Intraday Liquidity Management: A Tale of Games Banks Play

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MORTEN L. BECH

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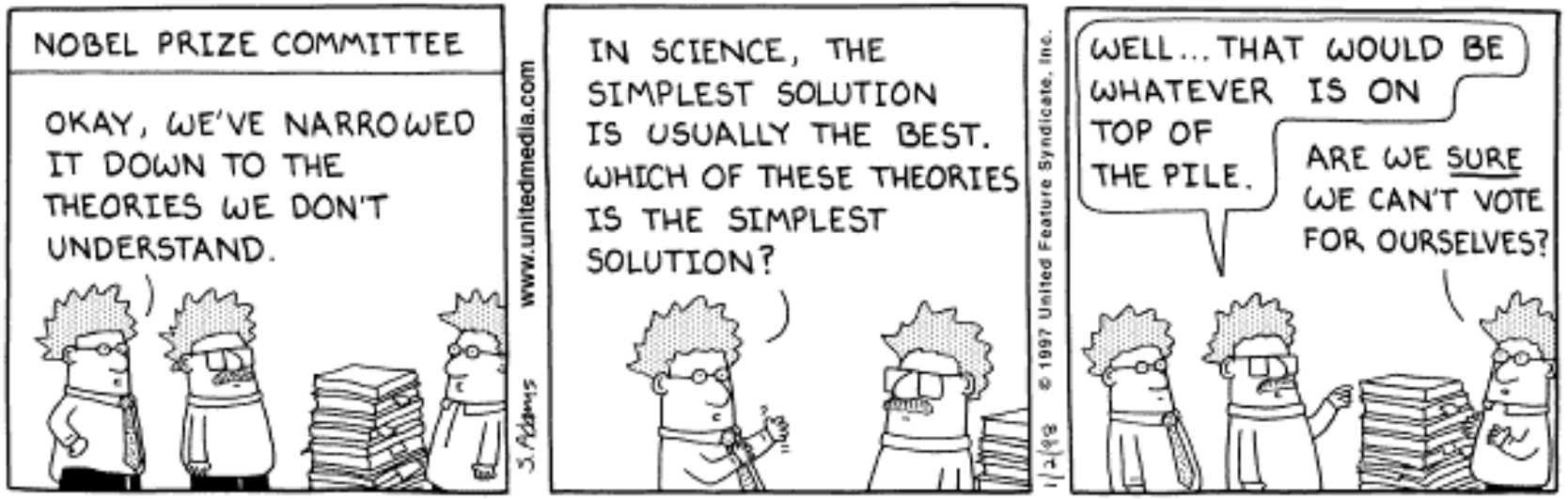
Occam's Razor

- William of Occam (1284-1347) was an English philosopher and theologian.
- Aristotelian principle that entities must not be multiplied beyond what is necessary
- A problem should be stated in its basic and simplest terms. In science, the simplest theory that fits the facts of a problem is the one that should be selected.



Game Plan

- Introduce a simple 2x2 game
- Show how it can be used to analyze many of the phenomena that face interbank payment system operators, users and other stakeholders
- Choice of intraday credit regime: no, **free**, **collateralized** and **priced** credit.
- Liquidity Savings Mechanisms
- Comparative Analysis
- **Repeated interaction**
- Settlement Risk: **Liquidity** and credit risk
- **Incomplete** Information
- Heterogeneity
- Many banks
- Multitudes of periods (decision points)
- **Repo run** game

Forthcoming EPR volume

- **Global Trends in Large-Value Payments**
  Morten L. Bech, Christine Preisig, and Kimmo Soramäki
- **An Economic Perspective on the Enforcement of Credit Arrangements: The Case of Daylight Overdrafts in Fedwire**
  Antoine Martin and David C. Mills
- **Intraday Liquidity Management: A Tale of Games Banks Play**
  Morten L. Bech
- **An Economic Analysis of Liquidity-Saving Mechanisms**
  Antoine Martin and James McAndrews
- **The Timing and Funding of CHAPS Sterling Payments**
  Christopher Becher, Marco Galbiati, and Merxe Tudela
- **Changes in the Timing Distribution of Fedwire Funds Transfers**
  Olivier Armantier, Jeffrey Arnold, and James McAndrews
- **Understanding Risk Management in Emerging Retail Payments**
  Michele Braun, James McAndrews, William Roberds, and Richard Sullivan

The Intraday Liquidity Management Game

- One day
- Two banks: A & B
- Two periods: Morning and Afternoon
- Each bank receives a $1 payment request at dawn (no uncertainty or private information)
- Q: Send or delay?
- Start with zero balance on settlement account
- Intraday liquidity available from central bank

- Banks try to minimize their settlement costs
- Maintain customer satisfaction
- F>0 is the fee for overdrafts at noon charged by the central bank
- C>0 is the per period opportunity cost of collateral
- D>0 is the cost of delaying a payment until the afternoon.

Free Intraday Credit

RTGS

Bank A \ Bank B	Morning	Afternoon
Morning	0, 0	0, D
Afternoon	D, 0	D, D

Collateralized Credit

Externality: Banks do not take into account the value of liquidity forwarded

RTGS

Bank B

Bank A	Morning	Afternoon
Morning	C, C	2C, D
Afternoon	D, 2C	C+D, C+D

C < D

Bank B

Bank A	Morning	Afternoon
Morning	2, 2	4, 3
Afternoon	3, 4	5, 5

Total cost = 4

C > D

Bank B

Bank A	Morning	Afternoon
Morning	3, 3	6, 2
Afternoon	2, 6	5, 5

Prisoner's Dilemma

Total cost = 10

Time is money (also intraday) so delay is costly. The cost is D > 0 per dollar

Priced Credit

Fee F charged by central bank for overdrafts

Bank B

Bank A	Morning	Afternoon
Morning	0, 0	F, D
Afternoon	D, F	D, D

F < D

Bank B

Bank A	Morning	Afternoon
Morning	0, 0	3, 4
Afternoon	4, 3	4, 4

Total cost = 0 (FIRST BEST)

F > D

Stag Hunt

Bank B

Bank A	Morning	Afternoon
Morning	0, 0	4, 3
Afternoon	3, 4	3, 3

Total cost = 0 or (6)

Rational players are pulled in one direction by considerations of mutual benefit and in the other by considerations of personal risk

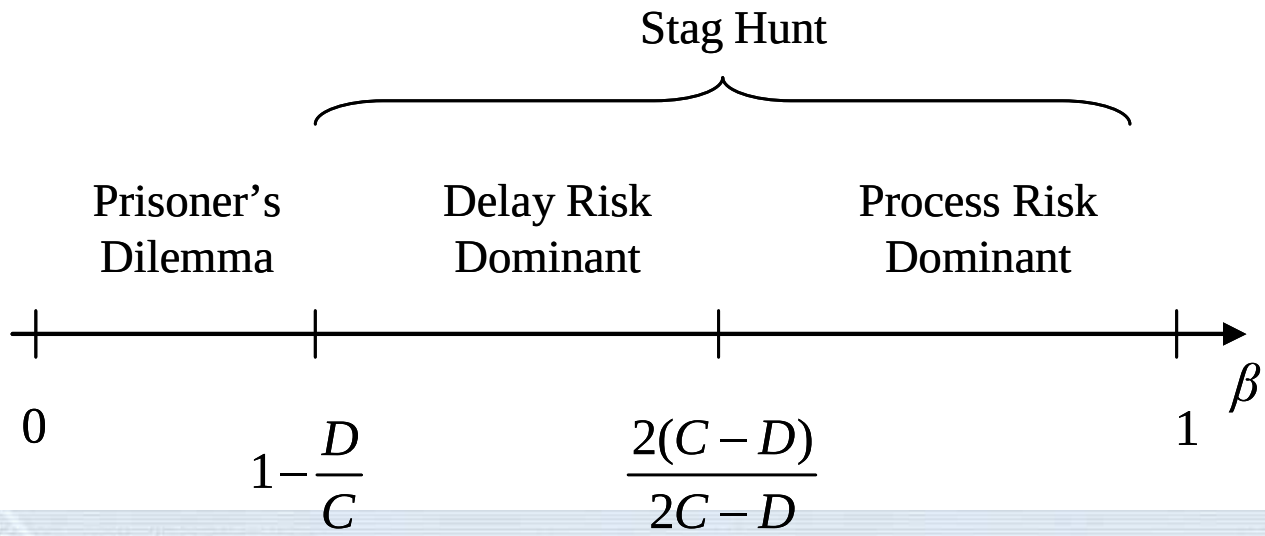
Haysanyi & Selten Risk Dominance: (m,m) if F < 2D, Otherwise (a,a)

Repeated Play (Collateralized Credit)

- Infinite play
- Trigger strategy
  - Send early but if …
- Discount the future
- Discount factor $0 < \beta < 1$
- $c^i(t,t) = C + \beta C + \beta^2 C + \beta^3 C + \ldots = \frac{C}{1-\beta}$

Bank A \ Bank B	trigger	always delay
trigger	C/(1-β)	2C+ β(C+D) / (1-β)
always delay	D+ β(C+D) / (1-β)	(C+D) / (1-β)

- C > D



Settlement Risk

- Liquidity risk: The risk that a counterparty will not settle for full value, when due, but at some unspecified time thereafter.
- Credit risk: The risk that a counterparty will not settle an obligation for full value, either when due or anytime hereafter

Liquidity Risk

Credit Risk see paper

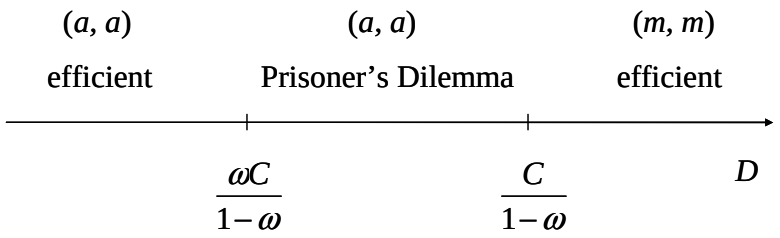
With ω outage in morning period

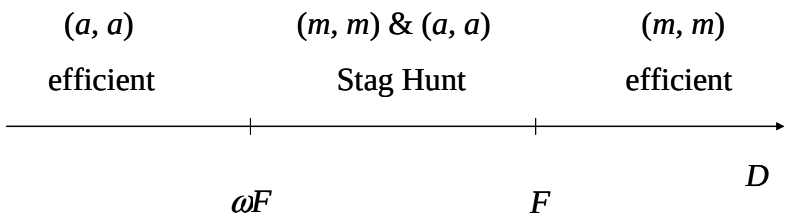
Bank B

Bank A	Morning	Afternoon
Morning	(1+ω)C + ωD	2C + ωD
Afternoon	ωC + D	D + C

Bank B

Bank A	Morning	Afternoon
Morning	$(1+\omega^2)F + \omega D$	(1+ω)F + ωD
Afternoon	D	D





Settlement risk makes (ceteris paribus) late settlement more likely.

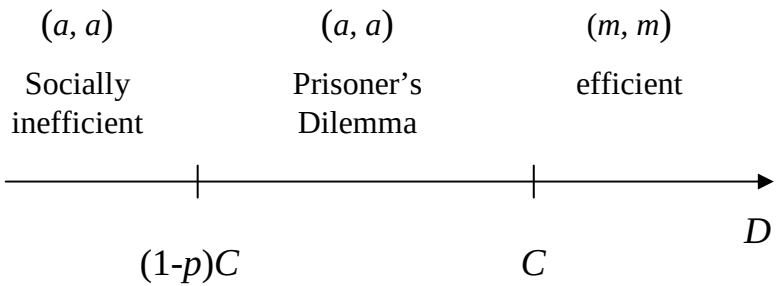
Late settlement may be efficient.

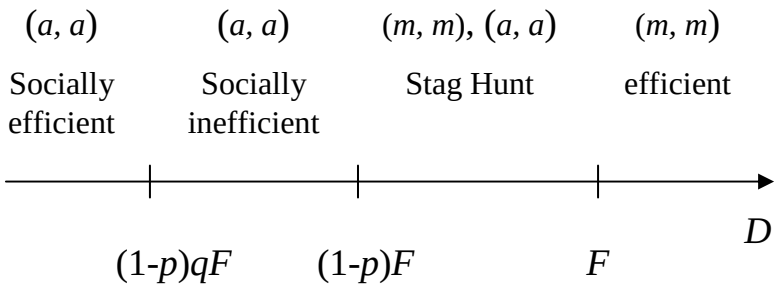
Incomplete Information

Instructions arrive at dawn (p – private info) and noon (q - uncertainty) → Baysian Game

Bank A \ Bank B	Morning	Afternoon
Morning	(2-p)C	2C
Afternoon	D + (1-p) C	D + C

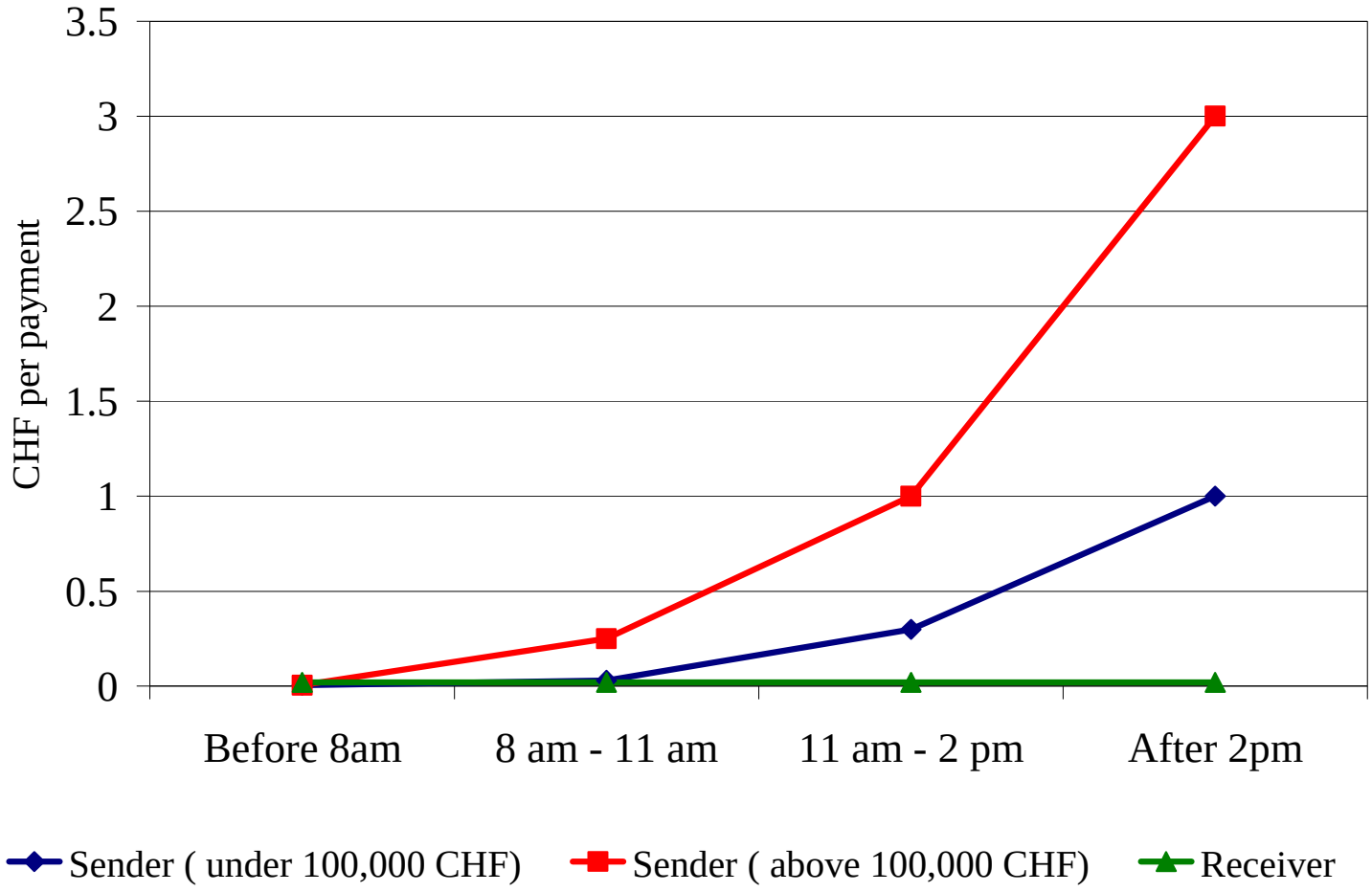
Bank A \ Bank B	Morning	Afternoon
Morning	(1-p)F + D	F
Afternoon	D	D





Incomplete information about payment flows increases (ceteris paribus) the likelihood of late settlement and in the priced credit case late settlement may be socially efficient.

The Swiss Price Schedule.



Source: <http://www.sic.ch>.

The Repo Run Game

- Two investors each with $1 to lend
- One dealer; needs two finance $2 of securities
- Dealer defaults with if she can only secure < $2
- r = repo rate, α = recovery value & λ = margin
- Harsanyi and Selten's (1988) Risk dominance:
  - (Deal, Deal) if r > -α((1+λ) -1)

STAG HUNT

Investor 2 \ Investor 1	Deal	No Deal
Deal	*r, r*	*(α(1+λ)-1), 0*
No Deal	*0, (α(1+λ)-1)*	*0, 0*

Heterogeneity

In 2006, FR eliminated of free intraday credit to GSEs for P&I payments.

Problem: P&I paid @ 8am. GSE covered their overdrafts just before close.

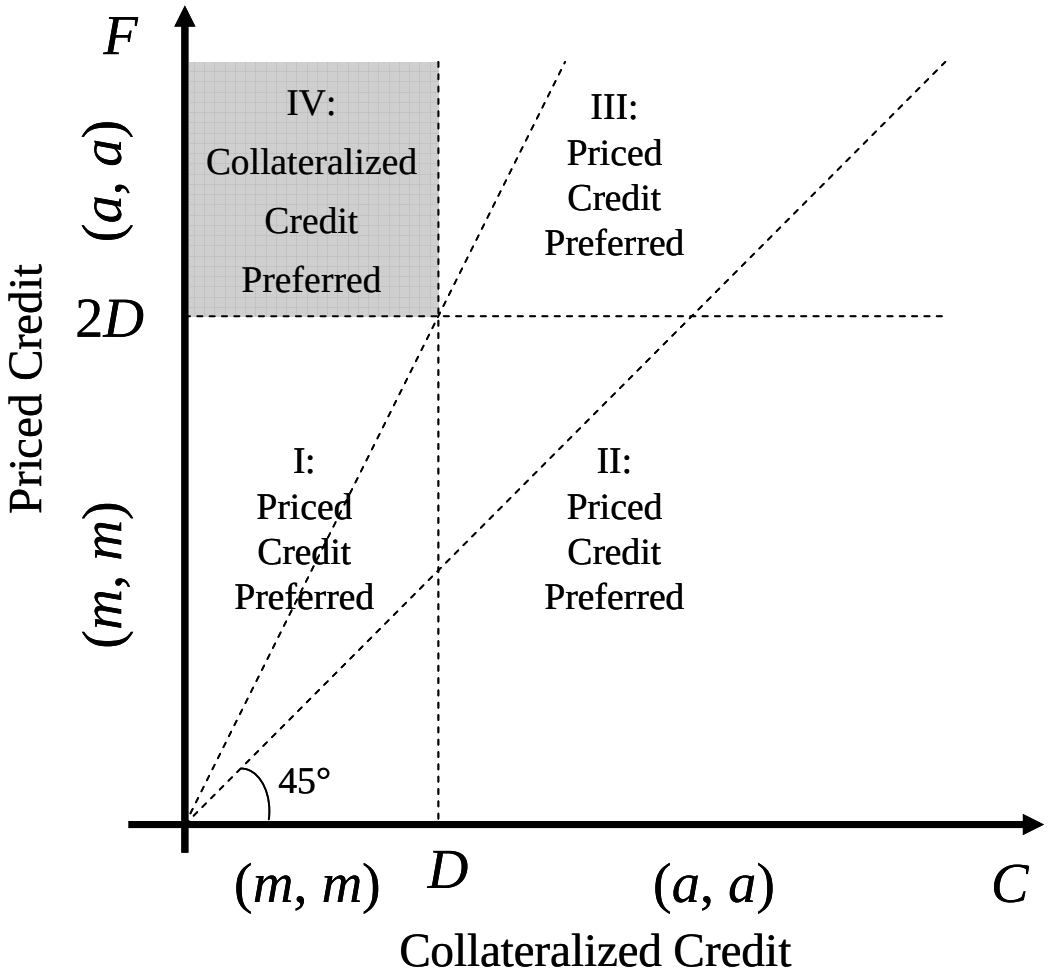
Bank \ Issuer	Morning	Afternoon
Morning	ρF, 0	(1+ρ)F, H
Afternoon	ρF, 0	ρF, H

More Periods

Bank A \ Bank B	M	A	E
Morning	0 0	F, D	2F, 2D
Afternoon	F, D	D, D	F+D, 2D
Evening	2D, 2F	2D, F+D	2D, 2D

Focal points!

Comparative Analysis



A digression: No Intraday Credit

R: Opportunity cost of reserves

		Bank B	
	R > D	Morning	Afternoon
Bank A	Morning	R, R	R, D
	Afternoon	D, R	D+R, D+R