Economics of Regulation:
Credit Rationing and Excess Liquidity

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Main contents - Liquidity

- Liquid asset and liquidity: ambiguity between the precautionary level and the excessive one,
- Compound lotteries: equivalent simple lotteries, (1) consisting of the constituent simple lotteries (2) on the one hand, and a single simple lottery whose probabilities are given by (3) on the other hand,
- Credit rationing: An excess demand for commercial loans at the ruling commercial loan rate (Jaffee-Modigliani, 1969).

3 stages: Liquid asset, liquidity, credit rationing

Main contents - Credit rationing

- Aggregation problem in equilibrium credit rationing modelling - Some credit rationing (credit rationed or sufficient funding) is mixed in a sense of funding level. Nash eq. in no credit rationing (first-best optimum investment) and low investment (first-best case for everybody) (Piketty, 1997; Geanakoplos, 2014; Stiglitz-Weiss, 1981),
- Some credit rationing (credit rationed or sufficient funding) done by individuals and commercial banks in the same problem.

How we can insert the problem of individuals to one of commercial banks as a regulator?

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An individual's problem

- If the individual borrows the amount B, and the interest is $\hat{r}$, then we say the individual defaults on his loan if the return R plus the collateral C is insufficient to pay back the promised amount,

$$C + R \leq \underbrace{B(1+\hat{r})}_{\text{loan for investment}} \tag{1}$$

Claim that consumption and investment don't stand in parallel. If the agent consume more, his utility increases. However, if the agent invest more, the satisfaction is not directly analogous to uncertain return on investment.

Fixed investment scale (Holmstrom-Tirole, 2011)

- We assume that agents consider initial investment I satisfies fixed investment scale $Z_1 > I > Z_0 > 0$. Most investors can have pleageable investment Z_0.
- A model considers a risk-neutral agent (entrepreneur in Holmstrom-Tirole, 2011) with an investment opportunity that is worth Z_1 to him. It is not self-financing in case of a positive net present value, $Z_1 > I$, because most investors can get a pledgeable Z_0 so the risk-taking agent should pay shortfall $I - Z_0 > 0$ converting the market value of their other existing assets.
- The portfolio can go forward if and only if the pledgeable income exceeds the portfolio's net financing, $I - \bar{A}$, that is when

$$A \geq \bar{A} \equiv I - Z_0 > 0 \tag{2}$$

Credit rationing (Holmstrom-Tirole, 2011)

- Let A be the maximum amount of capital that the agent can commit to the project either personally or through the commercial bank. A lower bound $\bar{A}$ on the amount of assets that the commercial bank or the agent needs to have in order to attract external funds. A commercial bank with less capital than $\bar{A}$ will be credit rationed. $A > I$ is in the situation that no external funds are needed.

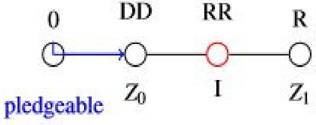
Necessary conditions for credit rationing (Holmstrom-Tirole, 2011)

1. a positive rent $Z_1 - Z_0 > 0$. If $Z_1 = Z_0$, then all projects with positive net present value ($Z_1 > I$) are also self financing ($Z_0 > I$) and hence can move forward.
2. the agent is capital poor in case of $A < (Z_1 - Z_0)$, the agent has enough capital up front to pay for the ex post rents earned and therefore all projects with positive net present value can go forward.

A commercial bank's a fixed reserve scale

- Remark that "capital poor" is in case of $A < (Z_1 - Z_0)$
  $\equiv 1 < \dfrac{(Z_1 - Z_0)}{A}$

where A is defined as the maximum in capital in a sense of a portfolio and $(Z_1 - Z_0)$ is a positive rent



	certain outcome	uncertain outcome
DD index	$\frac{DD-R}{R}$	$\frac{DD-R}{DD}$
DD (Demand Deposit)	R (Reserves)	
RR index	$\frac{R-RR}{RR}$	$\frac{R-RR}{R}$
RR (Required Reserve)		

- A commercial bank controls individuals by interest rate on loans like mortgate interest rate. In a regulatory aim, we assume that the agent deposit savings to demand deposit in the precautionary aim.

Excess liquidity, instrument from Micro to Macro

- excess liquidity: hoidings of precautionary ($\leftrightarrow$ inflationary potential) reserves in the country having a contraction in the *supply of credit* by banks because of pooly developed interbank market.

Excess Liquidity (EL) = Excess Cash + Excess Reserves (ER)

- Reserves (R) $<$ Demand Deposit (DD),
  $ER = \underbrace{(DD - R)}_{Level 11^{th}} + \underbrace{(R - RR)}_{Level 1^{st} to 10^{th}}$
- Reserves (R) $>$ Demand Deposit (DD) (precautionary reserves), ER = R - RR
  RR $\div$ DD (Level 1^{st} to 10^{th}, according to RR $\div$ DD $\div$ 10)
- Reserves (R) $>$ Demand Deposit (DD),
  $RR/DD > 1$ **(excess liquidity)**

Compound concern in Credit rationing

Example: Akerlof's used car market for lemons

Suppose there are only two qualities, good cars ("peaches") and bad cars ("lemons"), worth 5000 dollars and 1000 dollars, respectively. The buyer knows that half the cars are peaches and half are lemons. If she offers 5000 dollars, the sellers of either type surely accept, but the expected value of the car will only be equal to 3000 dollars (1000 dollars with 50% probability and 5000 dollars with 50% probability), so she will make expected losses of 2000 dollars...

when beliefs are formed enoughly to affect on decision procedures

Preferences can only depend on the consequences $(c_1, c_2, ..., c_n)$
Degenerated lotteries are also equivalent.

Compound lotteries

Compound Lotteries $(L_1, ..., L_k; a_1, ..., a_k)$ (MWG, session 6B) is the risk alternative that yields the simple lottery l_k with probability a_k for $k = 1, ..., K$, given K simple lotteries $l_k = (p_1^k, ...p_N^k)$, $k = 1, ..., K$ and probabilities $a_k \geq 0$ with $\sum_k a_k = 1$.

Utility function in incomplete structural representation

- (example 1, multi-valued prediction, Jovanovic, 1989, discrete form game) u is latent variable, θ is a parameter in the payoff matrix, S is the set of (pure) strategies, and $G(u \mid \theta)$ is the set of Nash equilibrium (pure) strategy profiles for given u and θ.

- solution for multiple equilibria: sub-correspondence? rationalizability? samples converge (ergodicity) and obey classical limit theorems? Why θ is given?

Utility function in incomplete structural representation

- Initially we consider decisions when the number of possible outcomes or "states" is finite. A regulator (decision maker) then indicates the choice structure θ to each state.
- Let L_θ be the consequence in complete structure θ,
- Let $1_\theta(L)$ be the indicator that the individual assigns to this complete structure θ, where $1_\theta : L \rightarrow \{0,1\}$ defined as $1_\theta(L) := 1 \text{if} L \in \theta, 0 \text{if} L \theta$ then the uncertain outcome or "prospect" is the $2 \times \theta$ vector:

$$(L_\theta; 1_\theta(L)) = ((L_1, ..., L_\theta); (1_\theta(L), ..., 1_\theta(L)). \qquad (4)$$

Under the axiom of choice on two uncertain outcomes, there exists a continous utility function $U(L_\theta; 1_\theta(L))$ over prospects.

Utility function in incomplete structural representation

- Given a structural parameter $\theta \in \Theta$ and the realization $u \in U$ of an unobservable random variable, the model predicts a nonsingleton set, denoted $G(u \mid \theta)$, of values for the outcome variable, that is $G(u \mid \theta)$ is a subset of the (finite) outcome space S.
- The question (Epstein-Kaido-Seo, 2016) is on how the realized outcome s is selected from $G(u \mid \theta)$.
- The object of interest is θ.

Utility function in incomplete structural representation

- Considering the set of all lotteries or prospects over the fixed outcome levels $L_1 < L_2 < L_3$, which can be represented by the set of all choice structure triples of the form $\Theta = (\theta_1, \theta_2, \theta_3)$, we can represent these lotteries by the points in the unit triangle in the (θ_1, θ_3) plane.
- Since upward movements in the triangle increase θ_3, the risky movements are all northwest movements.
- For $\theta_3 > 1$, it's possible but we assume there is limit of cognition as of $0 < \theta_3 \leq 1$ by a regulator.
- The value is revealed when preference structure u is corresponding θ-parametric choice structure Θ:

$$G(u \mid \theta_1 + \theta_3) \in \triangle(S), G(u \mid \theta_2) \notin \triangle(S). \tag{5}$$

Utility function in incomplete structural representation

Let's say we assume that we have three points (lotteries, probabilities). If a lottery is utility-representable, a lottery is θ-parametric structural which is complete in the choice structure.

$$\mathscr{P}_\theta = \left\{ P \in \triangle(S^\infty) : P = \int_{U^\infty} P_{u^\infty} dm_\theta^\infty(u^\infty) \right\}, \tag{6}$$

If the preference of a lottery is not revealed in the θ-parametric structure, we get certain decision procedure which is not interesting for a rational agent who is afford to get risk-taking outcome:

$$\mathscr{P}_{\theta^c} = 0. \tag{7}$$

$G(u \mid \theta_1 + \theta_3) \in \triangle(S)$,
$G(u \mid \theta_2) \not\subseteq \triangle(S)$ in the case of certain second outcome.

Again, there is possibility of $G(u \mid \theta_3) \not\subseteq \triangle(S)$ in the extreme case of risky preference on uncertain third outcome.

Utility function in incomplete structural representation

• (Compound convergences in this model)
Assume that u^∞ jointly follows a parametric compound convergence m^∞_θ, the i.i.d. product of the compound convergence

$$m_{\theta_1+\theta_3} \equiv \left\{ \frac{Z_1^1 - Z_0^3}{A^1}, \frac{Z_1^1 - Z_0^3}{A^3} \right\} \in \triangle, \tag{8}$$

defined as "redlining in credit rationing" on U.

- Markets play allocational.
- Redlining: the group of borrowers who can not obtain credit with a given supply of loanable funds.
- Financial autarky: savings and investment express the supply and demand of loanable funds.

Comparing different lotteries

lotteries, degenerated at the same portion in a von Neumann-Morgenstern utility function

- Preferences can only depend on the consequences $(c_1, c_2, ..., c_n)$ and their respective probabilities $(p_1, p_2, ..., p_n)$
- a utility function $F(c_1, c_2, ..., c_n; p_1, p_2, ..., p_n)$(by attaching numbers to indifference curves, where a curve corresponding to a higher level of preference gets a bigger number)
- the indifference map

$$EU(L) = p_1 u(c_1) + p_2 u(c_2) + ... + p_n u(c_n) \tag{9}$$

where F(=constant) exists by the indifference map consisted by contours.

$$EU(L) = 1_\theta \cdot G(u \mid (\theta_1 + \theta_3) + 1_\theta \cdot G(u \mid \theta_2). \tag{10}$$

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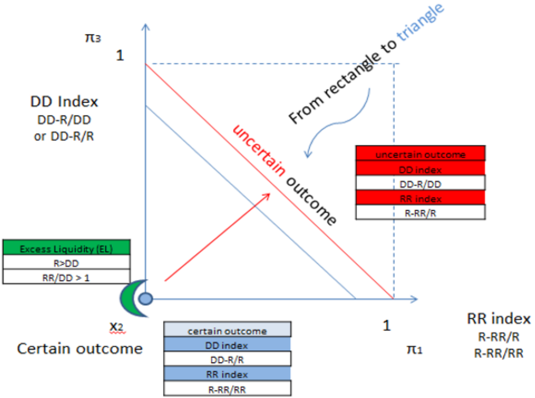
Compound convergences in incomplete structural triangle

Framework of risk preference in the Machina Triangle



Excess Liquidity in incomplete structural triangle

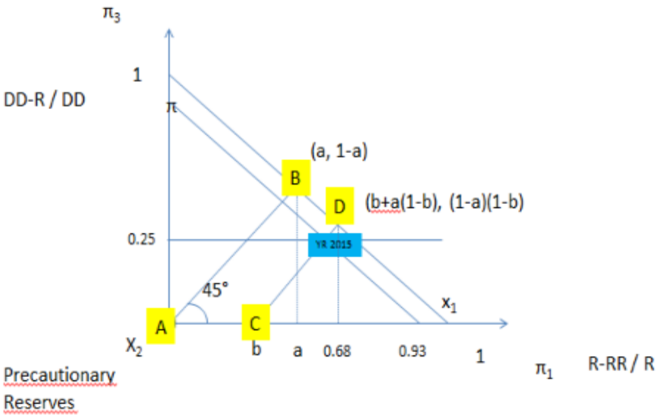
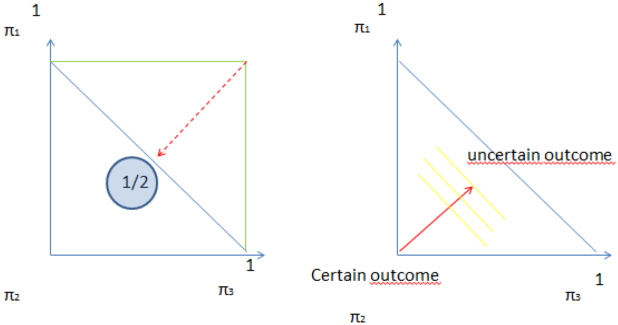


Figure 5. Remoted prospects from the origin point

Binary choice in uncertainty



Arguments in axioms of Triangle

1) Independence Axiom (Von Neumann and Morgenstern, 1944)

The preference relation $\succeq$ on the space of simple lotteries l satisfies the independence axiom if for all $L, L', L" \in l$ and $a \in (0,1)$, we have $L \succeq L'$ if and only if
$aL + (1-a)L" \succeq aL' + (1-a)L"$
The agent should choose the first lottery (L) than the second lottery (L') regardless of the third one ($L"$).

Example 1) There are three outcomes: "a trip to New-york," "eating a New york styled bagle," and "stayinig in the office." Suppose that you prefer the first lottery to the second one and the second one to third one. The choice to select the second lottery is rational if you anticipate that you cannot travel to New-york. However, the independence axiom forces you to prefer the first lottery to the second one (Machina Paradox in section 6.B MWG)

Arguments in axioms of Triangle

2) Preferential consquentialism (Vergopoulos, 2011)

The agent firstly recognizes the endogenous event (E), regardless of the preferred act g in the exogenous event (E^c), he will choose the preferred set f in the endogenous event (E): $f_E g \sim_E f$.

Example 2) You are invited for a dinner (E). You were supposed to drink a Beer (g) in case of staying at home (E^c). However, you decide to carry a Wine (f) for an invitation of dinner (E).

3-1) Savage's Sure Thing Principle (STP) (Savage 1954; Aumann, Hart)

For any event $E \subset \Omega$ and any acts $f, g, h, k \in B(\Omega)$, $f_E h \preceq_0 g_E h \leftrightarrow f_E k \preceq_0 g_E k$ where $\preceq_0$ is an optimal ex ante choice in the backward induction.

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Case comparison: MENA (Middle East and North Africa) countries

Which country can be better?

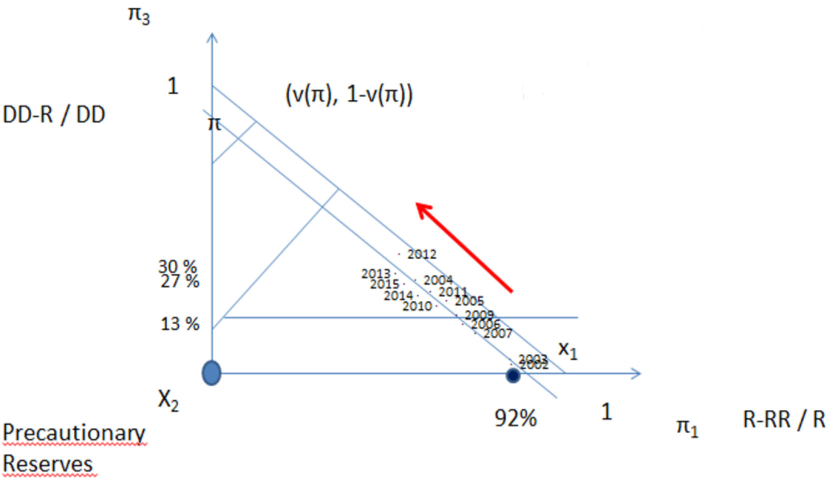
2. complementary economic information about village I and village II, reference: world bank data.

	Village I	Village II
Population (total)	7,416,083	5,612,096
GDP (millions, Current USD)	3,587	4,573
GDP per capita (Current USD)	4,830	8,148
commercial bank branches per 100,000 adults	19. 85	29.84
Domestic credit to private sector (% of GDP)	70	103
Bank nonperforming loans to gross loans (%)	5.6	4
Bank capital to asset (%)	12	8

(Current USD, million)	Village I	Village II
Outside Liquidity in domestic currency, liabilities		
currency issued	5,886	400
required reserve	2,053	19,200
excess reserve	1,981	44,400
reserve money	9,920	64,000
demand deposit, commercial banks	12,684	3,028
excess liquidity	R < DD	DD < R
Inside Liquidity		
overnight deposit window rate	2.75	2.75
credit rationed A	-10,631	60,972
domestic credit to private sector by banks to GDP (%)	70	99.2
net commercial bank lending and other private credits	250	-43

Table 3. Selected Liquid Characteristics in 2014 [5]

Application to MENA countries: Jordan



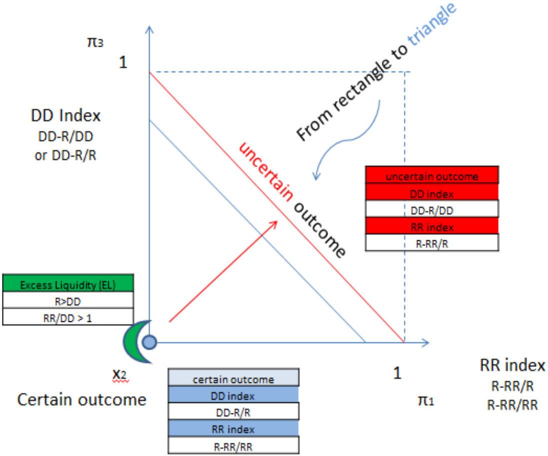
Application to MENA countries: Jordan

6.1. Village I (Jordan)

identification symbols: DD (Demand Deposit), RR (Required Reserves), R (Reserve), EL=Excess Liquidity

Year	DD-RR/R	R-RR/RR, Precautionary Reserves	RR/DD, RR index (1-11th)
1993	-35%	567%,certain outcome	23%,3th(below 30%)
1994	-37%	567%,certain outcome	24%,3th(below 30%)
1995	-38%	567%,certain outcome	24%,3th(below 30%)
1996	-36%	567%,certain outcome	24%,3th(below 30%)
1997	-41%	614%,certain outcome	24%,3th(below 30%)
1998	-33%	614%,certain outcome	21%,3th(below 30%)
1999	-38%	614%,certain outcome	23%,3th(below 30%)
2000	-29%	900%,certain outcome	14%,2th(below 20%)
2001	-15%	1150%,certain outcome	9%,1th(below 10%)
2002	1%	92%,uncertain outcome	11th(over 100%)
2003	2%	92%,uncertain outcome	11th(over 100%)
2004	27%	92%,uncertain outcome	11th(over 100%)
2005	23%	92%,uncertain outcome	11th(over 100%)
2006	12%	92%,uncertain outcome	11th(over 100%)
2007	9%	92%,uncertain outcome	11th(over 100%)
2008	0%	91%,certain outcome	1th(below 10%)
2009	12%	93%,uncertain outcome	11th(over 100%)
2010	15%	93%,uncertain outcome	11th(over 100%)
2011	20%	93%,uncertain outcome	11th(over 100%)
2012	30%	93%,uncertain outcome	11th(over 100%)
2013	28%	93%,uncertain outcome	11th(over 100%)
2014	22%	93%,uncertain outcome	11th(over 100%)
2015	25%	93%,uncertain outcome	11th(over 100%)

Application to MENA countries: Lebanon



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Comparative statics in investment