

Liquidity , Gridlocks and Bank Failures in Large Value Payment Systems

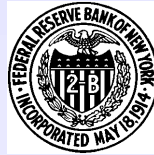
Presentation at the Bank of Finland

May 19, 2003

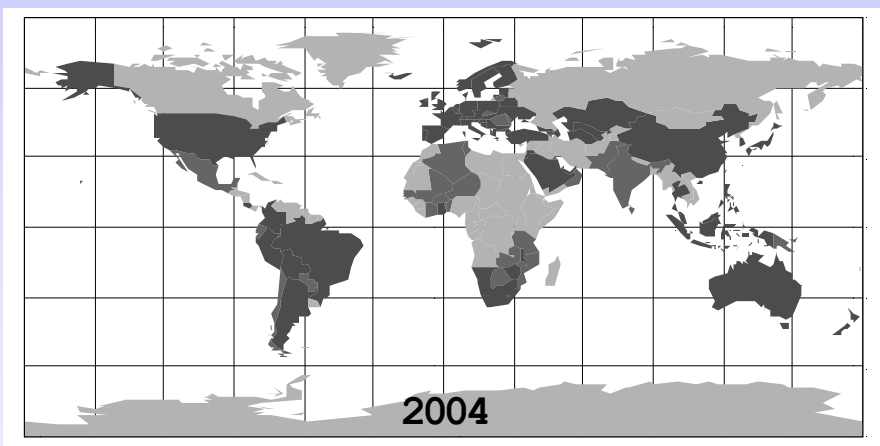
Morten Linnemann Bech

Federal Reserve Bank of New York

Payments Studies Function



Diffusion of RTGS

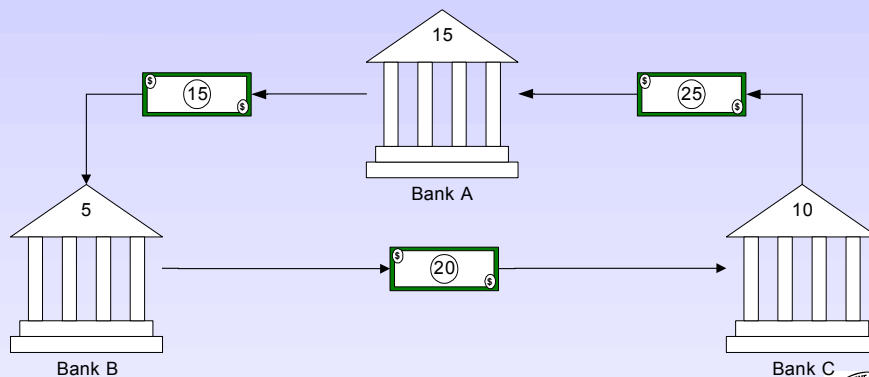


The Pros and Cons of RTGS

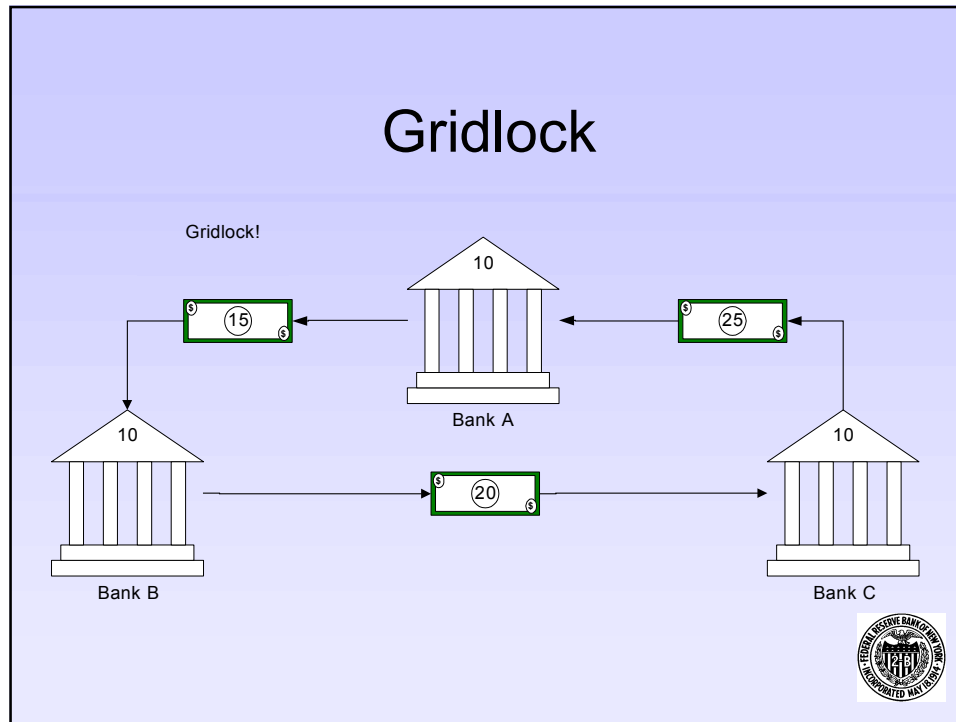
- No credit risk \Rightarrow low systemic risk ☺
- Liquidity requirement \uparrow ☹
 - ▲ Potential for gridlock
 - ▲ Gridlock = situation where the settlement of payments awaits the settlement of other payments



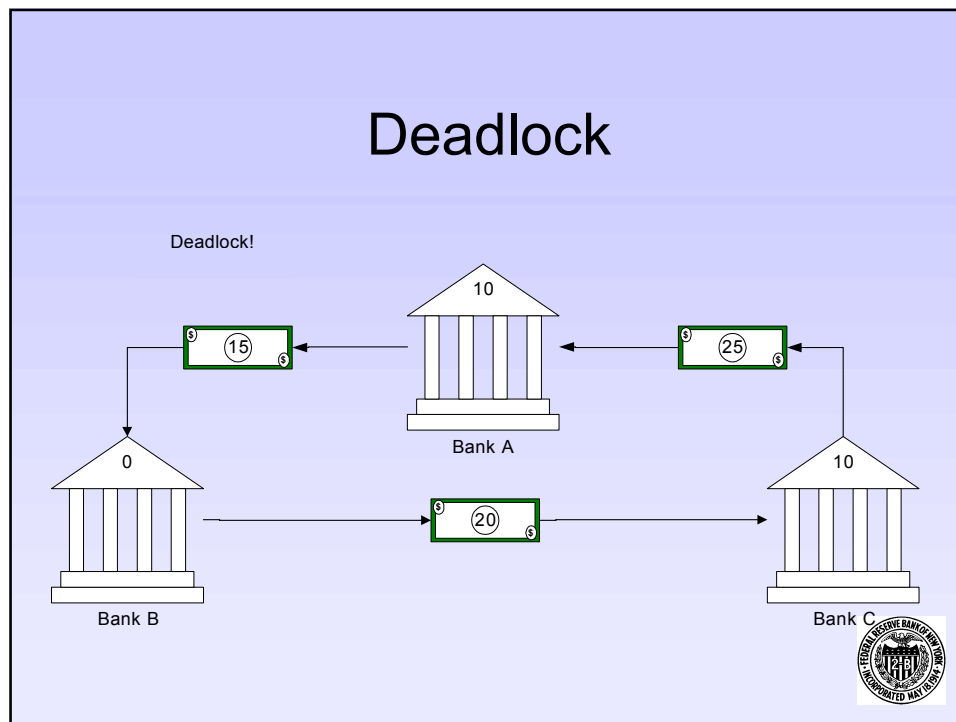
No Queue



Gridlock



Deadlock



Gridlock Resolution



Microsoft Excel
Worksheet



Activate all payments

Microsoft Excel - Worksheet in excel-1.ppt

File Edit View Insert Format Tools Data Window Help

75%

And

35

Activate all payments

Gridlock

Bank A					Bank B					Bank C				
Balance	Debits	Credits	New Bal.	Net	Balance	Debits	Credits	New Bal.	Net	Balance	Debits	Credits	New Bal.	Net
\$ 58	\$ (1208)	\$ 1202	\$ 127	\$ 127	\$ 80	\$ (1428)	\$ 722	\$ 185	\$ 185	\$ 51	\$ (108)	\$ 158	\$ 53	\$ 53
FIFO Queue					FIFO Queue					FIFO Queue				
Receives	Amount	\$ on 1	Solution		Receives	Amount	\$ on 1	Solution		Receives	Amount	\$ on 1	Solution	
1	C	\$ 102	1	102	A	\$ 80	1	80		A	\$ 51	1	51	
2	C	\$ 12	1	12	C	\$ 82	1	82		B	\$ 298	1	298	
3	B	\$ 208	1	208	A	\$ 280	1	280		A	\$ 168	1	168	
4	C	\$ 104	1	104	C	\$ 21	1	21		B	\$ 21	1	21	
5	D	\$ 12	1	12	A	\$ 256	1	256		D	\$ 45	1	45	
6	D	\$ 58	1	58	A	\$ 12	1	12		D	\$ 12	1	12	
7	C	\$ 23	1	23	C	\$ 51	1	51		A	\$ 53	1	53	
8	B	\$ 48	1	48	C	\$ 123	1	123		B	\$ 36	1	36	
9	C	\$ 492	1	492	A	\$ 51	1	51		A	\$ 12	1	12	
10	C	\$ 12	1	12	A	\$ 45	1	45		B	\$ 12	1	12	
11	C	\$ 21	1	21	A	\$ 70	1	70		B	\$ 23	1	23	
12	D	\$ 16	1	16	C	\$ 63	1	63		A	\$ 45	1	45	
13	C	\$ 26	1	26	C	\$ 285	1	285		A	\$ 21	1	21	
14	C	\$ 95	1	95	A	\$ 45	1	45		A	\$ 23	1	23	
15	C	\$ 5	1	5	C	\$ 34	1	34		B	\$ 47	1	47	



Gridlock

Microsoft Excel - Worksheet in mofen-1.xls

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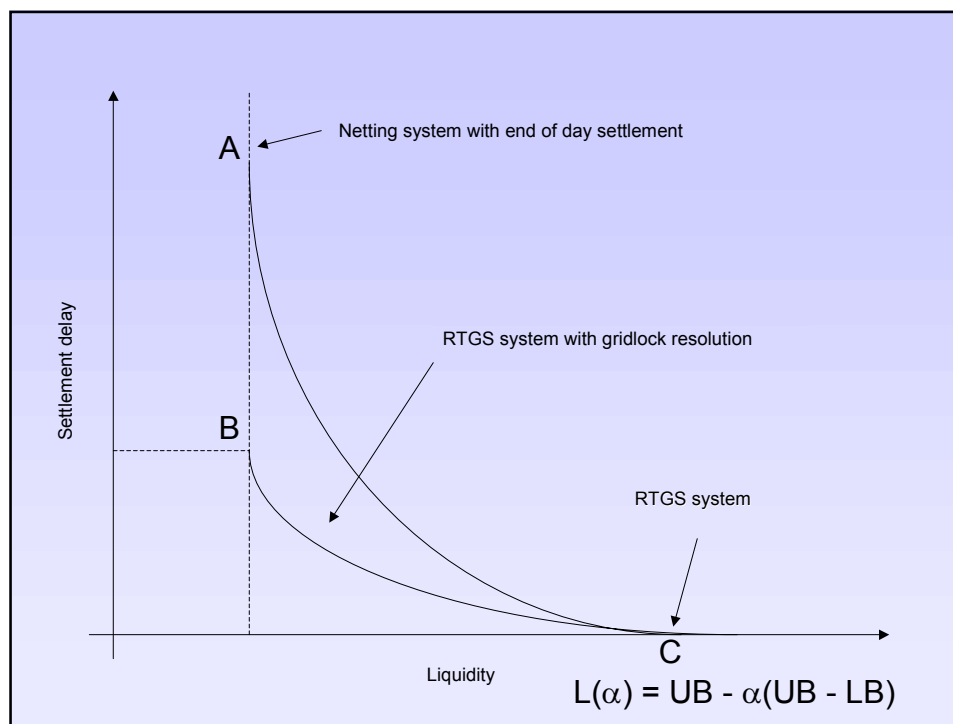
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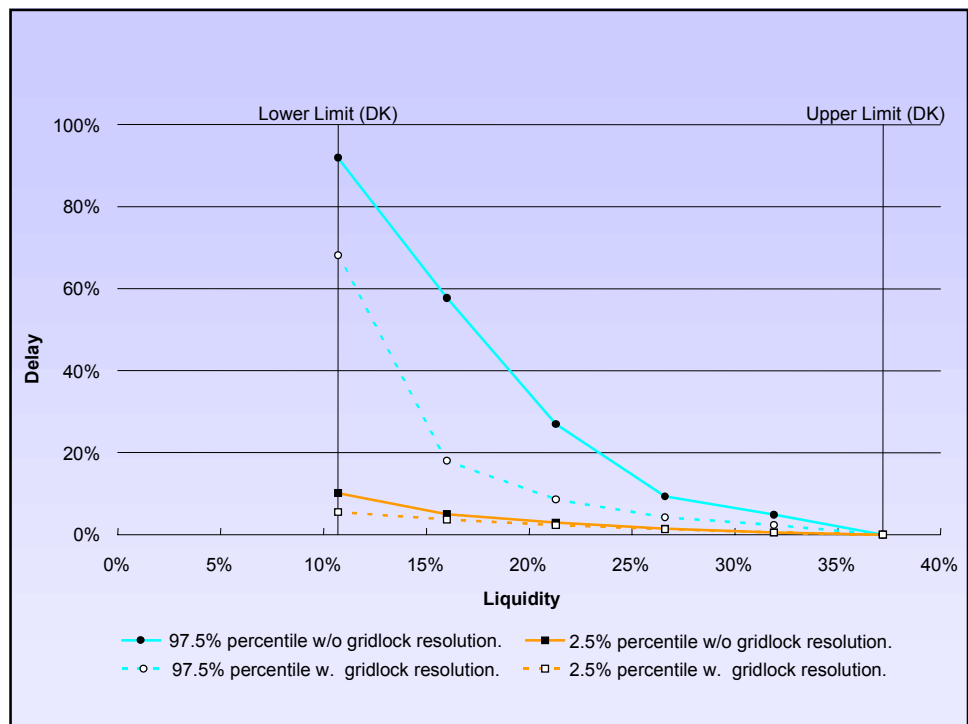
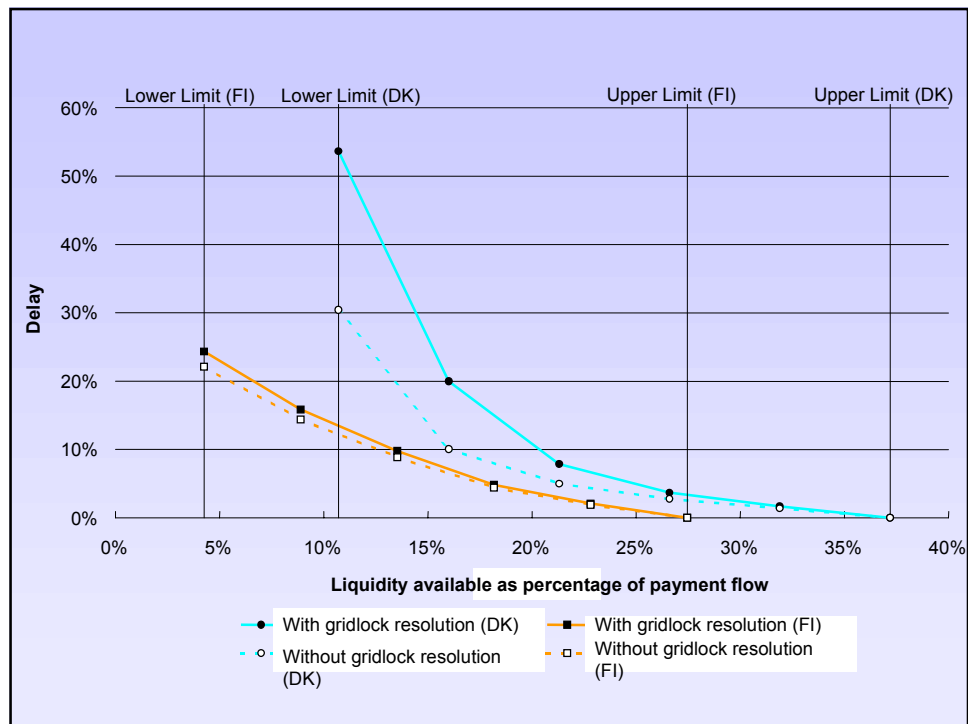
Activate all payments

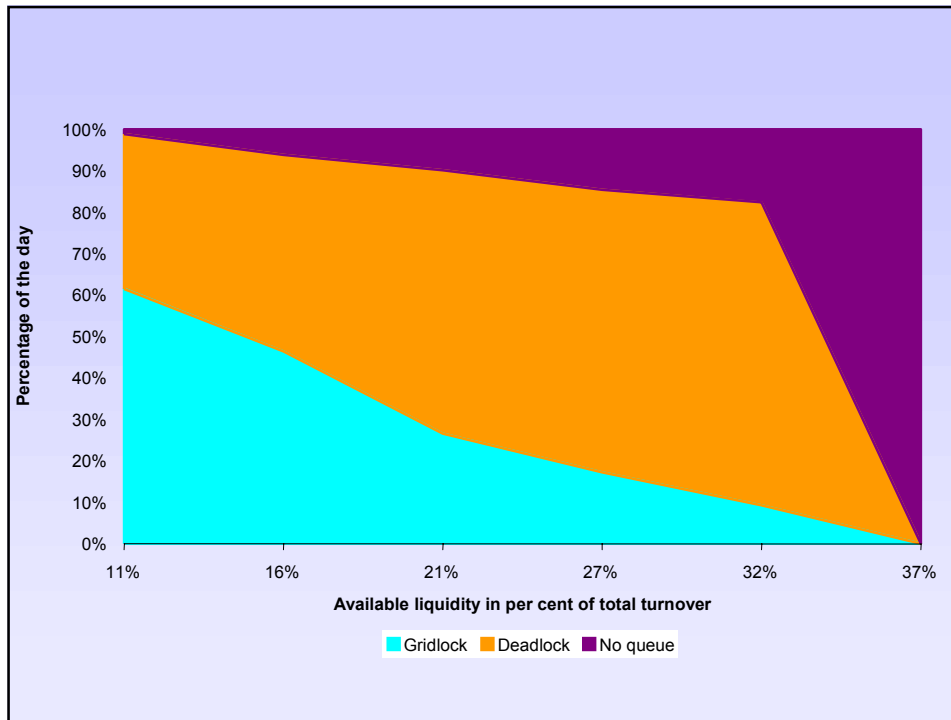
Gridlock

Stack A				Stack B				Stack C			
Balance	\$	Net	\$	Balance	\$	Net	\$	Balance	\$	Net	\$
Debits	\$	100	Queue	Debits	\$	100	Queue	Debits	\$	100	Queue
Credits	\$	50	Queue	Credits	\$	100	Queue	Credits	\$	100	Queue
New Bal.	\$	50		New Bal.	\$	100		New Bal.	\$	100	

FIFO Queue				FIFO Queue				FIFO Queue			
Receiver	Amount	Out	Solution	Receiver	Amount	Out	Solution	Receiver	Amount	Out	Solution
A	\$ 100	1	100	A	\$ 100	1	100	A	\$ 100	1	100
B	\$ 100	1	100	B	\$ 100	1	100	B	\$ 100	1	100
C	\$ 100	1	100	C	\$ 100	1	100	C	\$ 100	1	100
D	\$ 100	1	100	D	\$ 100	1	100	D	\$ 100	1	100
E	\$ 100	1	100	E	\$ 100	1	100	E	\$ 100	1	100
F	\$ 100	1	100	F	\$ 100	1	100	F	\$ 100	1	100
G	\$ 100	1	100	G	\$ 100	1	100	G	\$ 100	1	100
H	\$ 100	1	100	H	\$ 100	1	100	H	\$ 100	1	100
I	\$ 100	1	100	I	\$ 100	1	100	I	\$ 100	1	100
J	\$ 100	1	100	J	\$ 100	1	100	J	\$ 100	1	100
K	\$ 100	1	100	K	\$ 100	1	100	K	\$ 100	1	100
L	\$ 100	1	100	L	\$ 100	1	100	L	\$ 100	1	100
M	\$ 100	1	100	M	\$ 100	1	100	M	\$ 100	1	100
N	\$ 100	1	100	N	\$ 100	1	100	N	\$ 100	1	100
O	\$ 100	1	100	O	\$ 100	1	100	O	\$ 100	1	100
P	\$ 100	1	100	P	\$ 100	1	100	P	\$ 100	1	100
Q	\$ 100	1	100	Q	\$ 100	1	100	Q	\$ 100	1	100
R	\$ 100	1	100	R	\$ 100	1	100	R	\$ 100	1	100
S	\$ 100	1	100	S	\$ 100	1	100	S	\$ 100	1	100
T	\$ 100	1	100	T	\$ 100	1	100	T	\$ 100	1	100
U	\$ 100	1	100	U	\$ 100	1	100	U	\$ 100	1	100
V	\$ 100	1	100	V	\$ 100	1	100	V	\$ 100	1	100
W	\$ 100	1	100	W	\$ 100	1	100	W	\$ 100	1	100
X	\$ 100	1	100	X	\$ 100	1	100	X	\$ 100	1	100
Y	\$ 100	1	100	Y	\$ 100	1	100	Y	\$ 100	1	100
Z	\$ 100	1	100	Z	\$ 100	1	100	Z	\$ 100	1	100







Gridlock Resolution under Failure scenarios

- Financial failure scenario - the largest bank default at dawn.
- Operational failure scenario - the largest bank is unable to send payments until the last hour of the day
 - ▲ Other banks unaware
 - ▲ Low priority to payments to the bank with operational problems



The effect of a failure on settlement delay

- Liquidity available = upper bound

The delay indicator	Financial failure	Operational failure	
		w/o prioritization	w prioritization
Average delay	0.04	0.12	0.11
Maximum delay	0.26	0.31	0.30

- In the financial failure on average some 4.5% of payments remained unsettled but on the worst 27% of payments were not settled
- Delay indicator = 0.12 \approx Delay indicator when $\alpha = .5$, i.e., 50% reduction in liquidity



The effect of resolution under failure scenarios

	Financial failure	Operational failure	
		w/o prioritization	w prioritization
Number of days gridlocks occurred	6	24	25
Average share of day gridlocked	30%	19%	17%
Maximum share of day gridlocked	62%	60%	52%
Average decrease in settlement delay by gridlock resolution	31%	11%	10%
Maximum decrease in settlement delay by gridlock resolution	63%	43%	39%

