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 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
- What's at the root of 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 (Journal of Finance, 1984)
- Firms prefer internal funds
- If external finance is required, firms will resort to:
  1. debt finance
  2. bonds
  3. equity finance

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)

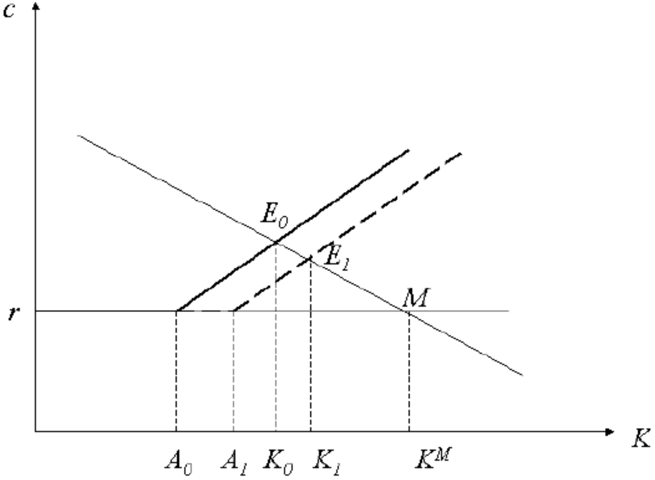
A sketch of the Financial Hierarchy theory

- 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)

- 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 ith 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: ρ
- The wedge between r and ρ depends upon the amount of external finance:

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

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 (AER, 1988)
- Balance Sheet channel: Greenwald and Stiglitz (QJE, 1993), Bernanke and Gertler (AER, 1989) and Kiyotaki and Moore (JPE, 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
- Balance sheet:

ASSETS	LIABILITIES
Reserves (r)	Deposits (D)
Loans $(D - r)$	

- Banks' specialization in overcoming informational asymmetries in the provision of both transaction services and credit to business
- Commercial banks: 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
- α 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:

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

b_t^f : loan

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/μ_t non-tradable fruit and α/μ_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

Alternative paths:

$$\begin{aligned} \text{Inv.} &: \quad 0, \frac{c}{\mu_t}, \frac{\alpha}{\mu_t}\frac{c}{\mu_{t+1}}, \frac{\alpha}{\mu_t}\frac{\alpha}{\mu_{t+1}}\frac{c}{\mu_{t+2}}, ... \\ \text{Sav.} &: \quad 0, 0, R\frac{c}{\mu_{t+1}}, R\frac{\alpha}{\mu_{t+1}}\frac{c}{\mu_{t+2}}, ... \\ \text{Cons.} &: \quad 1, 0, 0, ... \end{aligned}$$

Steady state:

$$\begin{aligned} \text{Inv.:} & \quad 0, \frac{c}{\mu}, \frac{\alpha}{\mu}\frac{c}{\mu}, \frac{\alpha}{\mu}\frac{\alpha}{\mu}\frac{c}{\mu}, ... \\ \text{Sav.} &: \quad 0, 0, R\frac{c}{\mu}, R\frac{\alpha}{\mu}\frac{c}{\mu}, ... \\ \text{Cons.} &: \quad 1, 0, 0, ... \end{aligned}$$

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:

$$U_I > U_S$$
$$U_I > U_C$$

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

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

Substituting this expression in the collateral condition:

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

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:

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

For a given level of farmers' landholding and debt at the previous date an equilibrium from date t onward is characterized by the path:

$$\{ (q_{t+s}, K_{t+s}, B_{t+s}) | \, s \geq 0 \}$$

This satisfies flow-of-funds constr., coll. constr. and Euler equation of the gatherer.
Rule out bubbles (transversality condition):

$$\lim_{s \rightarrow \infty} \left\{ \left(\beta' \right)^{s} q_{t+s} \right\} = 0$$

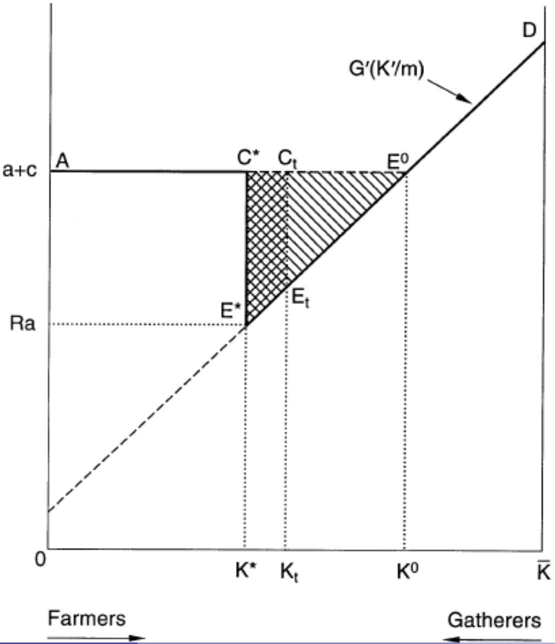
Using these three equations we can recover a unique steady state, $\{q, k^f, b\}$ with associated user cost, μ:

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

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

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

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


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

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

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

- η : elasticity of the residual supply of farmers' land with respect to the user cost at the steady state:

$$\frac{1}{\eta} = \left.\frac{d \log \mu\left(k_t^f\right)}{d \log k_t^f}\right|_{k_t^f = k^f} = -\left.\frac{d \log f'\left(k_t^g\right)}{d \log k_t^g}\right|_{k_t^g = \overline{K} - k^f} \times \frac{k^f}{\overline{K} - k^f}$$

- We consider $f''(\cdot) < 0$ to ensure that η 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 Δ.
- From time $t$and $t + 1$ the production technologies of the two agents return to their equilibrium level
- Perfect foresight: the shock is known to be temporary

Let us consider the BC of the farmer:

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

- Log-linear approximation around the steady state:

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

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

- 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:

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

We solve the resulting system to obtain:

$$\widehat{q}_t = \frac{\Delta}{\eta}, \tag{18}$$

$$\widehat{k}_t^f = \frac{\eta}{1+\eta}\left(1+\frac{1}{\eta}\underbrace{\frac{R}{R-1}}_{\text{Amplification Factor}}\right)\Delta. \tag{19}$$

The role of elasticity η

Persistence:

$$\widehat{k}^f_{t+s} = \left(\frac{\eta}{1+\eta}\right)^s \widehat{k}^f_t, \qquad s > 0$$

Market Clearing:

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

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 π of farmers can invest (entrepreneurs), while $1 - \pi$ cannot (households)

Entrepreneurs

Flow-of-funds Constraint

$$y^f_{i,t} + b^f_{i,t} = q_t \left(k^f_{i,t} - k^f_{i,t-1} \right) + \phi \left(k^f_{i,t} - \lambda k^f_{i,t-1} \right) + Rb^f_{i,t-1} + c^f_{i,t} \quad (20)$$

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

Collateral Constraint

$$b^f_{i,t} = \frac{q_{t+1} k^f_{i,t}}{R}$$

Assuming that investing is strictly better than consuming, the ith entrepreneur faces the following constraint:

$$\left(q_t + \phi - \frac{q_{t+1}}{R} \right) k^f_{i,t} = \left(\alpha + \lambda\phi + q_t \right) k^f_{i,t-1} - Rb^f_{i,t-1}$$

Households

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

In this case, land is solely subject to depreciation

Aggregation

Land Dynamics

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

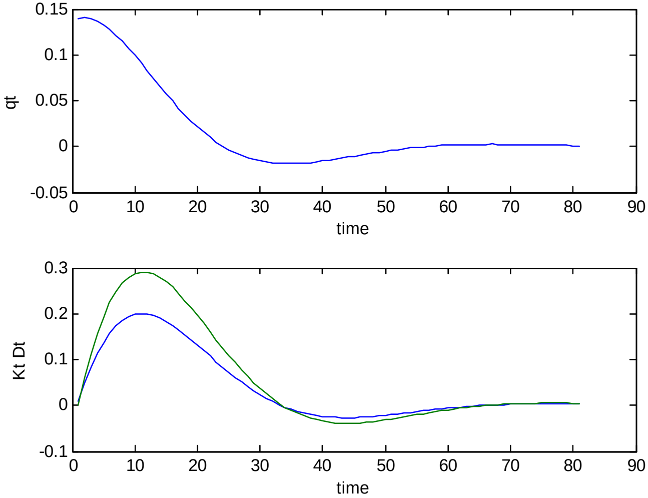
Debt Dynamics

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

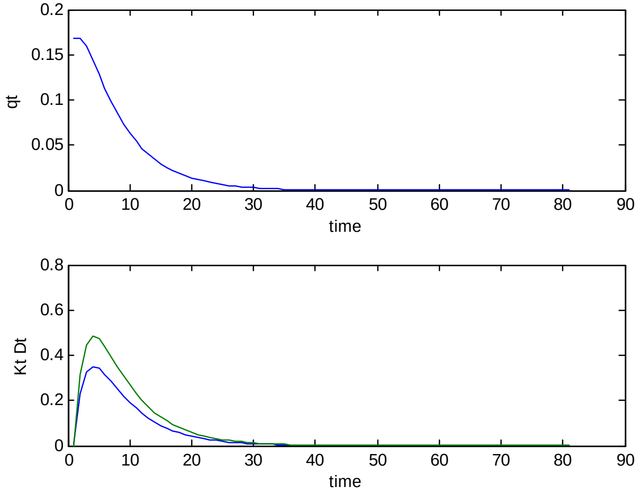
Asset Price (Gatherer's Euler Equation)

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

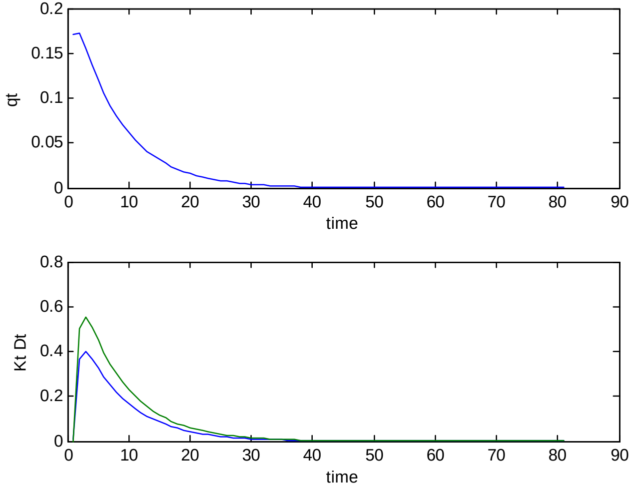
Numerical example



Numerical Simulations ($\pi = 0.5$)



Numerical Simulations ($\pi = 0.8$)

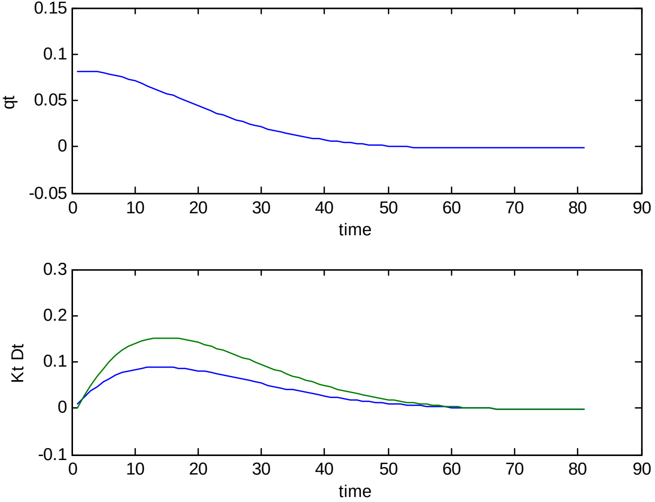


- Loan-to-value (LTV) ratio: amount of the loan as a percentage of the total appraised value of real property:

$$b^f_{i,t} = \chi \frac{q_{t+1} k^f_{i,t}}{R} \quad 0 < \chi \leq 1$$

- χ : 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 ($\chi = 0.5$)