - 1/Rq_{t+1} \) can be thought of as the downpayment required to purchase a unit of land.
Equilibrium

- Note that since in equilibrium the farmers are credit constrained and there is one interest rate in the economy, the farmers hold an inefficiently small amount of land in comparison with an unconstrained first best outcome.
- This gives the intuition for the result they find that in equilibrium, an increase in the agg. land holdings of farmers \( K \) increases output (even though, due to it’s fixed supply, it is just a compositional shifting of land from gatherers to farmers).
- An increase in the land holdings of farmers also increases the asset value of land, further easing their credit constraint in a feedback loop.
A Temporary Technology Shock

- Suppose there that in period $t$ only there is an unexpected shock which increases the output of both farmers and gatherers by a factor of $1 + \Delta$.
- They show that the $q_t$ will increase from it’s steady state value by the same order of magnitude as the shock ($\hat{q} = 1/\eta \Delta$)
- What is more $K_t$ increases by more than the size of $\Delta$, and both of these deviations have some persistence.
- That is, a temporary shock has large and persistent effects!
- Contrast this to the first best economy without credit constraints where agg. output would raise only in period $t$ and there would be no effect at all in $K$ or $q$. 
Investment & Cycles

- Adding 'trees', a form of capital whose supply is not fixed (unlike land) enables them to talk about investment in the model.
- They also add the assumption that a farmer can invest this period only with probability $\pi$ which is inspired by the idea that at the individual firm level investment is typically occasional and lumpy.
- These help weaken somewhat the leverage effect which is arguably too strong, they also bring out certain dynamics that are hidden by the simple model.
Farmers

- Investment in trees costs $\phi$ per unit of land planted, and trees depreciate at rate $\lambda$. Thus farmers’ flow-of-funds constraint becomes

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

- The other change is that at each date $t$, with probability $1 - \pi$, a farmer may now face the additional technological constraint $k_t \leq \lambda k_{t-1}$

- Notice that the simple model is embedded as the case $\phi = 0$, $\pi = 1$. 
In response to the same tech shock as discussed before the responses of $q$ and $K$ are still smaller but still of the same magnitude as before.

Lower $\pi$ or higher $\phi$ leads to smaller contemporaneous effects, more persistence, and more volatility in prices relative to quantities.

In fact the response can take a (decaying) cyclical form, and the peak can occur a few periods after the shock itself.
Conclusion

▶ To confirm the robustness of their findings the appendix presents an OLG model which does not rely on the assumptions of linear preferences but differing discount rates, nor that some of the farmers output is nontradable.

▶ Conclude that the interactions between credit constraints and asset prices is important, both amplifying the effects of credit constraints and generating cycles.

▶ Strengthen the case for the importance of credit fluctuations in the business cycle.