# Credit and Business Cycles

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- Financial Hierarchy
- Bank Lending Channel
- Balance Sheet Channel
- Credit Cycles

- Modigliani-Miller theorem (MM, 1958): financial structure is both indeterminate and irrelevant to real outcomes
- Perfect substitutability between different forms of funding
- Cost of capital is the same regardless of the way funds are raised
- This hypothesis is implicit in the IS-LM framework

- MM theorem is based on the assumption of perfect and complete information
- Imperfect substitutability:
  - Gap between internal finance and total investment
  - Asymmetric information between lenders and borrowers
- Asymmetric information or imperfect enforceability of financial contracts:
  - Wedge between the cost of funds raised externally and the opportunity cost of internal funds: *external finance premium (EFP)*
  - EFP: cost implicit in the principal-agent problem characterizing the relationship between financial intermediaries and borrowers

## Financial Hierarchy

- The cost of different sources of external funding increases in the degree of asymmetry between borrowers and lenders
- Pecking order theory (or financial hierarchy): Myers and Majluf (1984)
- Firms prefer internal funds
- If external finance is required, firms will resort to:
  1. debt finance
  2. bonds
  3. equity finance

- Assumption: production (investment) cost greater than internally generated funds (net worth)
- Financial gap: firms need to resort to the credit market
- New equity issues are too costly due to adverse selection phenomena
- At a given share price, only overvalued firms are willing to sell their shares
- Potential shareholders anticipate that these companies are adversely selected$\longrightarrow$ no trade on the equity market
- Under these conditions the announcement of an equity issue is generally interpreted as bad news by the investors
- The stock market becomes a typical *market for lemons* (Akerlof, 1970)

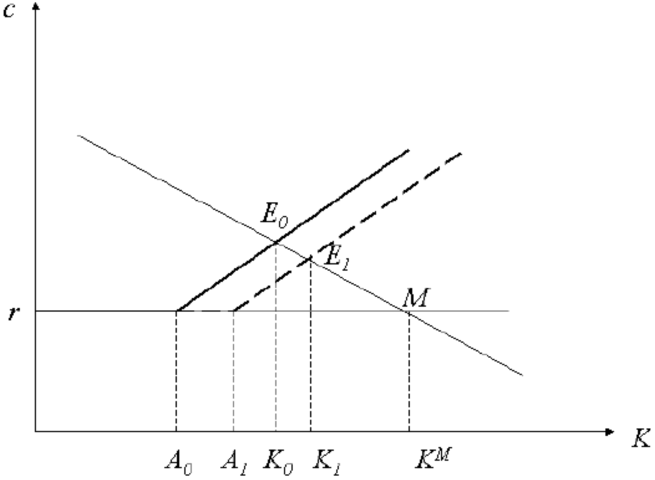
**A sketch of the Financial Hierarchy theory**

- Internal finance ($A$): retained profits (cash flow tout-court) which in turn constitute the net worth
- The cost of internal finance can be quantified based on the concept of opportunity cost (OC)
- The OC of internal finance equals the interest rate on a financial investment the firm could undertake and that it must renounce if the real investment is entirely covered with internal finance ($r$)

- Suppose $A = A_0$
- Demand for capital $K = f(c) \quad f^{'} < 0$
- This can be derived from a profit maximization problem
- In this case investment takes place up to the point where

$$MCK = MPK$$

## Funding Opportunities



- In a MM world, external and internal finance would have the same cost ($r$).
- Thus $c = r$
- The i$^{th}$ firm would invest up to $K^M$
- The gap $K^M - A_0$ is covered with external finance and leverage equals:

$$\frac{K^M - A_0}{K^M} = 1 - a_0$$

- In the anti-MM world, information is asymmetric
- External finance is more expensive than internal finance
- Cost of external finance: $\rho$
- The wedge between $r$ and $\rho$ depends upon the amount of external finance:

$$r - \rho = \varepsilon \left( K^M - A_0 \right), \quad \varepsilon > 0$$

Thus, from $K^M = A_0$ the cost for external finance schedule is upward sloping

## Conclusions

- Inefficient exploitation of resources
- Relevance of financial structure, compared to the MM paradigm:
  - Assume net worth increases from $A_0$ to $A_1$

- Bank Lending channel: emphasis on banks' balance sheet and substitutability between different forms of finance to extend credit
- Balance Sheet channel (Financial Accelerator): emphasis on borrowers' balance sheet and the premium for external finance

## Some Literature

- Bank Lending view: Bernanke and Blinder (1988)
- Balance Sheet channel: Greenwald and Stiglitz (1988, 1990, 1993), Bernanke and Gertler (1989, 1990) and Kiyotaki and Moore (1997)
- These frameworks emphasize the role financial frictions and the interaction of heterogeneous agents
- Renewed interest for the Wicksellian view that credit has both relevance in the propagation of business cycles and MPTM
- Distinct role played by financial assets and liabilities and the need to distinguish between different types of non-monetary assets

- The bank lending channel highlights the nature of credit and the special role played by commercial banks in the credit markets
- **Essence of the mechanism:** monetary policy can affect the external financial premium by influencing the supply of intermediated credit
- Model economy: commercial banks represent the only source of external funding
- Banks' liabilities: deposits

- Banks' specialization in overcoming informational asymmetries in the provision of both transaction services and credit to business
- Commercial banks represent in most of the countries the main source of external funding for small and medium-sized firms
- Monetary policy decisions affecting the reserve position of the banks can in turn generate adjustments in the interest rates and in the banking sector's balance sheet
- Policy induced reductions in banks' reserves, for instance, are likely to lead to a reduction in the level of deposits, which should be matched by a fall in the supply of loans, at least to the extent that banks cannot adjust their position in reserves by issuing new non reservable liabilities
- Furthermore, changes in the interest rates can in turn reflect in effects on the demand for money, consumption and investment decisions of firms and households

**Kiyotaki and Moore (1997) (KM hereafter)**

- Asymmetric information between borrowers and lenders
- Moral hazard: lenders face a maximum limit to the credit they can obtain
- Role of collateralizable assets
- Collateral constraints affect the scale of production: underutilization of resources
- The higher the collateral value, the higher the credit obtained and in turn investment spending and production

- The economy is composed by a large number long-lived agents: 2 categories
- Farmers: financially constrained agents who produce by means of inalienable human capital
- Gatherers: agents endowed with alienable human capital, and hence financially unconstrained
- The distribution of the agents according to their nature is exogenously postulated by KM
- Two goods:
    - fruit (output)
    - land→a durable and collateralizable good, whose supply is exogenously imposed to $\overline{K}$

**Farmers**

Output, produced by means of a technology of both labour and land, can be consumed or lent at a constant gross rate of return $R = (1 + r)$.
Farmers' technology:

$$y_t^f = (\alpha + c)k_{t-1}^f \tag{1}$$

- $y_t^f$: output produced by the farmer in $t$
- $k_{t-1}^f$: land available to the farmer at time $t$
- $\alpha$ and $c$: positive productivity parameters
- $c$: share of non-tradeable output that can only be employed in the productive process (bruised fruit)

**Gatherers**

Gatherers access to the following technology:

$$y_t^g = f(k_{t-1}^g) \tag{2}$$

- $y_t^g$: output of the gatherer in $t$
- $f(\cdot)$: decreasing returns to scale technology
- $k_{t-1}^g$: land available to the gatherer at time $t-1$
- Production process: time-to-build technology

## Inalienability and Impatience

- Each farmer's technology is individual-specific
- Once the production has started, no one can successfully complete the productive process but the farmer
- In principle, farmers have incentive to threaten their creditors to withdraw their labour and default
- KM assume that lenders cannot force borrowers to repay their debts unless previously secured
- $\beta < \beta^{'}$: heterogeneity is characterized by different discount rates across households
- Furthermore, if discount rates are equal then the steady state income distribution would be indeterminate: a number of hypothesis are necessary

**Collateral Constraint**

Gatherers collateralize farmers' land, by imposing the following constraint:

$$b_t^f = \frac{q_{t+1} k_t^f}{R} \tag{3}$$

The maximum loan farmers can get at time $t$ is equal to the one-period discounted value of the land in $t+1$

$q_{t+1}$: price of the land at time $t+1$.

**Flow-of-funds constraint**

$$y_t^f + b_t^f = q_t \Delta k_t^f + R b_{t-1}^f + c_t^f \tag{4}$$

$c_t^f$: farmers' consumption

Substituting the collateral constraint into the budget constraint:

$$c_t^f = (\alpha + c)k_{t-1}^f - \mu_t k_t^f \tag{5}$$

User cost of land: $\mu_t = q_t - (q_{t+1}/R)$.
Preferences are such that farmers only consume bruised fruit, $ck_{t-1}^f$.

In order to determine the consumption/saving behavior of the farmer, we recall that one unit of tradable output can be employed in three ways:

- **Investment**. It consists in investing $1/\mu_t$ in land, which yields $c/\mu_t$ non-tradable fruit and $\alpha/\mu_t$ tradable fruit at date $t+1$. The non-tradable fruit is consumed and the tradable fruit is invested which yields $(\alpha/\mu_t)(c/\mu_{t+1})$ non-tradable fruit and $(\alpha/\mu_t)(\alpha/\mu_{t+1})$ tradable fruit at date $t+2$, and so on
- **Saving**. The second one consists in saving the unit of tradable output and use the return to saving $R$ to begin a strategy of investment – like the first one – from $t+1$ onward
- **Consumption**. The third option consists in consuming right away one unit in $t$

Discounted steady-state utility associated with the three strategies:

- $U_I = \beta c/(1-\beta)\alpha$ (investment)
- $U_S = R\beta^2 c/(1-\beta)\alpha$ (saving)
- $U_C = 1$ (consumption)

Need to impose a condition in order to ensure that farmers will actually invest, rather than saving/consuming:

$$\begin{aligned} U_I &> U_S \\ U_I &> U_C \end{aligned}$$

**Assumption 1**

Using the fact that

$$U_I > U_S$$

entrepreneurs eat all their non-tradable output iff:

$$\frac{1}{\beta} > R = \frac{1}{\beta'}.$$

**Assumption 2**

Farmers consume no more than the bruised fruit and use all tradable output for making deposits:

$$U_I > U_C$$

which in turn translates into

$$c > \left(\frac{1}{\beta} - 1\right)\alpha.$$

Farmer's demand for land is given by

$$k_t^f = \frac{1}{\mu_t}[(\alpha + q_t)k_{t-1}^f - Rb_{t-1}^f] = \frac{\alpha}{\mu_t}k_{t-1}^f \tag{6}$$

Substituting this expression in the collateral condition:

$$b_t^f = \frac{q_{t+1}\alpha k_{t-1}^f}{R\mu_t} \tag{7}$$

Alienability of human capital for the gatherers implies the existence of a single constraint:

$$y_t^g + Rb_{t-1}^g = q_t \Delta k_t^g + b_t^g + c_t^g \tag{8}$$

As $k_t^f = \overline{K} - k_t^g$:

$$c_t^g = f(k_{t-1}^g) + \mu_t(\overline{K} - k_t^g) \tag{9}$$

The maximization problem for the gatherer implies that his preferences are such that $R\mu_t = f'(k_t^g)$. Demand for land:

$$k_t^g = f'^{-1}(R\mu_t) \tag{10}$$

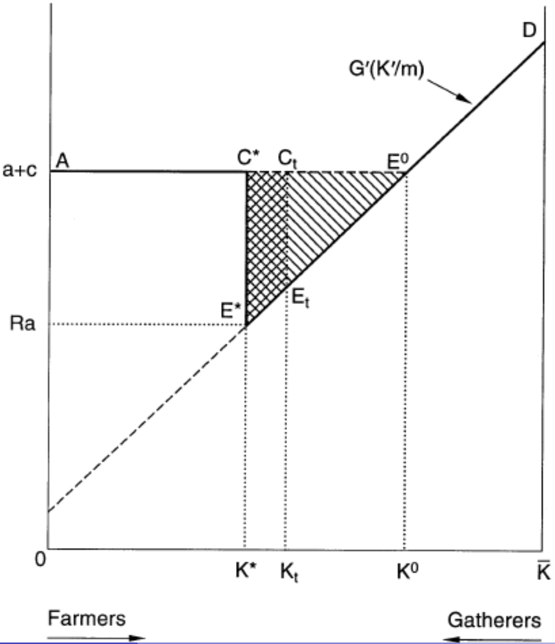
Using these three equations we can recover a unique steady state, $\{q, k^f, b\}$ with associated user cost, $\mu$:

$$q = \frac{\alpha R}{R-1}$$

$$b = \frac{\alpha}{R-1} k^f \tag{11}$$

$$\mu = \alpha \tag{12}$$

$$k_t^g = k_{t-1}^g = \overline{K} - k^f = \overline{K} - f'^{-1}(R\alpha) \tag{13}$$


D
G′(K′/m)
a+c
A
C*
C_t
E⁰
E_t
E*
Ra
0
K*
K_t
K⁰
K̄
Farmers
Gatherers

- We log-linearize the model economy around the steady state:

$$\begin{bmatrix} \widehat{k}^f_t \\ \widehat{q}_t \end{bmatrix} = \begin{bmatrix} \frac{\eta}{1+\eta} & 0 \\ -\frac{R-1}{\eta} & R \end{bmatrix} \begin{bmatrix} \widehat{k}^f_{t-1} \\ \widehat{q}_{t-1} \end{bmatrix}$$

- $\eta$ : elasticity of the residual supply of farmers' land with respect to the user cost at the steady state
- We consider $f''(\cdot) < 0$ to ensure that $\eta$ is positive
- Jacobian Matrix: lower triangular

## Productivity Shock

- At time $t-1$, we assume the model economy is at the steady state
- We introduce an unexpected one-period shock to farmers' productivity, denoted by $\Delta$.
  Let us consider the BC of the farmer:

$$\mu_t k_t^f = [(\alpha + q_t)k_{t-1}^f - Rb_{t-1}^f]$$

  Log-linear Approximation:

$$RHS \longrightarrow [\alpha + \Delta\alpha + q_t - q]k^f \longrightarrow [\alpha + \Delta\alpha + q\widehat{q}_t]k^f$$

$$LHS \longrightarrow [1 + (1+\eta)]\,\widehat{k}_t^f$$

- After time $t$ the system returns to its original position
- The financial constraint faced by the farmer holds with equality $(\beta < \beta^{'})$

Percentage deviation of land from its steady state:

$$\widehat{k}_t^f = \frac{\eta R}{(R-1)(\eta+1)}\widehat{q}_t + \frac{\eta \Delta}{\eta+1}, \tag{14}$$

From time $t+1$ onwards, land dynamics will turn on the following path:

$$\widehat{k}_{t+s}^f = \left(\frac{\eta}{1+\eta}\right)^s \widehat{k}_t^f, \qquad s > 0 \tag{15}$$

Next, we need to determine the evolution of the asset price, $q_t$. From the Gatherer's Euler equation:

$$q_t = \beta' f'\left(\overline{K} - k_t^f\right) + \beta' q_{t+1} \tag{16}$$

After log-linearizing the Euler condition and plug it back into the linearized constraint of the farmer:

$$\widehat{q}_t = \frac{(R-1)(\eta+1)}{\eta\left((\eta+1)R-\eta\right)}\widehat{k}_t^f \tag{17}$$

We solve the resulting system to obtain:

$$\begin{aligned} \widehat{q}_t &= \frac{\Delta}{\eta}, && (18)\\ \widehat{k}_t^f &= \frac{\eta}{1+\eta}\left(1+\frac{R}{\eta(R-1)}\right)\Delta. && (19) \end{aligned}$$

**Extended Version:** Section II KM (1997)

- Let us assume that there is a continuum of farmers, as in the original KM framework
- Land as a reproducible asset
- Depreciation
- Probability of investing
- A fraction $\pi$ of farmers can invest (entrepreneurs), while $1-\pi$ cannot (households)

**Entrepreneurs**

Flow-of-funds Constraint

$$y_{i,t}^{f} + b_{i,t}^{f} = q_t \left( k_{i,t}^{f} - k_{i,t-1}^{f} \right) + \phi \left( k_{i,t}^{f} - \lambda k_{i,t-1}^{f} \right) + R b_{i,t-1}^{f} + c_{i,t}^{f} \quad (20)$$

$\phi \left( k_{i,t}^{f} - \lambda k_{i,t}^{f} \right)$: input for reproduction of capital

Collateral Constraint

$$b_{i,t}^{f} = \frac{q_{t+1} k_{i,t}^{f}}{R}$$

Assuming that investing is strictly better than consuming, the i$^{th}$ entrepreneur faces the following constraint:

$$\left( q_t + \phi - \frac{q_{t+1}}{R} \right) k_{i,t}^{f} = \left( \alpha + \lambda \phi + q_t \right) k_{i,t-1}^{f} - R b_{i,t-1}^{f}$$

**Households**

$$k^f_{j,t} = \lambda k^f_{j,t-1}$$

In this case, land is solely subject to depreciation

## Aggregation

Land Dynamics

$$\begin{aligned} K_t &= \int k^f_{j,t} dj + \int k^f_{i,t} di = \\ &= (1-\pi)\,\lambda K_{t-1} + \frac{\pi}{\left(q_t + \phi - \frac{q_{t+1}}{R}\right)} \left[\left(\alpha + \lambda\phi + q_t\right) K_{t-1} - RB_{t-1}\right] \end{aligned}$$

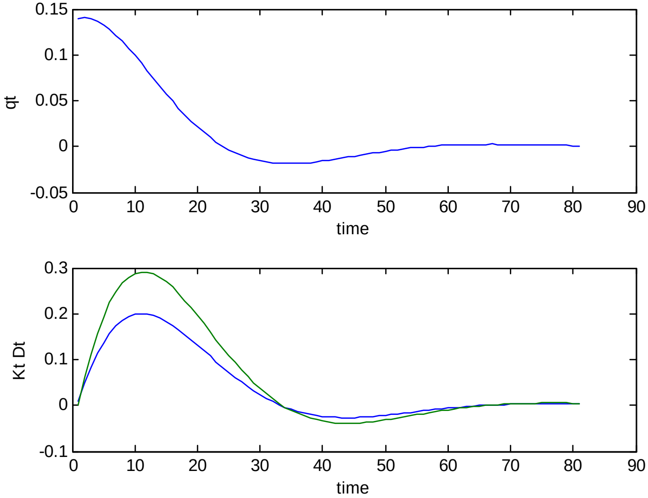
Debt Dynamics

$$B_t = q_t\left(K_t - K_{t-1}\right) + \phi\left(K_t - \lambda K_{t-1}\right) + RB_{t-1}$$

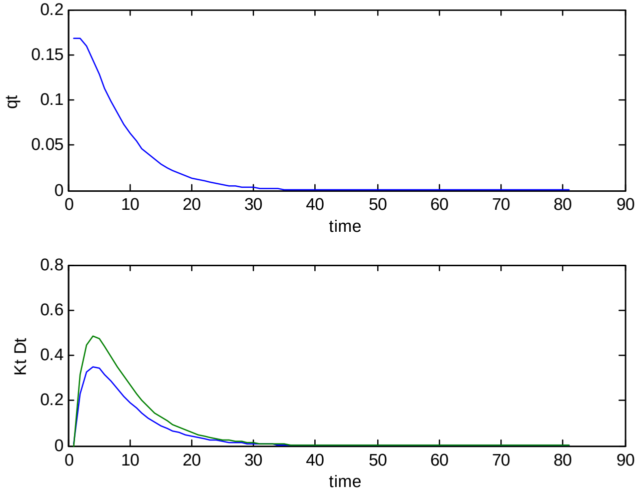
Asset Price (Gatherer's Euler Equation)

$$R = \frac{f'\left(\overline{K} - K_t\right) + q_{t+1}}{q_t}$$

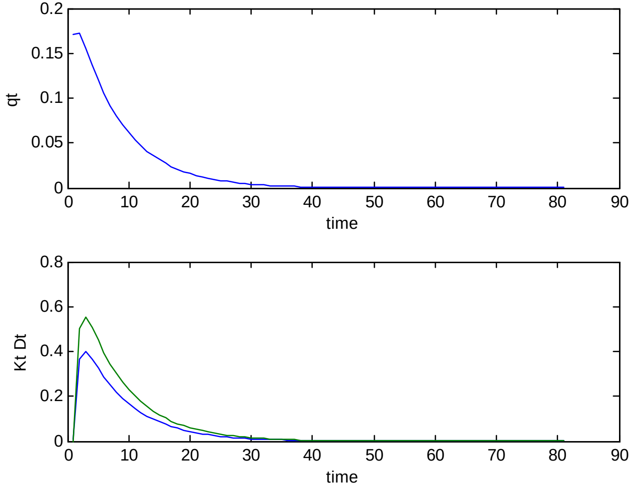
# Numerical example



# Numerical Simulations ($\pi = 0.5$)



# Numerical Simulations ($\pi = 0.8$)

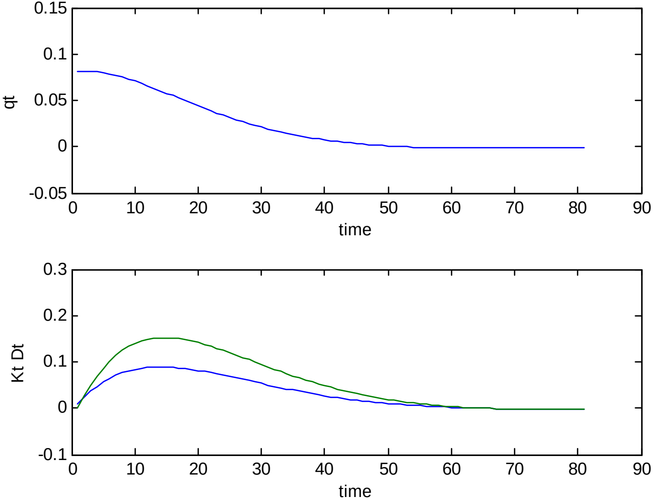


- Loan-to-value (LTV) ratio: amount of the loan as a percentage of the total appraised value of real property:

$$b_{i,t}^{f} = \chi \frac{q_{t+1} k_{i,t}^{f}}{R} \quad 0 < \chi \leq 1$$

- $\chi$ : LTV
- As $\chi \uparrow$, the qualification guidelines for certain mortgage programs become more strict
- Lenders can require borrowers of high LTV loans to buy mortgage insurance

# Numerical Simulations ($\chi = 0.8$)



# Numerical Simulations ($\chi = 0.5$)