

Macroeconomics and Banking

Credit Market Equilibrium w/Rationing.

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The views presented here do not necessarily agree with or reflect those of Norges Bank.

- The great depression: financial channels may have worsened situation
- Japan's "lost decade" - due to problems in financial sector?
- The most recent financial crisis -origin?
- How is the economic cycle affected by the financial sector?
Implications for monetary policy?

Global recovery in danger of skidding off course

By Chris Giles in London

The global recovery "is in danger of skidding off course", according to the latest Brookings Institution-Financial Times tracking index of the world economy, with **growth slowing down sharply** amid financial turbulence and policy paralysis.

The gloomy prognosis applies across the Group of 20 leading economies, the TIGER index shows, although the slide back towards stagnation is much more prevalent in the advanced world compared with emerging economies.

More

ON THIS STORY

Interactive Tracking the global economic recovery

Lagarde softens stance on EU banks

G7 struggles to find common ground

Juncker wants full-time Eurogroup chief

Lagarde demands further action

Professor Eswar Prasad of the Brookings Institution said: "Debt crises, weak employment growth and policy dithering in the major advanced economies have exacerbated global economic uncertainty".

The TIGER index combines **measures of real economic activity**, financial variables and indicators of confidence according to the degree to which they are all moving up or down at the same time. Using sophisticated statistical methods it can capture the co-movements of data which are measured on very different basis and

across many countries.

The financial market component of the indicator has been particularly hard hit, reflecting widespread anxiety in markets since the spring and the lack of rapid resolution to the **uncertainties hanging over the eurozone** and the US debt ceiling.

Editor's C

ANALYSIS



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Simple macro models often exclude financial sector:

- Sticky prices make nominal interest rate changes become real interest rate changes
- Only two types of capital: Money and Bonds, no modelling of financial intermediation.

- **Bank lending channel:** Emphasis on banks as being special, transforming short term deposits into long term lending, and providing monitoring services, as in Diamond and Dybvig, and in result 2.7 in F&R.
- Traditional assumption: Regulations make reserve requirements binding. Quantitative measures affect credit and/or money aggregates (as in F&R sections 3.1.1, 3.1.2 (not focussed in this course), see also section 6.2.3 in textbook). But Disyatat: reserve requirements not binding, money multiplier not a structural relationship.

- **Balance Sheet Channel/Broad Credit Channel, or bank lending channel reinterpreted:** Banks and other financial intermediation still important, as in Diamond and Dybvig: Costly for society if good projects go underfinanced, lack financing, or financing is interrupted. Emphasis on information problems. *Transmission of monetary policy and lesson for monetary policy is different, because...*
- "External Finance Premium" => Collateral and balance sheets, both of bank and customer, important. See Bernanke and Gertler, Disyatat, and also section 2.5 of F&R. Woodford covers effects of bank balance sheets for the macroeconomy.

Credit rationing, banks and transmission mechanism of monetary policy: Three lectures

- Today: Credit Rationing in Equilibrium + introducing External Finance Premium. Literature: Arnold and Riley (A&R: Intuition, not math required). Chapter 5 of F&R (excluding section 5.4).
- Next time: The Credit Channel/Bank Lending Channel of Monetary Policy. Literature: Bernanke and Gertler (B&G) + Disyatat (D) + Chapter 6 of F&R (sections 6.2.3, 6.2.4, and 6.3 may be skipped). The interbank market and how monetary policy (including open market operations) affect market interest rates and bank lending.
- Third time: Financial Intermediation and Macroeconomic Analysis. The effects of "Quantative Easing" and "Credit Easing" in deregulated financial markets. Monetary Policy and Financial Stability. Literature: Woodford + Haugland and Vikøren.

- Perfect markets: Modigliani and Miller theorem states that financing irrelevant to value of firm(project). If so, no macro effects of financing conditions either.
- Market imperfections: regulation regime and funding structure of a) customers and b) banks matters.
- Examples of imperfections: Asymmetric information.
- "Too little lending" or "Too much lending" or just right? (\Rightarrow all projects with positive NPV get financing, and only those)?

Credit market equilibrium with rationing

- Possible motivation: Adverse selection.
- Info about customers a real problem, as shown in ad. for credit information company:



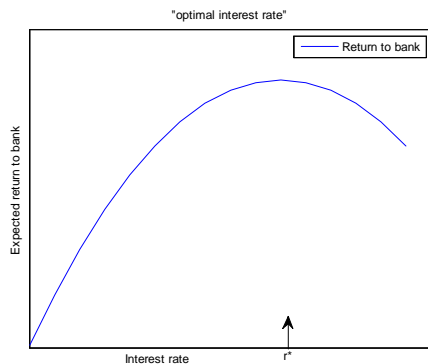
- Says "You will lose money on some of these people, while one will be your best customer - can you tell them apart?"

Equilibrium credit market rationing

Original paper on equilibrium credit market rationing: Stiglitz and Weiss (1981); Updated by Arnold and Riley (2009): Rationing unlikely to happen in S&W model, and only "low-risk" agents rationed. But:

- 1 Does not diminish importance of market imperfections/"credit conditions": Still costly when projects with positive value go underfinanced, or moral hazard leads to irresponsible lending.
- 2 The S&W paper, and A&R's follow-up, concerns a particular definition of equilibrium credit market rationing.

Main message of Arnold and Riley: Mean return to bank not like this.....



See also figure 5.1 in F&R

...but like this, if adverse selection as in Stiglitz and Weiss (1981)

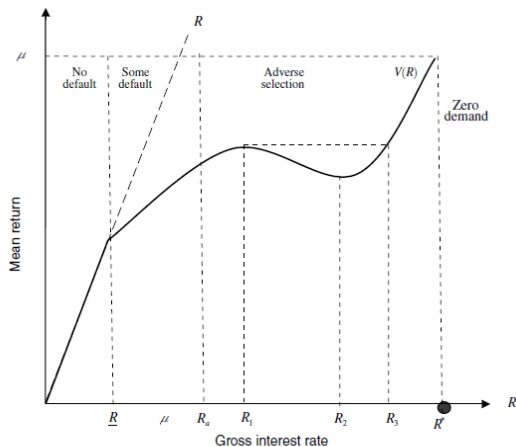


FIGURE 1. EXPECTED LENDER REVENUE AS A FUNCTION OF THE LOAN RATE

Equilibrium Credit Market Rationing

Definition

There is credit rationing if some borrowers' demand for credit is turned down, even if this borrower is willing to pay all the price and non-price elements of the loan contract.

Definition

Type I credit rationing: partial or complete rationing among all agents within given group

Definition

Type II credit rationing: randomly selected borrowers from group obtain full amount of loan, while others are rationed.

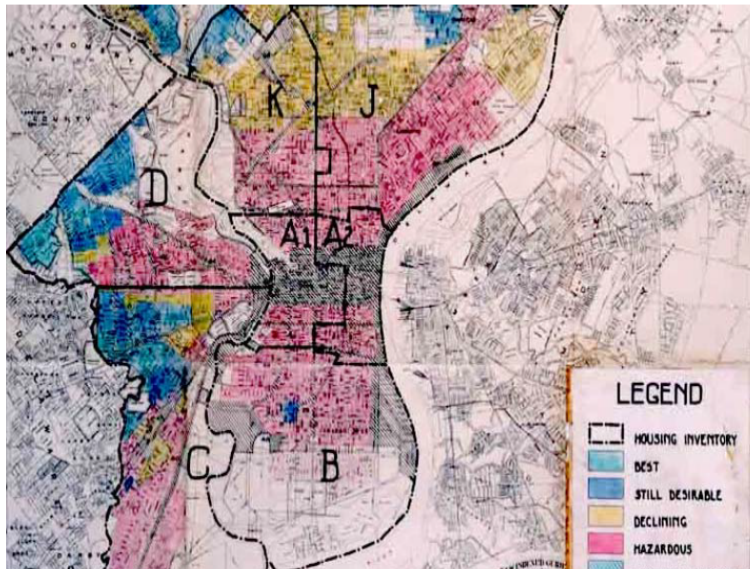
On the F&R definition of Equilibrium Credit Rationing

- Red-lining: Declining credit to a whole group of borrowers. For example due to break down of market (as in "Market for Lemons"), or undercapitalized firms in result 2.7 i F&R. Usually distinguished from credit-rationing.
- Increasing interest rate or demanding more collateral as size of loan increases: not rationing
- *Dis-equilibrium* credit rationing if interest rate regulation.

File:Home Owners' Loan Corporation Philadelphia redlining map.jpg

From Wikipedia, the free encyclopedia

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Model by Stiglitz and Weiss/Arnold and Riley

- Credit rationing of type I and II may happen
- Group of indivisible projects, return $y(t) = \mu + z(t)$, same μ for all projects, $z(t)$ mean zero, high or low variance (depending on type t). Each applicant needs one unit of funding.

- Borrower defaults if

$$C + \mu + z \leq R$$

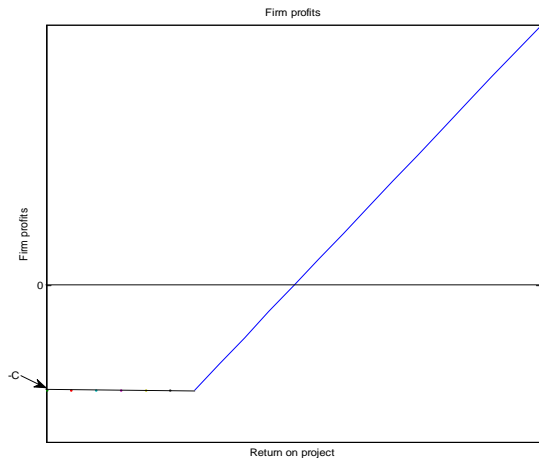
- Net return to borrower of type $z(t)$:

$$U(z, R) = \max(\mu + z - R; -C)$$

- Return to bank for each project:

$$\rho(z, R) = \min(C + \mu + z, R)$$

Firm's profit convex function of return on project, z



Bank's profit concave function of return on each project z . But in aggregate?

- Downside for borrower limited, upside increases with risk. The reverse for bank, for **each** loan.
- But not straightforward to go from each project to aggregation.
- Trade-off: $R \uparrow \Rightarrow$ profit \uparrow , given no default, but probability of default \uparrow as $R \uparrow$.
- And **also, pool of borrowers may change, they take more risk on average.** This effect on profit may outweigh effect of R on profit.
- Arnold and Riley carefully aggregate banks' return as amount of lending increases and pool of borrowers changes.

- Bank gets whatever return the borrowers do not get \Rightarrow Mean return to lender = average project return minus mean return to borrowers **who still are in the market:**

$$V(R) = \mu - \bar{U}(R)$$

- Last borrower remaining in market as $R \uparrow$ gets zero expected return: $\bar{U}(R) = 0 \Rightarrow$ expected average return for bank maximized when R reaches max, and is then equal to μ . \Rightarrow Mean return to bank cannot be globally hump-shaped in Stiglitz-Weiss model:

Banks' Mean Return as a Function of Lending rate R

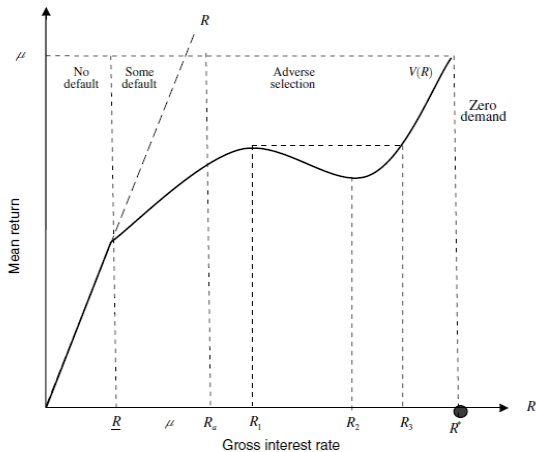
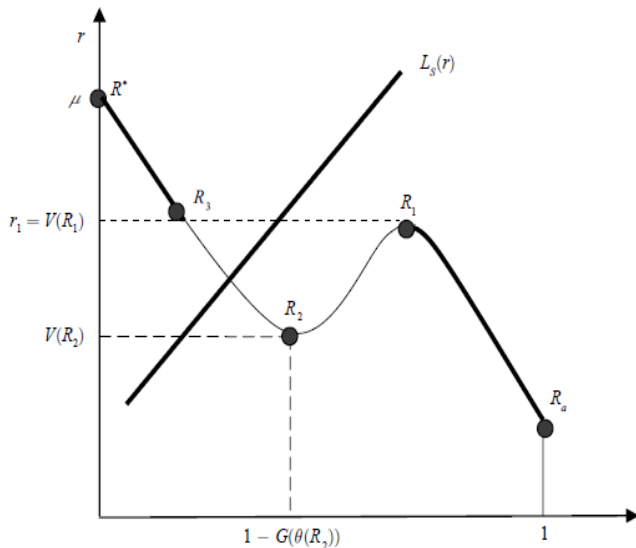


FIGURE 1. EXPECTED LENDER REVENUE AS A FUNCTION OF THE LOAN RATE

Bank's demand for funding, and supply of funding to banks



Which market are we studying?

- A&R focus on supply and demand for *bank funding*. *Let adverse selection affect funding demand*
- In F&R, focus is on *supply of lending by banks*, given some assumed funding costs. Costs from attracting a more risky pool of borrowers is taken into account when calculating *supply of bank lending*.
- F&R conclude with a "backward bending" supply of lending. Inspired by Stiglitz and Weiss.

Credit rationing in equilibrium with adverse selection.

Summary.

- Arnold and Riley support the conclusion that rationing in equilibrium is possible. But they say that if there is credit rationing, it has to be at least two equilibrium lending rates.
- Low-rate- customers are rationed, high rate customers not.
- The two-rate outcome with rationing is empirically unlikely.
- Now: Over to the external finance premium as basis for credit channel of monetary policy transmission/financial accelerator mechanism.

Example

Suppose borrower can invest in project G or project B. B is more risky.
Payoff: $G < B$, but expected return $\pi_G G > \pi_B B$.
In bad state of the world, payoff is 0 for both projects.

$$\begin{aligned} E\rho^G &= \pi_G [G - (1 + r_I)L] - (1 - \pi_G)C, \\ E\rho^B &= \pi_B [B - (1 + r_I)L] - (1 - \pi_B)C \end{aligned}$$

The interest rate that gives equal expected return for the two projects is characterized by:

$$(1 + r_I^*)L - C = \frac{\pi_G G - \pi_B B}{\pi_G - \pi_B}$$

Example exactly as in 5.3.3 when $C = 0$, $(1 + r_I^*)L = R$.

The interest rate as an incentive mechanism

Interest rate above $r_l^* \Rightarrow$ project B is chosen \Rightarrow Expected profit to lender is

$$\pi_B(1 + r_l^H)L + (1 - \pi_B)C$$

Interest rate below this rate \Rightarrow project G is chosen \Rightarrow Expected profit to lender is

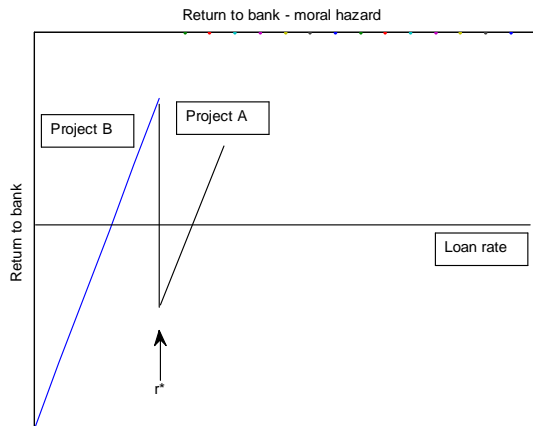
$$\pi_G(1 + r_l^L)L + (1 - \pi_G)C$$

Since in borderline case ($r = r_l^*$)

$$\pi_B(1 + r_l^*)L + (1 - \pi_B)C < \pi_G(1 + r_l^*)L + (1 - \pi_G)C$$

\Rightarrow Depending on the costs of funding and competition from other banks, lender may want to offer r_l that is (marginally below) r_l^* .

Nonmonotonic return to bank with moral hazard



- In examples above, if $C = L(1 + r_l)$, no default risk and no non-linearities, no moral hazard.
- If collateral lower, default risk exists, and external finance more expensive than internal finance (alternative cost \approx risk free rate), because of agency costs
- Fall in borrowers net worth increases external finance premium and reduces spending and production in the economy

External finance premium central in discussion of financial crisis

- Definition of financial crisis: collateral constraint suddenly binding (Christiano, Rust, Roldos (2002)): Monetary Policy in a Financial Crisis, NBER WP9005
- Variants of the premium in many modern models of credit channel

A simple external finance premium model

Example

Two periods, 0 and 1. Entrepreneur uses inputs in period 0 to produce in period 1. Fixed input K , variable input x_1 . Market price of K at end of period is q_1 per unit. Output period 1: $a_1 f(x_1)$. Gross cashflow from previous production $a_0 f(x_0)$. Entrepreneur maximizes period 1 output net of debt repayment, $a_1 f(x_1) - r_1 b_1$, subject to accounting identity

$$x_1 = a_0 f(x_0) + b_1 - r_0 b_0 \quad (1)$$

Unconstrained optimal value of x_1 :

$$\text{Max}_{x_1, b_1} (a_1 f(x_1) - r_1 b_1) = \text{Max}_{b_1} [a_1 f(a_0 f(x_0) + b_1 - r_0 b_0) - r_1 b_1]$$

implies $x_1 = x_1^*$ such that

$$a_1 f'(x_1^*) = r_1$$

An external finance premium:

But borrowing is subject to constraint (no unsecured borrowing)

$$b_1 \leq (q_1 / r_1)K \quad (2)$$

Which implies

$$x_1 \leq a_0 f(x_0) + (q_1 / r_1)K - r_0 b_0 \quad (3)$$

When x_1 is suboptimal,

$$x_1 < x_1^* \Rightarrow a_1 f'(x_1) > r_1$$

($f(\cdot)$ is concave) \Rightarrow Shadow price for internal funding = $a_1 f'(x_1)$, higher than r_1 , reflects "agency costs".

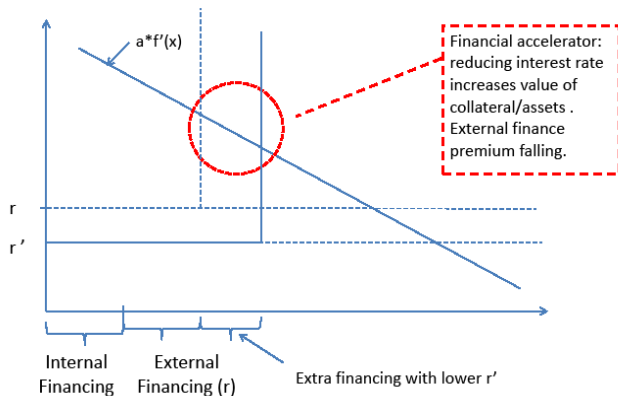
A Financial Accelerator

- Internal funds special value
- Agency premium $a_1 f'(x_1) - r_1$ increases when $a_0 f(x_0) \downarrow$ or $(q_1/r_1)K \downarrow$ or $r_0 b_0 \uparrow$ because borrowing constraint more binding
- Higher agency premium reduces spending x_1 and production $f(x_1)$
- Financial accelerator: fluctuations in borrowers net worth lead to fluctuations in real activity
- Negative demand shock reduces net worth \Rightarrow downturn amplified by collateral-effects

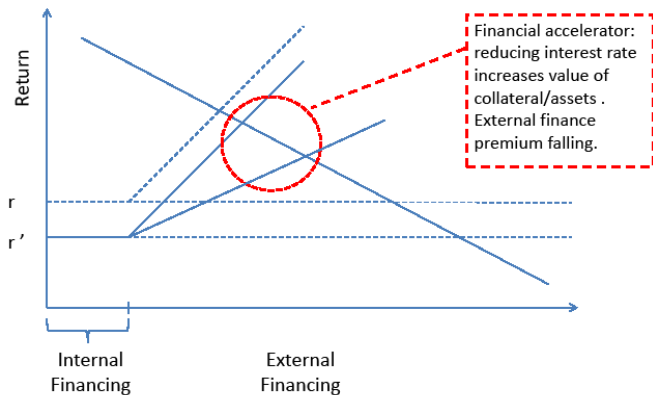
Monetary policy may affect firms and household's cash flow (lower interest rate payments), thereby capitalization of firms and disposable income for households. Also, the interest rate directly affects the value of assets => May make it easier for firms to finance themselves directly, or may give firms access to bank loans at a lower interest rate.

Effects of monetary policy in financial accelerator model:

External finance premium, collateralized financing only



External finance premium



External finance premium/credit market and economic cycle captured by F&R, section 2.5:

Result 2.5: (High) monitoring costs and (low) probability of project success may make it too expensive for firms to borrow in market, they may be able to borrow in bank, or may be declined credit.

Result 2.6: Firms may build reputation and thereby lower external finance premium, and be able to issue direct debt.

Example

Positive shock to income, or a sudden higher probability of success, may impact the economy for many periods: easier for firms to get financing, projects with positive NPV that did not get financing before, now get started. Positive outlook self-confirmed.

External finance premium/credit market collapse captured by Freixas and Rochet, section 2.5:

Result 2.7: At equilibrium, only well-capitalized firms ($A \geq \bar{A}$) can issue direct debt. Firms with intermediate capitalization ($\underline{A}(\beta, r) \leq A \leq \bar{A}$) borrow from banks, and undercapitalized firms ($A \leq \underline{A}(\beta, r)$) cannot invest.

Result 2.8: Credit crunch, collateral squeeze and savings squeeze affects firms access to bank finance, and direct finance.

Example

Higher income increases A in the next period. More firms can issue direct debt, borrow from banks, and fewer are not able to invest. Higher bank capital due to good bank earnings/low losses enable banks to lower their lending rate.

External finance premium: Firms' and banks' direct borrowing

Market reactions – Premiums on Norwegian bonds

Spread over five-year swap rates. Per cent. Week of 2 July 2007 – week of 1 August 2011

