

Macro-Modelling

with a focus on the role of financial markets

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Macro Implications

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The Origins

- Before 1600s finance was mostly informal and in small scale.
- First true financial market: Amsterdam Stock Exchange (1611). First boom and bust in the price of tulips.
- Modern finance fully spur in England in 1700s. A key contributor was the Bank of England (1694) and the industrial revolution.
- Financial dominance moved to the US early 1900s.

US Timeline of Financial Development

- 1836-1863 Free-banking era: All banks were chartered by states and cannot expand outside a given state. Weak regulation. No national currency. Small banks.
- In 1863 the National Banking Act allowed the federal government to charter banks and to establish a national currency (Comptroller of the Currency), maintaining the interstate restrictions.
- The fear of big banks delayed the implementation of a Federal Reserve until 1913. Frequent bank runs forced its implementation.
- Still, the Fed was decentralized in 12 loosely connected regional central banks. Lack of cooperation to face the Great Depression?

Free Banking Era

- Free-banking era was characterized by monopolistic, inefficient and unstable banks inside each state. Historians have found this period chaotic and filled with speculators, wildcat banks, and bank failures.
- Lockett (1980) "... free banking degenerated into so called **wildcat banking**. Banks of very dubious soundness would be set up in remote and inaccessible places "where only the wildcats thrive." Bank notes would then be printed, transported to nearby population centers, and circulated at par. Since the issuing bank was difficult and often dangerous to find, redemption of bank notes was in this manner minimized. These and similar abuses made banking frequently little more than a legal swindle."

Free Banking Era

- Rolnick and Weber, AER, 1983.
- Misleading to characterize the free banking experience as a failure of laissez-faire banking.
- Were the problems with free banks caused by some inherent instability in the banking business, or can they be explained by the laws and regulations that governed free bank activities?

Free Banking Era

- Rolnick and Weber, AER, 1983.

State (Free Banking Years)	Free Banks (1)	Free Banks with Redemption Information (2)	Free Banks that Closed (% of Col. 1) (3)	Free Banks that Failed (% of Col. 2) (4)
New York (1838–63)	449	445	160 (36)	34 (8)
Wisconsin (1852–63)	140	140	79 (56)	37 (26)
Indiana (1852–63)	104	77	89 (86)	24 (31)
Minnesota (1858–62)	16	16	11 (69)	9 (56)
Total	709	678	339 (48)	104 (15)

Sources: New York, Indiana, and Minnesota state auditor reports and Wisconsin state auditor reports as given in U.S. Congress (1838–63).

Great Depression

- The Great Depression put an end to a period of deregulation and laissez-faire in banking.
- In the period 1929-1933, 9000 banks failed.
- In 1933:
 - The SEC was created to enforce accounting, information disclosure and restrict insider trading.
 - The Glass-Steagall Act separated the banking industry from the stock and bond security industries.
 - Federal Reserve Bank was strengthened and partly centralized in the Federal Reserve Board of Governors.

The Recent Evolution of Banking in the US

- Now two thirds of the US banking system are state chartered.
- There are multiple regulatory agencies.
- The US banking system had moved towards concentration because of deregulation and mergers (one-stop shopping or universal banking).
- Since 1930, the number of banks was constant. Since 1984, it has fallen from more than 14,000 banks to less than 8,000 banks today.
- For comparison, less than 100 in Japan. No other nation has more than 1,000 banks.

Key of Modern Banking

- **Power of Central Banks.**
- Besides the Federal Reserve in the US, the European Central Bank (ECB) is also very important in the world. Similar lines than the Fed.
- Central Bank independence in most countries.

Key of Modern Banking

- Central Banks main functions.
 - Facilitate financial transactions by issuing new currency, clearing checks and short-term seasonal loans.
 - Regulate the banking system.
 - Lender of last resort (preventing potential bank runs).
 - Monetary policy and regulate the money supply. They control the monetary base (both currency and reserves held by banks) with the hope of changing money supply and being influential to real activity.

Effects of financial markets on development

- Financial Development
 - Facilitates Risk Management
 - Helps borrowers and lenders hedge, pool and diversify risk.
 - Smooth consumption by increasing liquidity.
 - Generates a Better Allocation of Resources.
 - Increases the amount of aggregate savings in an economy.
 - Allocate resources more efficiently.
 - Facilitates trade.
 - Generates a Better Monitoring of Borrowers.
 - Ex ante monitoring.
 - Intermediate monitoring.
 - Ex-post monitoring.

Effects of financial markets on development

- These effects translate into growth through
 - Trade.
 - Capital accumulation.
 - Technological innovation.

Facilitates Risk Management

- Risk hedging: One party transfers part of the risk from a financial transaction to another party. **Trade and Capital accumulation**
- Risk diversification: Purchase of large portfolio of assets so the risk associated with a single one is spread over the entire pool. **Technology**
- Risk pooling: Aggregation of small amounts of savins so that everybody shares the risk of the assets purchased with the pool. **Technology**

Facilitates Risk Management

- **Risk hedging** improves liquidity, which facilitates trade.
 - Easy and speed with which agents can convert assets into purchasing power at agreed prices. As we discussed informational asymmetries and transaction costs inhibit liquidity.
- Recall financial intermediaries provide liquidity.
- "*The industrial revolution had to wait for the financial revolution*" (Bencivenga, Smith, and Starr (66)). The creation of liquid capital markets, with assets as equity, bonds and demand deposits that investors can sell quickly, allowed the industrial revolution to happen.

Facilitates Risk Management

- As stock markets transaction costs drop, more investment can occur on the illiquid, high return projects.
- Long gestation production technologies generate higher returns but requires that ownership be transferred throughout the life of the production process. If this exchange of ownership claims is costly, long run production technologies are less attractive.
- As discussed, if equity markets exist, all agents will use equity and none banks. Banks will only emerge if there are large impediments in trading in securities markets.

Facilitates Risk Management

- However more liquidity may have ambiguous effects, because
 - increases investment returns.
 - lowers uncertainty.
- Higher returns and lower uncertainty may in fact reduce savings rates if the income effect dominates the substitution effect.
- If saving rates decline, economic growth can actually decelerate.

Facilitates Risk Management

- High return projects tend to be riskier than low return ones...but individuals do not like risk.
- By reducing risk, the portfolio shifts towards higher expected return projects, which has an ambiguous effect on saving rates.

Facilitates Risk Management

- **Risk diversification** affects savings and also technological change.
- A diversified portfolio reduces the risk of taking innovative projects.
- Higher technological change accelerate economic growth.

Facilitates Risk Management

- **Risk pooling** also may improve resource allocation by enhancing risk diversification, liquidity, and the size of feasible firms.
- To attract and pool many investors is costly and depend critically on reputation or government guarantees.
- Financial systems that are more effective at pooling the savings of individuals can improve the resource allocation and boost technological innovation.

A Better Resource Allocation

- It is difficult and costly for lenders to learn about market conditions, future prospects, managers' quality, etc.
- Improving information about projects.
 - Financial intermediaries are better at selecting the most promising projects and induce a more efficient allocation of capital and faster growth

A Better Resource Allocation

- It is difficult and costly for small investors to learn about market conditions, future prospects, managers' quality, etc.
- Improving information about managers.
 - Financial intermediaries may also boost the rate of technological innovation by identifying those entrepreneurs with the best chances of successfully initiating projects and introducing new products and production processes.

A Better Resource Allocation

- It is difficult and costly for lenders to learn about market conditions, future prospects, managers' quality, etc.
- Improving corporate control and accountability.
 - Financial arrangements that improve corporate control tend to promote faster capital accumulation and growth by improving the allocation of capital.

A Better Resource Allocation

- Hence, financial intermediaries facilitate transactions.
- More specialization requires more transactions, and financial intermediaries reduce transaction costs.
- This link between facilitating transactions, specialization, innovation, and economic growth were core elements of Adam Smith's (1776) *Wealth of Nations*.

A Better Monitoring of Borrowers

- Financial intermediaries monitoring reduce the risk involved in lending, also increasing savings and technological innovation.
- Stock markets may also promote corporate control by linking managerial compensation to stock prices and aligning the interest of managers with those of owners.
- The fear of takeovers also introduce incentives for managers to behave. However under asymmetric information this risk is reduced (Myers and Majluf, 84).

Big Open Question

- What's first, the egg or the chicken?

Big Open Question

- What's first, the egg or the chicken?
- Financial development may spur economic development.
- Economic development may also spur financial development.
- Do we have a virtuous circle?

Standard Macro Theories

- These theories give ALMOST no treatment to financial markets!!!
- This is a big missing link in macroeconomics
- and this is the main recent critique to macroeconomics.

The New Critique to Macroeconomics

- The recent financial crisis gave elements to many economists to criticize the status of the profession.
- Among the fiercest critics is Paul Krugman.
- Main criticism to new macroeconomics.
 - <http://www.nytimes.com/2009/09/06/magazine/06Economic-t.html>
 - Freshwater vs. Saltwater.
 - Beauty of models vs. Relevance of models.
 - Excessive confidence on efficient markets and rationality.
 - No role to financial markets.

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 - Freshwater vs. Saltwater.
 - Beauty of models vs. Relevance of models.
 - Excessive confidence on efficient markets and rationality.
 - No role to financial markets.
- To my view, not a constructive (not even accurate) criticism.

The Origin of Macroeconomics

- Macroeconomics was created in the aftermath of the Great Depression to explain business cycles.
- Policies that reduce economic volatility can improve welfare. However the important question is:
- How much welfare improves by eliminating output fluctuations?
- Research initiated by Nobel economist Robert Lucas (87) suggests NOT MUCH!!!

Phases of Business Cycles

- Recession: Two or more consecutive quarters of negative GDP growth.
- Through of a recession: Point in time at which GDP reaches its lowest level before it begins to rise again.
- Expansion: Two or more consecutive quarters of positive GDP growth.
- Peak of an expansion: Point in time at which GDP reaches its maximum level before it begins a decline again.

NBER Recession Dates

- Go to <http://www.nber.org/cycles/cyclesmain.html>

Main Characteristics of Business Cycles

- Some facts about business cycles
 - Are not uniform.
 - Are not symmetric.
 - Recessions became less frequent over time.
 - The most volatile components of GDP are consumption of durables and investment.

The Role of Financial Markets on Business Cycles

- Most funds required for the consumption of durables and investment are channeled through financial intermediaries.
- 3 out of 10 leading NBER indicators are related to financial markets directly,
 - Monetary base (procyclical).
 - Stock prices (S&P500) (procyclical, very volatile then not accurate).
 - Interest rate spreads (procyclical)
- 3 out of 10 leading NBER indicators are related to financial markets indirectly,
 - Manufacturers' new orders for capital
 - Manufacturers' new orders for materials
 - Housing starts

Welfare Costs of Business Cycle

- Business cycle fluctuations reduce social welfare.
- Lucas' proposed measure:
 - Percentage increase in consumption that would be necessary to make a representative consumer indifferent between a non-fluctuating consumption trend and one that is subject to business cycles.
- Under the assumption that business cycles are random shocks around a trend growth path.
 - Lucas formula:

$$\lambda = \frac{1}{2}\sigma^2\theta = \frac{1}{2}(0.32)^2 2 = 0.001$$

- Eliminating all fluctuations is worth 0.1% of annual consumption

Welfare Costs of Business Cycle

- Critiques to this approach
 - Missing large potential recessions.
 - For example, the recent crisis or the Great Depression.
 - Equity Premium Puzzle (Mehra and Prescott)
 - Risk in returns to an asset that is correlated with aggregate consumption should be small (less than 0.5 percentage points). In fact the premium has averaged around 6 percentage points.
 - Keynesian critiques
 - Business cycles are not fluctuations above and below a trend. Instead, booms are times when the economy is near its potential output trend, and recessions are times when the economy is substantially below trend.
 - Hence the welfare cost of business cycles is larger, because an economy with cycles not only suffers more variable consumption, but also lower consumption on average.

Main Macroeconomic Theories

- Classical Theory.
- Debt-Deflation Theory.
- Keynes.
- Keynesian Theory.
- Financial Instability Hypothesis.
- Monetarist Theory.
- Neoclassical Theory.

- **New Theories with a Role for Financial Markets.**

Classical Theory

- **Adam Smith, "Wealth of Nations" (1776).**
- Main assumptions
 - Perfect competition
 - Representative agent.
 - Real values (not nominal) are used in making economic decisions.
- Money is only used as a medium of exchange.
- Money neutrality since prices are perfectly flexible.
- Money only affects inflation.

Classical Theory

- Considering an aggregate production function.

$$Y = Af(K, L)$$

- Changes in aggregate demand only affect prices.
- What matters is what determines A , K and L .
- NO ROOM for financial intermediaries or financial markets.

Classical Theory

- Based on these assumptions, Modigliani-Miller showed the irrelevance of financial structure. It does not matter whether a firm finance projects with bonds, debt or equity.
- Financial markets are irrelevant for real output levels and fluctuations.
- Money is relevant for development but just because it facilitates trade.
- Trade facilitates specialization and hence development.

Debt-Deflation Theory

- **Irving Fisher (1933)**
- **Expansions** lead to lending booms.
- Build-up in **debt** that make firms and households financially fragile.
- Any external shock (reduction in profits) leads to **deflation** (firesale of assets and reduction in their price).
- Increase in fragility since debt is not indexed to value of assets.
- Insolvency and more bankruptcies.
- Fragility of lending institutions and credit crunch.
- Drop in investment and consumption of durables lead to **recessions**.

Debt-Deflation Theory

- Market participants overreact to market conditions.
- This highlights the potential negative effects of deflation.
- Deflation can lead to disintermediation (pull out money from banks and keep it 'under the couch').

Great Depression

- Main characteristics
 - Drop in stock prices, 85%
 - 25% of all banks failed (more than 10,000 banks)
 - Investment virtually disappeared.
 - GDP drop by 50%
- It is not clear what originates it. We'll discuss it later.

Keynes (1936)

- Main points

- **Money is a financial asset**, not only medium of exchange, less risky than others.

Money affects the supply and demand of other financial assets, affecting financial intermediation.

- **Uncertainty** is key, since finance takes place over time.

For example, because of "beauty contests" in stock markets, investors care not only about the expectations of future conditions but also about the expectations other investors have.

Keynes (1936)

- Main points

- **Animal spirits:** Individual views of the future are speculative, subjective, sensitive to changes in market perception and self-fulfilling. This does not mean irrationality. It means the environment changes and the past is not enough to assign probabilities to future events.
- **Investment depends more on uncertainty and stock prices than on interest rates.** Hence, monetary policies are not very effective.

Keynes (1936)

- Main points

- **Danger of leverage:** Keynes shares with Fisher the idea that recessions start in expansions (because of high leverage) and are generated from even small reductions in confidence.
- **Wages are sticky:** Stickiness is generated by coordination failures. This is the reason why an unstable aggregate demand can affect real activity. Otherwise prices and wages adjust and there is no transmission to real activity.

Keynes (1936)

- Solutions to recessions I: Wait... wait... wait...
 - Wait until confidence resumes.
 - Wait until wages gradually adjust.

We don't know how long it takes. *"In the long run, we're all dead"*

Keynes (1936)

- **Solutions to recessions II: Active macro policies to stimulate demand.**
 - **Monetary Policy:** Reduces interest rates. This increases investment both directly and indirectly by increasing stock prices.
However, investment is not very sensitive to interest rates. Confidence is more important
Also, money hoarding in bad times for precautionary motives generates a "*liquidity trap*"
 - **Fiscal Policy:** With the hope of a spending multiplier greater than 1.

Keynesians

- **Hicks (1936)** created the framework of IS-LM to explain Keynes ideas, but downplayed the focus assigned to financial markets.
- Main differences between Hicks and Keynes. In Hicks,
 - Wages and prices are fixed.
 - Changes in aggregate demand are driven by exogenous changes in consumption, not investment, since the decisions to consume durables follow the same elements as the decisions to invest.
However, this took the focus out of investment and financial markets, highlighting more job volatility than investment volatility.
 - Keynesians advocate monetary policies, since they did not only ignore financial markets in general but also liquidity traps.

Financial Instability Hypothesis

- **Minsky (1982)**. Post-keynesian.
 - Reassert the role of financial systems as the primary factor in driving aggregate demand volatility and business cycles.

Financial Instability Hypothesis

- Mechanism
 - Financial structure is important for the stability of firms.
 - **Hedged finance:** Cash flows $>$ Debt $>$ Interest payments.
 - **Speculative finance:** Debt $>$ Cash flows $>$ Interest payments.
 - **Ponzi finance:** Debt $>$ Interest payments $>$ Cash flows.
 - As optimism increase firms move from the hedged finance to the Ponzi finance, generating a fragile financial structure.
 - These positions are decided based on exogenous economic conditions.
 - When pessimism hits, defaults escalate.
 - Irrational behavior (excessive exuberance and panics).

Financial Instability Hypothesis

- Regulation
 - Bailouts are needed to eliminate instability generated by exogenous conditions.
 - However, forecasting the existence of bailouts lead firms to move towards financial structures that are more fragile.
 - Minsky proposed regulation should impede firms to move towards speculative and Ponzi finance. Not clear how to do it!

Monetarism

- **Friedman (1950s)**

- Reassert classical principles in a model that better explain business cycles.
- Minimizes the role of financial systems in creating aggregate demand volatility.
- Money is basically a medium of exchange. Hence, monetary policy may only affect investment directly through interest rates.
- Main sources of business cycles: Erratic monetary policies of misguided central banks.

Monetarism

- Principles
 - Prices and wages are perfectly flexible, but there is imperfect information about aggregate prices.
 - Adaptive expectations. Then expectations stickiness. Different than Keynes, probabilities are known but agents can be systematically surprised by central banks.
 - Changes in money supply responsible for changes in aggregate demand and business cycles.
 - Changes in aggregate demand affect GDP in the short-run, not in the long-run, through quantitative theory

$$MV = PY$$

Monetarism

- Recessions are generated by lower than expected money supply.
 - Reduces prices
 - Increases real wages
 - Increases unemployment.
- Monetary policies **CREATE**, DO NOT eliminate, instability.
- **Central Banks should not move money supply irregularly.**

Monetarism

- Complete disregard of financial markets. Except,
 - Central Banks may enter just to avoid bank runs.
 - Banks should impose 100% of reserves, to avoid instability through the monetary multiplier. But this weakens the benefits of banks, reducing lending and resource reallocation.

Neoclassical

- **Rational Expectations. Lucas (1972)**
 - Inconsistency of adaptive expectations with rational choice in forming expectations. **Why agents are not also rational in forecasting optimal choices by governments?**
 - Individuals should use available information to forecast optimal monetary policies, so there are no systematic surprises.
 - Monetary policies cannot stimulate output during recessions if everyone knows exactly how policymakers are going to respond.
 - **Policy is absolutely irrelevant.**

Neoclassical

- **Real Business Cycles. Kydland and Prescott (1982)**
 - Aggregate demand is irrelevant to real activity and money neutrality always hold, exactly as in classical theory.
 - Aggregate supply $Y = Af(K, L)$ only matters.
 - Business cycles are driven by changes in aggregate productivity A
 - Changes in input prices.
 - Changes in technology.
 - Changes in taxes and regulations.
 - **Business cycles are EFFICIENT.**
 - Complete disregard to financial markets (savings smoothly become investments).

Effectiveness of Stabilization Policy

- Keynes: The government can be successful in managing the trade-off between output and inflation.
- Friedman: Discretionary powers of central banks should be revoked.
- Neoclassic: Policy irrelevance. Low inflation policies are time inconsistent. Laissez-faire.

New Theories

- Theories that put more weight to financial markets to understand macroeconomic fluctuations spur after the 1980s.
- Focus on microeconomic behavior of heterogenous banks, financial markets, firms and households.
- This is why is so important to understand the foundations of financial intermediaries (what we saw during the first part of the class).

New Theories

- The focus is on the availability of **credit**, not just on the total amount of **liquidity or the money supply**.
 - Liquidity in the system refers to the total amount of loanable funds.
 - Credit refers to the total amount of loanable funds that a financial system is actually willing to provide.
 - Perceived default risk is critical in determining credit.

New Theories

- Financial transactions are imperfectly competitive because information is imperfect and asymmetric.
 - As interest rates increase, asymmetric information increases default risk in two ways
 - Adverse selection: Worst borrowers look for loans.
 - Moral hazard: Encourages more risk taking by borrowers
 - Since financial institutions are both borrowers and lenders, are subject both to suffer and to generate adverse selection and moral hazard.
 - Asymmetric information determines the supply of credit, particularly for newer, smaller firms.

Financial Accelerator Model

- **Bernanke and Gertler (1989).**
- Costly state verification in a Real Business Cycle model.
- **Debt-Deflation meets Real Business Cycle.**
- Main idea.
 - The borrowers' net worth is key in determining their solvency and risk of default.
 - Hence, net worth affects agency problems and the intermediation cost.
 - Net worth is procyclical.
 - In recessions the costs of intermediation increase, reduce the net return of investment and depress investment, magnifying the recession.

Financial Accelerator Model

- Bernanke and Gertler (1989). Main elements.
 - Two period lived agents. Overlapping generations.
 - Two types of agents:
 - Entrepreneurs: A fraction η of agents. Each has a single project with cost, $\omega \sim U[0, 1]$ to produce capital.
 - Investors. Monitoring cost γ .
 - Two goods:
 - Output: Can be consumed, stored or invested.
 - Capital. Fully depreciated in one period.
 - Production functions:
 - $y_t = \theta_t f(k_t)$
 - $k_{t+1} = (\kappa - h_t \gamma) i_t$, where $\kappa = \pi \kappa_L + (1 - \pi) \kappa_H$ (the output is non-observable to investors).

Financial Accelerator Model

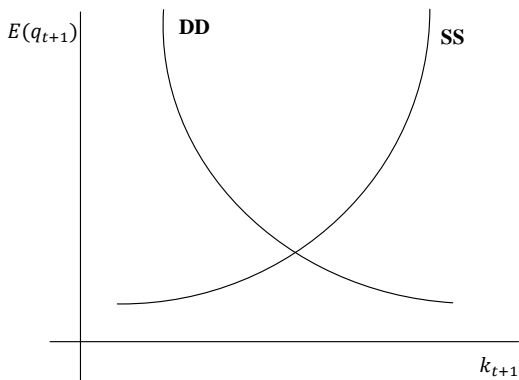
- Bernanke and Gertler (1989). Main elements.
 - Preferences
 - Entrepreneurs: $E_t(c_{t+1}^e)$
 - Investors. $U(c_t^y) + \beta E_t(c_{t+1}^o)$
 - Labor income at wage w_t . Average savings
 - Entrepreneurs: $S_t^e = w_t L^e$
 - Investors: $S_t = w_t L - c_y^*(r)$, where c_y^* is the optimal consumption when young and r is the storage rate of return.

Financial Accelerator Model

- Perfect Information ($\gamma = 0$).
 - Denote q_t price of capital in terms of output.
 - Expected gross return of a project: $E_t(q_{t+1})\kappa$
 - Cost of a project: $rx(\omega)$
 - Then $\bar{\omega}$ is defined by $E_t(q_{t+1})\kappa - rx(\bar{\omega}) = 0$.
 - Then $k_{t+1} = \kappa\bar{\omega}\eta$
- Supply of capital and Demand from output.
- SS curve: $E_t(q_{t+1}) = \frac{rx\left(\frac{k_{t+1}}{\kappa\eta}\right)}{\kappa}$
- DD curve: $E_t(q_{t+1}) = E_t(\theta_{t+1})f'(k_{t+1})$

Financial Accelerator Model

- Investment is constant and production (the consumption and inventories) move with productivity shocks.



Financial Accelerator Model

- Asymmetric Information ($\gamma > 0$)
- Consider entrepreneurs who require to borrow $x(\omega) > S^e$
 - Full collateralization. The entrepreneur can pay even when the worst outcome κ_L occurs.

$$E_t(q_{t+1})\kappa_L \geq r(x(\omega) - S^e)$$

- Incomplete collateralization. Monitoring problem because entrepreneurs are tempted to lie and say they produced κ_L

$$E_t(q_{t+1})\kappa_L < r(x(\omega) - S^e)$$

Financial Accelerator Model

- Asymmetric Information ($\gamma > 0$)
- Costly State Verification Contract
 - If entrepreneurs report κ_H , $R = E_t(q_{t+1})\kappa_H - C_{t+1}^e$.
 - If entrepreneurs report κ_L , they pay $E_t(q_{t+1})\kappa_L$ and get monitored with probability p . If entrepreneur told the truth, the lender gets nothing extra. If the entrepreneur lied, the lender gets $E_t(q_{t+1})(\kappa_H - \kappa_L)$.
- Entrepreneurs tell the truth in good states.

$$E_t(q_{t+1})\kappa_H - R \geq (1 - p)E_t(q_{t+1})(\kappa_H - \kappa_L)$$

$$c_{t+1}^e \geq (1 - p)E_t(q_{t+1})(\kappa_H - \kappa_L)$$

Financial Accelerator Model

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- Lenders prefer to lend than to store at rate r

$$x(\omega)r \leq (1 - \pi)R + \pi E_t(q_{t+1})\kappa_L - \pi p\gamma + rS^e$$

$$(x(\omega) - S^e)r \leq (1 - \pi)[E_t(q_{t+1})\kappa_H - c_{t+1}^e] + \pi E_t(q_{t+1})[\kappa_L - p\gamma]$$

Financial Accelerator Model

- Asymmetric Information ($\gamma > 0$)
- The two constraints bind. Optimal monitoring probability p is

$$p^* = \frac{(x(\omega) - S^e)r - E_t(q_{t+1})\kappa_L}{E_t(q_{t+1})[(1 - \pi)(\kappa_H - \kappa_L) - \pi\gamma]}$$

- and consumption of the entrepreneur in good states is,

$$c_{t+1}^e \geq (1 - p^*)E_t(q_{t+1})(\kappa_H - \kappa_L)$$

Financial Accelerator Model

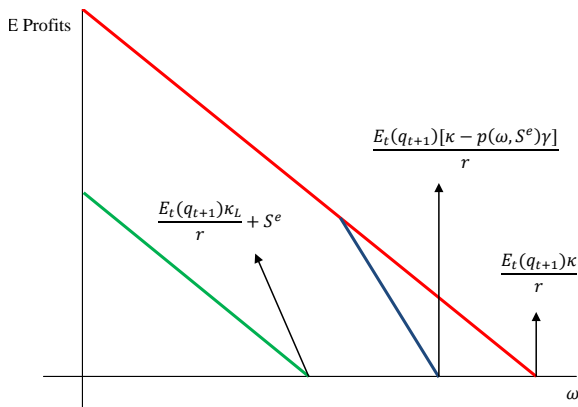
- Asymmetric Information ($\gamma > 0$)
- What projects SHOULD be financed (efficiency)

$$E_t(q_{t+1})\kappa \geq rx(\omega)$$

- What projects ARE financed.
 - The fully collateralized: $E_t(q_{t+1})\kappa_L \geq r(x(\omega) - S^e)$
 - Partially collateralized if $E_t(q_{t+1})(\kappa - p^*\gamma) \geq rx(\omega)$

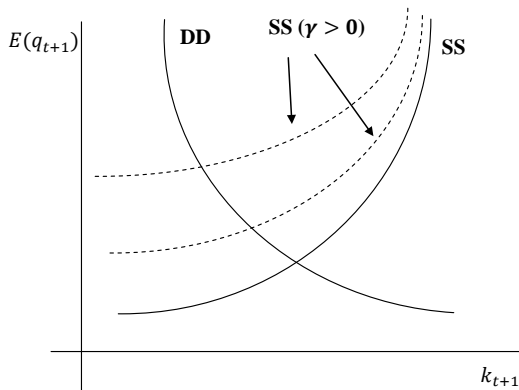
Financial Accelerator Model

- Cyclical movements in S^e affects investment, no longer constant. Can you see how?



Financial Accelerator Model

- Now investment depend on a current variable, which is the net worth of entrepreneurs that affect agency costs.



Financial Accelerator Model

- Where exogenous movements in S^e come from?
 - Redistribution of endowment from entrepreneurs to lenders. "Debt-deflation" story in which a combination of unindexed contracts and deflation redistributes wealth from debtors to creditors.

Financial Accelerator Model

- Implications

- Financial frictions **do not generate** business cycles.
- Financial frictions **do amplify** business cycles.
- The financial accelerator effect is nonlinear and asymmetric over time.
- Financial instability has asymmetric effects across borrowers and lenders.
- How long a recession lasts depend on the flexibility of agent to reevaluate the default risk.
- Monetary policy that reduces interest rates may be irrelevant if there is a "**pessimism trap**".

Financial Accelerator Model

- Critiques
 - If investment is not sensitive to interest rates, it may be even less sensitive to intermediation costs.
 - Quantity constraints (no credit) seem more relevant than price constraints (always a price at which credit is available).

Financial Accelerator Model

- A Quantitative Analysis (Carlstrom and Fuerst, 97)
 - Calibration analysis of Bernanke and Gertler.
 - They replicate the hump-shaped response of output, i.e., it generates some propagation dynamics that are absent in the technology shock.
 - Households delay their investment decisions until agency costs are at their lowest, several periods after the shock.
 - Agency costs fall over time because the productivity shock increases the return to internal funds, which in turn distributes wealth from households to entrepreneurs.

Credit Rationing

- In the Financial Accelerator model, credit is price-rationed.
- In the coming models credit is quantity-rationed.
- Why do lenders prefer to impose credit limits instead of changing the price of credit?

Credit Rationing

- Stiglitz and Weiss (1981)
 - Increases in interest rates increase the default risk of borrowers (and hence of the lender)
 - Adverse selection: Attract borrowers less likely to pay.
 - Moral hazard: Induce borrowers to take more risks.
 - Lenders restrict credit quantity.
 - Credit rationing is not a disequilibrium event.

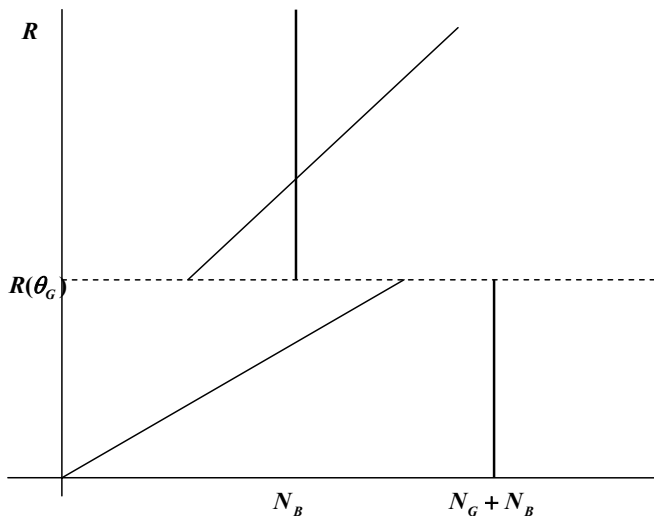
Credit Rationing - Model

- Disregard for a moment moral hazard and collateral.
- E need \$1 from L to start a project.
- Projects pay $y \sim F(\cdot, \theta)$
- Two types of projects $\theta = \{\theta_G, \theta_B\}$, only known by E.
- Standard Debt Contract:
 - Profits to L: $\gamma(y, R) = \min\{y, R\}$
 - Profits to E: $\pi(y, R) = \max\{0, y - R\}$

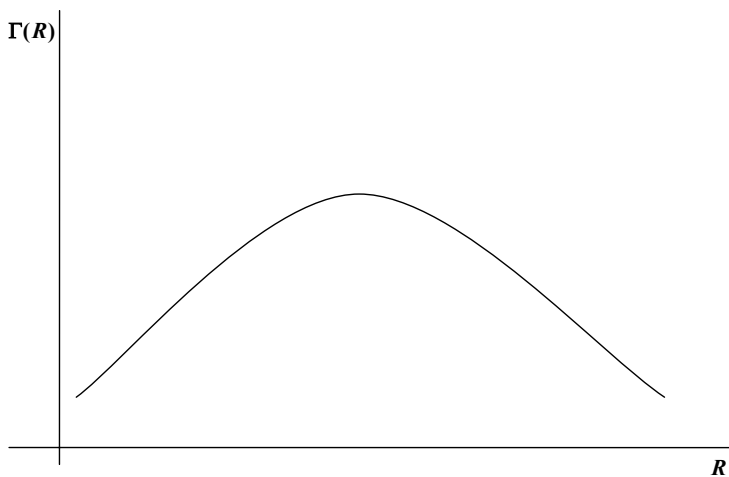
Credit Rationing - Model

- Define $\Gamma(R|\theta) = E_y [\gamma(y, R)|\theta]$
- Define $\Pi(R|\theta) = E_y [\pi(y, R)|\theta]$
- All projects need to generate a minimum $\bar{\Pi}$.
- Define $\bar{R}(\theta)$ such that $\Pi(\bar{R}|\theta) = \bar{\Pi}$
- If G 's cash flows SOSD B 's cash flows, $\bar{R}(\theta_G) \leq \bar{R}(\theta_B)$

Credit Rationing - Graphical idea



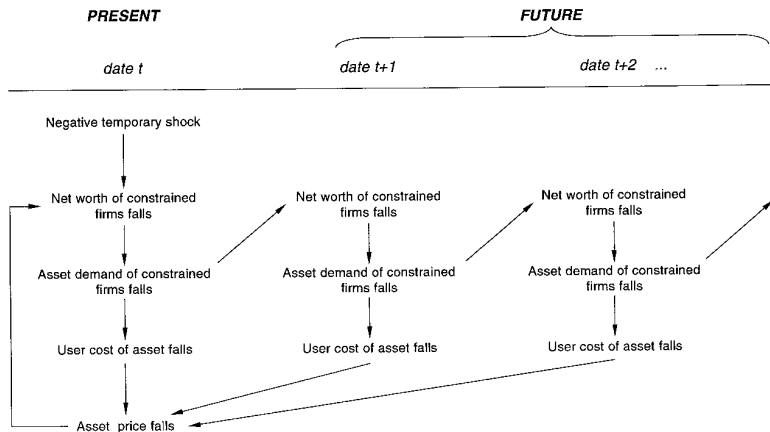
Credit Rationing - Graphical idea



Credit Rationing KM (Kiyotaki and Moore, 1995)

- Credit frictions \rightarrow amplification & persistence of shocks
- Two roles for capital
 - Factor of production.
 - Collateral for loans.
- Negative productivity shock
 - Reduces output; reduces value of collateral.
 - Reduces borrowing, which reduces output further.
 - "Multiplier" effects amplifies losses.

Credit Rationing KM - Graphical Intuition



Credit Rationing KM - Agents

- Farmers. measure 1

$$E_t \sum_{s=0}^{\infty} \beta^s x_{t+s}$$

- Gatherers, measure m

$$E_t \sum_{s=0}^{\infty} \beta'^s x'_{t+s}$$

- Farmers *more* impatient ($\beta < \beta'$) (will imply that Farmers are the borrowers in equilibrium)
- Both use land k_t to produce fruit
- Value of land $k_t q_t$ used as collateral

Credit Rationing KM - Farmers (constrained)

- Farmers' production function for fruit

$$y_{t+1} = (a + c)k_t$$

- They can borrow b_t at rate R . Assume ck_t is bruised fruit.
- Borrowing Constraint (from inalienability of farmers' human capital)

$$Rb_t \leq q_{t+1}k_t$$

- Farmers' resource constraint (x_t is consumption of fruit, $x_t = ck_{t-1}$)

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

Credit Rationing KM - Gatherers (unconstrained)

- They do not have specific skills to threat not paying.
- Gatherers' production function for fruit

$$y'_{t+1} = G(k'_t)$$

$G(\cdot)$ has decreasing returns to scale

- Gatherers' budget constraint (x'_t is consumption of fruit)

$$G(k'_{t-1}) + b'_t + q_t k'_{t-1} = x'_t + Rb'_{t-1} + q_t k'_t$$

Credit Rationing KM - Equilibrium

- Sequences of land prices, allocations of land, debt, consumption for farmers and gatherers

$$\{q_t, k_t, k'_t, b_t, b'_t, x_t, x'_t\}$$

such that everyone's optimizing and markets clearing.

- No uncertainty: perfect foresight

Credit Rationing KM - Equilibrium Results: Farmers

- Farmers always borrow the maximum $b_t = q_t k_t$ and invest in land

$$b_t = q_{t+1} k_t / R \quad \text{and} \quad x_t = c k_{t-1}$$

- Implied optimal land holdings

$$k_t = \frac{1}{q_t - q_{t+1}/R} \underbrace{[(a + q_t)k_{t-1} - Rb_{t-1}]}_{\text{net worth}}$$

$$u_t \equiv q_t - q_{t+1}/R = \text{"down payment"}$$

- Farmers spend entire net worth on difference between price of new land q_t and amount against which they can borrow against each unit*

Credit Rationing KM - Equilibrium Results: Gatherers

- Gatherer's demand for land (from deriving in their RC)

$$G'(k'_t)/R = u_t = \underbrace{q_t - (q_{t+1}/R)}_{\text{user cost}}$$

Credit Rationing KM - Farmers in the Aggregate

- Farmer aggregate landholding & borrowing

$$K_t = \frac{1}{u_t} [(a + q_t)K_{t-1} - RB_{t-1}]$$

$$B_t = \frac{1}{R} q_{t+1} K_t$$

Credit Rationing KM - Market Clearing

- Land market resource constraint (m is the measure of gatherers).

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

- Land market clearing

$$u_t = q_t - q_{t+1}/R = G' \left(\underbrace{\frac{1}{m}(\bar{K} - K_t)}_{k'} \right) / R$$

- No bubbles in land price: $\lim_{s \rightarrow \infty} E_t(R^{-s} q_{t+s}) = 0$

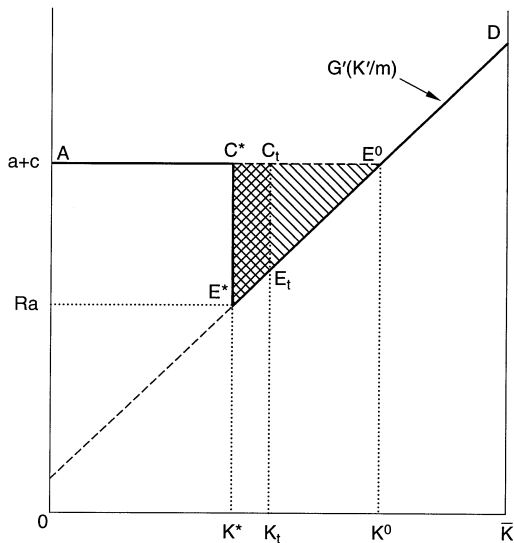
Credit Rationing KM - Steady State

$$u^* = (1 - 1/R)q^* = a$$

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

$$(R - 1)B^* = aK^*$$

Credit Rationing KM - Steady State



One-time Productivity Shock *with Credit Constraints*

- Say $y_{t+1} = (1 + \Delta)(a + c)k_t$
- Period of shock (period t)

$$u(K_t)K_t = (a + \Delta a + q_t - q^*)K^*$$

- Subsequent periods (periods $t + s$, $s = 1, 2, \dots$)

$$u(K_{t+s})K_{t+s} = aK_{t+s-1}$$

One-time Productivity Shock *with Credit Constraints*

- Log-linearize around steady state defining

$$\hat{X}_t = \frac{X_t - X^*}{X^*}$$

- Period of shock (period t)

$$(1 + 1/\eta)\hat{K}_t = \Delta + \frac{R}{R-1}\hat{q}_t$$

- Subsequent periods (periods $t + s$, $s = 1, 2, \dots$)

$$(1 + 1/\eta)\hat{K}_{t+s} = \hat{K}_{t+s-1}$$

where η denotes elasticity of land supply of gatherers to user cost

Static Response of Land Price & Land Holdings

- Land price response

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

- Overall land holding response

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

Long Run Response of Land Price & Land Holdings

- Land price response

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

- Overall land holding response

$$\hat{K}_t = \underbrace{\frac{1}{1 + \frac{1}{\eta}} \left(1 + \frac{R}{R-1} \frac{1}{\eta} \right)}_{>1} \Delta$$

Long Run Response of Land Price & Land Holdings

- Land price response

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

- Overall land holding response

$$\hat{K}_t = \underbrace{\frac{1}{1 + \frac{1}{\eta}} \left(1 + \frac{R}{R-1} \frac{1}{\eta}\right)}_{>1} \Delta$$

- Say $\eta = 1$, $R = 1.05$

$$\hat{K}_t \approx 11\Delta$$

Long Run Response of Output & Productivity

$$\hat{Y}_{t+s} = \underbrace{\frac{a+c-Ra}{a+c}}_{\text{Productivity diff.}} \underbrace{\frac{(a+c)K^*}{Y^*}}_{\text{Farmers' share}} \hat{K}_{t+s-1}$$

Credit Rationing KM - Net Worth Shock

- One time reduction in debt obligations
- Increases net worth
- Farmer increases leverage, production
- Another view of Bernanke-Paulson policies?

One-time Productivity Shock *at First-Best Steady State*

- Say $y_{t+1} = (1 + \Delta)(a + c)k_t$
- Output rises by Δ
- Net worth rises
- But prices q^0 unaffected; land k^0 unaffected
- No change to future variables

Credit Rationing KM - Conclusions

- Firms' productive capital also used as collateral
- Amplification of real shocks through lower collateral value of capital
- Real effects of lower asset values

Credit Rationing KM - Critiques

- Kocherlakota (QR, 2000): Quantitative importance likely to be small if land & capital share less than 0.4
- Andres Arias (WP, 2005): Calibrated RBC model with KM credit constraints deliver small amplification effects
- Does this work through "investment wedge?" or TFP, or both?
- *Real effects of housing/stock bubbles*

Credit Rationing

- Macroeconomic implications of credit rationing.
 - Given credit chains, credit rationing transmits and amplifies otherwise small and irrelevant shocks through financial systems.
 - Reduces aggregate demand by reducing investment and consumption and ALSO aggregate supply by reducing capacity.
 - Effects on business cycle are asymmetric and nonlinear.
 - Business cycles do not have the same impact on all borrowers.
- Additionally, credit rationing renders monetary policy irrelevant when risk are low or very high.
- The empirical relation between macroeconomic variables and interest rates vanishes in those cases.

Equity Rationing

- Hellmann and Stiglitz (2000).
- Managers may decide to impose equity limits because,
 - New stocks dilute the returns on existing equity.
 - New equity may send unwanted signals about the firm standing.
- Competitive financial systems may actually have more credit and equity rationing than segmented markets.

Equity Rationing

- Jerman and Quadrini (2009).
- They found that tighter credit conditions, given equity rationing, have a crucial role in explaining the recent recession and all other US recessions since mid 1980s.
- Their model also match pretty well the volatility of the main macro variables.

Monetary Transmission Mechanism

- Interest Rates Reduction.
- Channels in traditional theories.
 - Reduce interest rates.
 - Increase stock prices and wealth.
 - Depreciation of real exchange rate.
- Balance sheet channels.
 - Reduce costs of intermediation.
 - Increase the value of assets used as collateral, loosening credit limits.
 - Reduce risk externalities, loosening credit limits.

Monetary Transmission Mechanism

- The main addition is that
 - **Monetary policy may not affect aggregate demand** (through direct impact on investment and consumption).
 - **Monetary policy may affect aggregate supply.** (through balance sheet channels,)
 - The effects of monetary policy is asymmetric and nonlinear, exactly as intermediation costs.
- Changes in monetary policy have little impact on credit if risk perceptions are exceptionally high or low ("**pessimism trap**").

Summary

- Two types of financial frictions in macro
 - Price rationing.
 - Pledgeability of future profits.
 - Magnification and persistence of real shocks.
 - Quantity rationing
 - Pledgeability of current assets.
 - Magnification and persistence of real shocks.
- Open questions: Financial shocks as generators of crises!!! Recent developments, Christiano, Motto and Rostagno (2008), Goodfriend and McCallum (2007) and Jerman and Qadrini (2009).