

Understanding contagious bank runs

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<i>Player B</i>	up	down
<i>Player A</i>		
up	60, 60	0, 40
down	40, 0	20, 20

Why would anyone not play *up*? ..strategic uncertainty, beliefs,..

deposit repaid,
interest

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 40
withdraw deposit	40, 0	20, 20

Bank fails;
Early liquidation value of 40;
Sequential service constraint

What is the link to bank runs?

assets	liabilities
cash = 1	equity = 1
loan = 2	deposit = 1
	deposit = 1

- pooling
- maturity mismatch
 - => deposit: on demand
 - => loan: long term
 - => loan cannot easily be sold at full value

What is the link to bank runs?

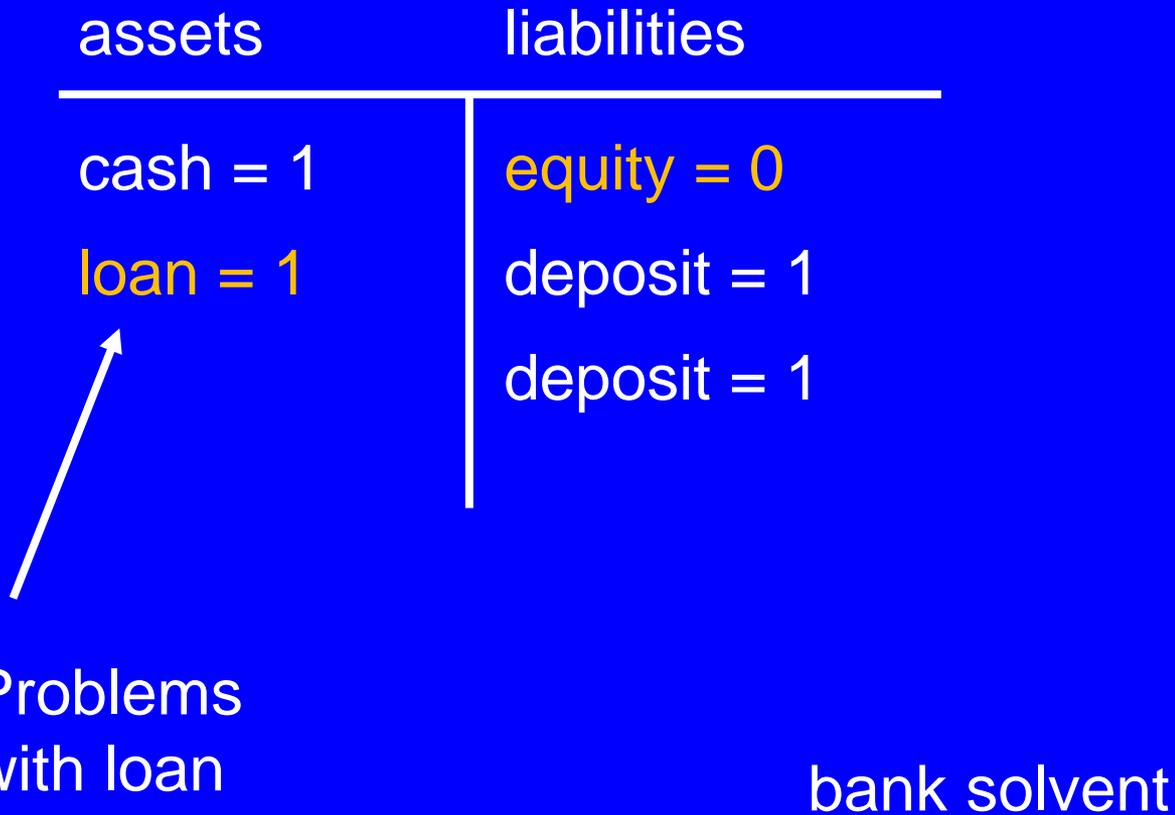
assets	liabilities
cash = 1	equity = 1
loan = 2	deposit = 1
	deposit = 1

What is the link to bank runs?

assets	liabilities
cash = 1	equity = 0
loan = 1	deposit = 1
	deposit = 1

Problems with loan

bank solvent



What is the link to bank runs?

assets	liabilities
cash = 1	equity = -1
loan = 0	deposit = 1
	deposit = 1

Only 1 unit to pay back, but 2 depositors:

Information => be the first, run

“fundamental run”

bank insolvent:
bankrupt

What is the link to bank runs?

assets	liabilities
cash = 0	equity = 0
loan = 2	deposit = 1
	deposit = 1

“small” relative to
deposits/loans

bank solvent

What is the link to bank runs?

assets	liabilities
cash = 0	equity = 0
loan = 2	deposit = 1
	deposit = 1

depositor wants to withdraw (why?)

~~bank solvent~~

bank fails despite good loan portfolio

liquidate loan at a loss to serve withdrawing depositor ("fire sale;" maturity mismatch), say loan = .9

remaining depositor loses deposit

What is the link to bank runs?

assets	liabilities
cash = 0	equity = 0
loan = 2	deposit = 1
	deposit = 1

solvent bank exposed to bank run: depositor who believes that the other depositor withdraws also wants to withdraw
 \Rightarrow depositors incur a loss on average (inefficient)

\Rightarrow solvent bank fails; “**pure panic run**”

\Rightarrow Type of coordination game shown before

<i>Player B</i>	up	down
<i>Player A</i>		
up	1, 1	0, .9
down	.9, 0	.45, .45

Bank runs relevant?

- Before 2007: history of economics
- After 2007: Northern Rock (classic queuing); Fortis; Latvia: SEB (ATMs); Spain: July 2012, 74 billion taken from savings accounts (4.5% reduction in savings balance); Jiangsu/China: March 2014

12 December 2011 Last updated at 12:11 GMT

Panic fuels Latvian run on bank

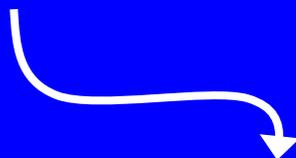


Some customers have rushed to take their money out of the bank



Bank runs relevant?

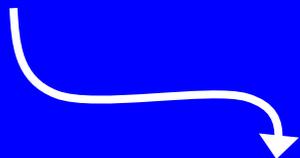
- Before 2007: history of economics
- After 2007: Northern Rock (classic queuing); Fortis; Latvia: SEB (ATMs); Spain: July 2012, 74 billion taken from savings accounts (4.5% reduction in savings balance); Jiangsu/China: March 2014



Coordination problem (panic)?
Information?
Liquidity demand correlated?
=> **Experimental identification**

Bank runs relevant?

- Before 2007: history of economics
- After 2007: Northern Rock (classic queuing); Fortis; Latvia: SEB (ATMs); Spain: July 2012, 74 billion taken from savings accounts (4.5% reduction in savings balance); Jiangsu/China: March 2014
- Deposit insurance!?

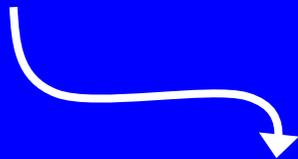


People seem to be relatively unaware of it, and about its specifics (Bartirolo 2011; Sträter et al. 2008)

Insured also run (e.g. Iyer-Puri 2012; He-Manela 2012; Karas et al., 2013; Pyle et al., 2012); trust in insurance fund?

Bank runs relevant?

- Before 2007: history of economics
- After 2007: Northern Rock (classic queuing); Fortis; Latvia: SEB (ATMs); Spain: July 2012, 74 billion taken from savings accounts (4.5% reduction in savings balance); Jiangsu/China: March 2014
- Deposit insurance!?



Deposit insurance bad for bank incentives: is it safe to reduce it, get rid of it? => **experiments to study the counterfactual**

Bank run experiments

Madies (2006): Is there a coordination problem?

=> observes coordination failure; partial deposit insurance does not help

Garratt-Keister (2009): Role of liquidity demand.

=> Find few panic runs; uncertain liquidity shocks can trigger panics; role of repeat withdrawal opportunities

Schotter-Yorulmazer (2009): Dynamics; insolvent banks.

=> observing others leads to faster runs; insiders; partial insurance works

Kiss et al. (2011/2012): Dynamics; sequential

=> observability of withdrawals reduces incentive to run for early depositors; partial insurance works

Trautmann-Vlahu (2013): Strategic defaults.

=> Uncertainty about bank quality and other borrowers leads to more coordination failure (w/o affecting equilibria)

Bank run experiments

Madies (2006), Garratt-Keister (2009), Schotter-Yorulmazer (2009), Kiss et al. (2011/2012), Trautmann-Vlahu (2013); Martin Dufwenberg's review chapter (2013), "Banking on experiments"

⇒ pure panic runs surely exist in lab

⇒ depend on banks' strength

⇒ depend on uncertainty about banks and other depositors

⇒ sequential structure important



'within bank contagion'

Contagious bank runs

2012: Spanish
banks in trouble



Do German savers run
on German banks?

information about
banks' fundamentals?

panic contagion?

remark:
stress tests

“Field evidence:”

- Great depression (Calomiris-Mason 1997; Saunders-Wilson 1996)
- Emerging markets (Iyer-Puri 2012; Iyer-Peydro 2013; De Graeve-Karas 2010)

⇒ some evidence on “contagion” for solvent banks

⇒ maybe correlated shocks across banks/ across households

⇒ if contagion, not clear which channel

⇒ in general: under what conditions does it happen?

Contagious bank runs: experiments

Our study (& Chakravarty et al. (2014)*):

Does the observation of a coordination failure (bank run) at another bank make depositors more likely to run?

Role of economic linkages between the banks?

Transmission channel (which beliefs)?

*Chakravarty, Surajeet , Fonseca, Miguel A. and Kaplan, Todd R.: "An Experiment on the Causes of Bank Run Contagions." EER

Design: coordination problem

'strong bank'

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 40
withdraw deposit	40, 0	20, 20

- same equilibria
- both banks solvent
- both banks can fail

'weak bank'

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	50, 50	0, 40
withdraw deposit	40, 0	20, 20

Design: coordination problem

‘strong bank’

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 40
withdraw deposit	40, 0	20, 20

BUT: dominance criteria suggest (keep, keep) in strong bank more robust:

$$PD = (a-b)/a$$

$$RD = \ln[(b-d)/(a-c)]$$

‘weak bank’

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	50, 50	0, 40
withdraw deposit	40, 0	20, 20

(a,a)	(d,c)
(c,d)	(b,b)

Design: coordination problem

'strong bank'

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 40
withdraw deposit	40, 0	20, 20

- If bank's type uncertain:

- beliefs about the banks' strength

- beliefs about the other player

'weak bank'

<i>Depositor B</i>	keep deposit	withdraw deposit
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keep deposit	50, 50	0, 40
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Design: coordination problem

'strong bank'

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 40
withdraw deposit	40, 0	20, 20

Note:

Interest rate known;
here *expected* return
interpretation: other
uncertain reasons for
failure included in
payoffs; uncertainty
about type only

'weak bank'

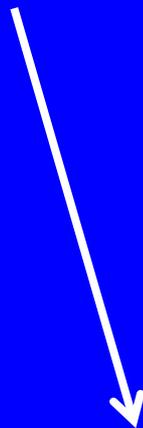
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keep deposit	50, 50	0, 40
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Design: contagion

2 types of depositors:

Leaders:

- know their bank's fundamentals (=know the game payoffs)
- do not observe others



1. no leaders ("Baseline")
2. no linkages (banks uncorrelated)
3. linkages (banks identical)

Followers:

- do not know their bank's fundamentals (uncertainty, 50-50)
- observe 1 coordination outcome of leaders

Design: Implementation Linkages

Sessions of 20 subjects

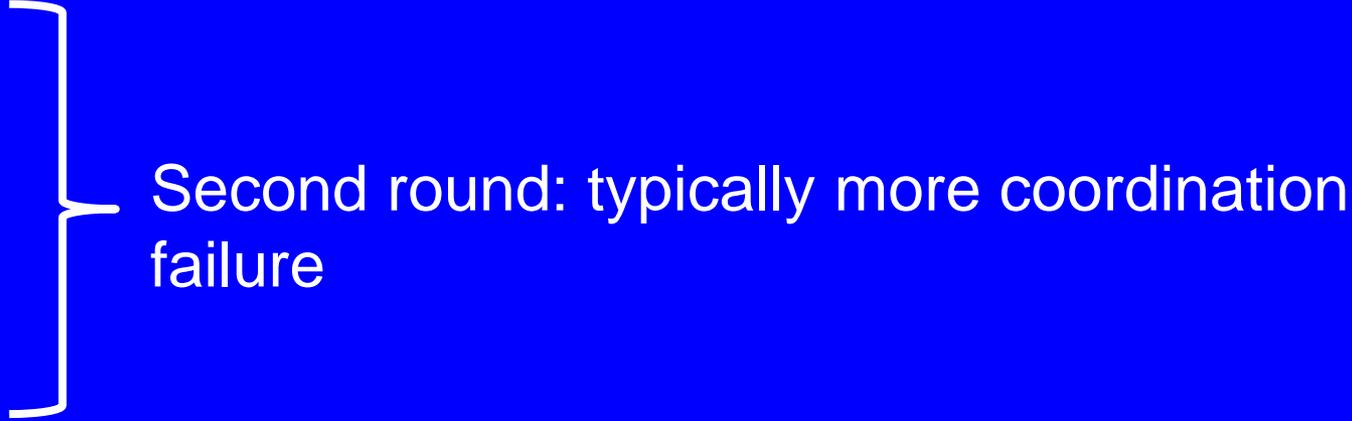
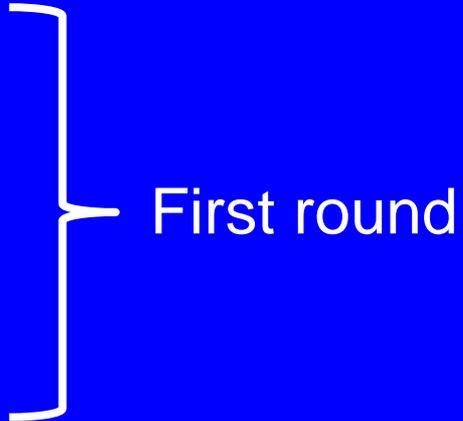
4 “Leaders”

strong bank
L1: L2

weak bank
L3: L4

weak bank
L1: L3

strong bank
L2: L4



Treatment *Linkages*, same bank fundamentals (uncertain for followers)

Design: Implementation Linkages

Sessions of 20 subjects

4 “Leaders”

strong bank
L1: L2

weak bank
L3: L4

weak bank
L1: L3

strong bank
L2: L4

info on #
withdrawals
→

→

→

→

4x4 “Followers”

(strong bank),
4 followers, group 1

(weak bank),
4 followers, group 2

(weak bank),
4 followers, group 3

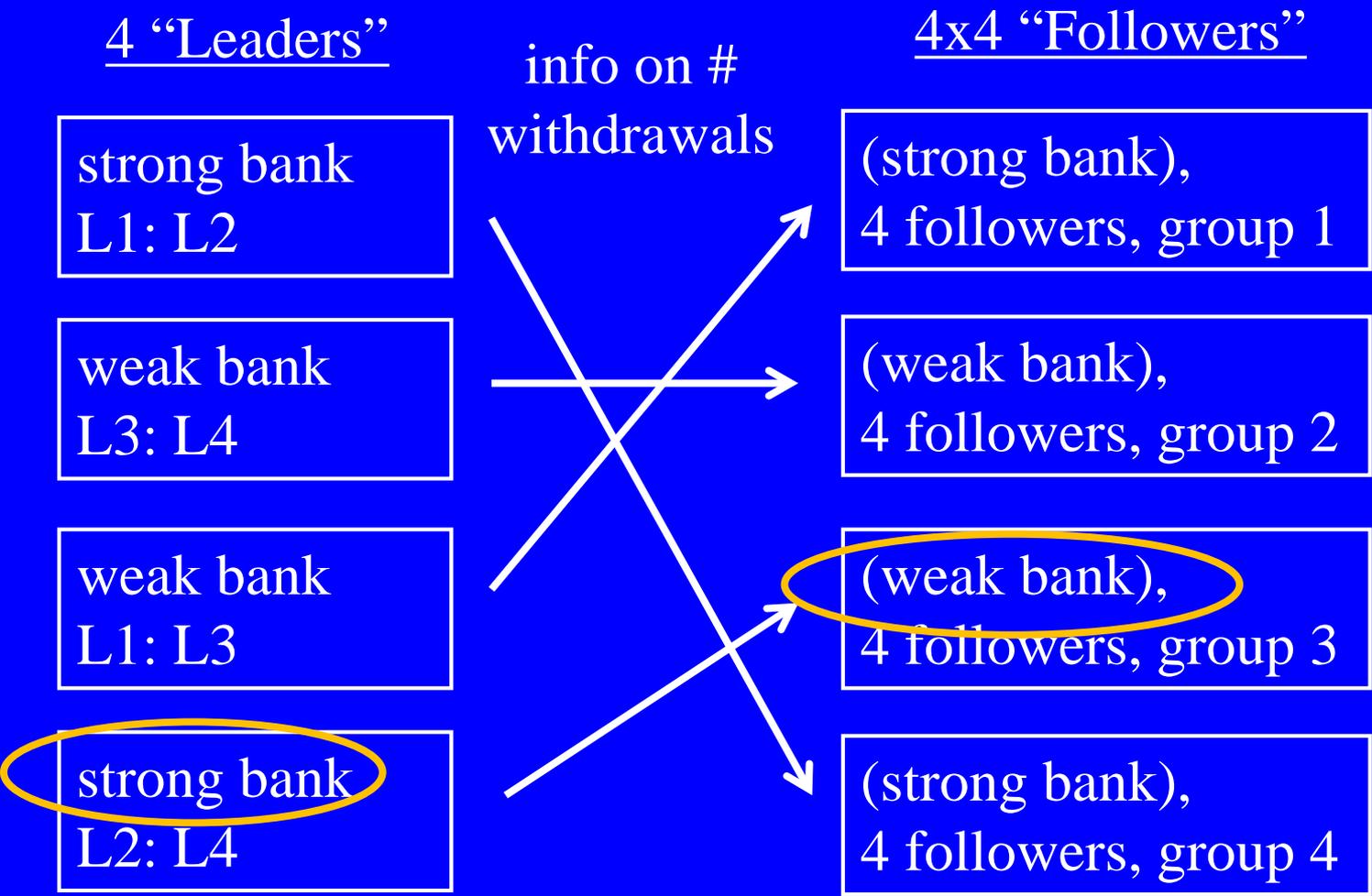
(strong bank),
4 followers, group 4

same info
for all 4
depositors

Treatment *Linkages*, same bank fundamentals (uncertain for followers)

Design: Implementation Linkages

Sessions of 20 subjects



Treatment *No-Linkages*, uncorrelated bank fundamentals (uncertain for followers)

Design: more details

=> leaders not aware of being “observed,” and followers knew that

=> followers played two rounds with the same bank, but new partner

=> measured beliefs about

- strength of bank
 - whether other player withdraws
- } - no incentives
- Likert scale which we normalize [0,1]
- on the same screen as decision

Design: more details

=> leaders not aware of being “observed,” and followers knew that

=> followers played two rounds with the same bank, but new partner

=> measured beliefs about

- strength of bank
- whether other player withdraws

=> risk attitude (loss aversion)

⇒ Treatment *Baseline*: no leaders, bank uncertain

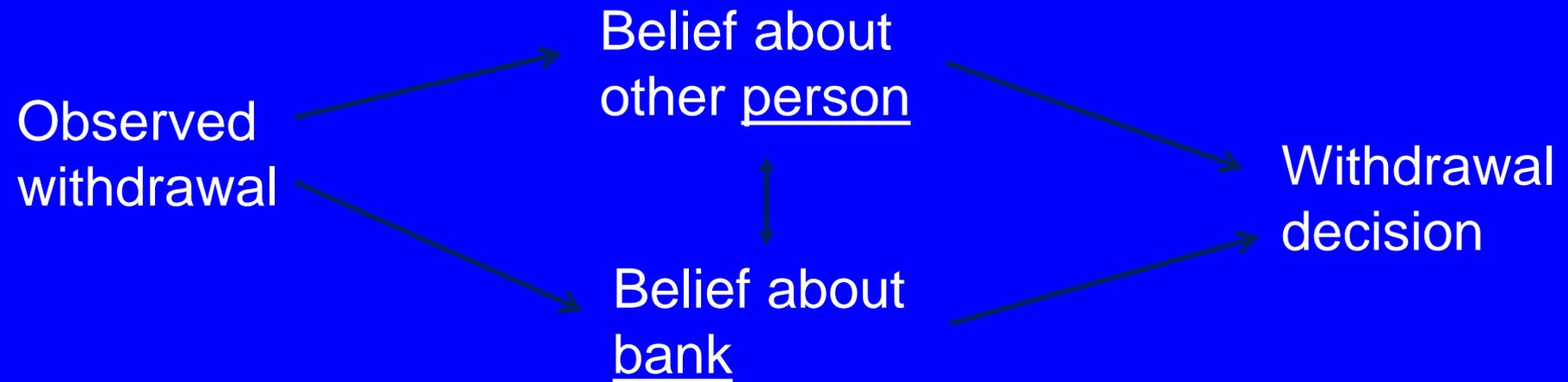
⇒ additional leaders

⇒ Between-subject design; 1 point=10c; run at CREED lab

Conditions for followers (overview):

Treatment:	Linkages	No-Linkages	Baseline
Conditions:			
Uncertainty about asset quality of their bank	Yes	Yes	Yes
Observe leaders behavior	Yes	Yes	No
Asset quality of leader-bank and follower-bank always identical	Yes	No	-

Transmission channel?



- how is each stage of the contagion channel affected by the presence of linkages?
- which belief channel is more relevant?

Transmission channel?

p : probability bank strong

q : probability other depositor withdraws

$$E[\text{payoff} \mid \text{Keep}] = (1 - q) \cdot p \cdot 60 + (1 - q) \cdot (1 - p) \cdot 50 = (1 - q)(50 + 10p)$$

$$E[\text{payoff} \mid \text{Withdraw}] = (1 - q)40 + q \cdot 20 = (2 - q) \cdot 20$$



$$E[\text{payoff} \mid \text{Withdraw}] - E[\text{payoff} \mid \text{Keep}] = 30q - (10 - 10q)p - 10$$

$$p \uparrow \Rightarrow -10 + 10q$$

$$q \uparrow \Rightarrow +30 + 10p$$

Given our parameter choices,
would expect stronger effect
of belief about others than
about bank

Results:

Results: Leaders

Bank type:	Strong bank	Weak bank
Number of leaders games:	20	20
0 withdrawals	12	7
1 withdrawal	7	11
2 withdrawals	1	2
Withdrawal frequency	23%	38%

- => Fewer withdrawals for strong banks, but low overall rate of withdrawal (solvent banks!); ‘contrast effect’
- => Variation in observed # of withdrawals (leaders’ main role: create observation for followers)

Results: Leaders

	Bank type:	Strong bank	Weak bank
	Number of leaders games:	20	20
0 withdrawals		12	7
1 withdrawal		7	11
2 withdrawals		1	2
Withdrawal frequency		23%	38%

in the analyses of followers we pool 1 and 2 withdrawals. All effects are in fact monotonic, but too small sample size with 2 withdrawals:

no withdrawal vs. withdrawals

Results: Followers

Treatment	Baseline
Observed withdrawal by leaders	
Withdrawal frequency	23%
Belief other withdraw	0.31
Belief bank strong	0.55
Observations	n=60

$$\text{SEV}(\text{keep}) = .55 * (.69 * 60) + .45 * (.69 * 50) = 38.30$$

$$\text{SEV}(\text{run}) = .69 * 40 + .31 * 20 = 33.80$$

Results: Followers

Treatment	No-Linkages			Baseline
	Yes	No		
Observed withdrawal by leaders				
Withdrawal frequency	21%	16%		23%
Belief other withdraw				0.31
Belief bank strong				0.55
Observations	n=28	n=44		n=60

Results: Followers

Treatment	No-Linkages		Linkages		Baseline
	Yes	No	Yes	No	
Observed withdrawal by leaders					
Withdrawal frequency	21%	16%	52%	13%	23%
Belief other withdraw	0.43	0.38			0.31
Belief bank strong	0.56	0.56			0.55
Observations	n=28	n=44	n=48	n=24	n=60

* indicates significant difference between Linkages (Yes) and Baseline (23%) for Withdrawal frequency.

 * indicates significant difference between Linkages (No) and Baseline (23%) for Withdrawal frequency.

 ns indicates no significant difference between Linkages (Yes) and Linkages (No) for Withdrawal frequency.

Results: Followers

Treatment	No-Linkages		Linkages		Baseline
	Yes	No	Yes	No	
Observed withdrawal by leaders					
Withdrawal frequency	21%	16%	52%	13%	23%
Belief other withdraw	0.43	0.38	0.52	0.31	0.31
Belief bank strong	0.56	0.56	0.50	0.60	0.55
Observations	n=28	n=44	n=48	n=24	n=60

negative signal seems to have stronger effect (also in Chakravarty et al. 2014)

Results: Followers

Treatment	Linkages	
	Yes	No
Observed withdrawal by leaders		
Withdrawal frequency	52%	13%
Belief other withdraw	0.52	0.31
Belief bank strong	0.50	0.60
Observations	n=48	n=24

$$\text{SEV}(\text{keep}/\text{obs}>0) = .50*(.48*60) + .50*(.48*50) = 26.40$$

$$\text{SEV}(\text{run}/\text{obs}>0) = .48*40 + .52*20 = 29.60$$

$$\text{SEV}(\text{keep}/\text{obs}=0) = .60*(.69*60) + .40*(.69*50) = 38.64$$

$$\text{SEV}(\text{run}/\text{obs}=0) = .69*40 + .31*20 = 33.80$$

Results: Followers; beliefs => withdrawals

	Treatment	Baseline
Dependent variable		<i>Withdraw</i>
Leaders withdrawal		
Belief other withdraw		0.722*** [0.185]
Belief bank strong		-0.217 [0.230]
Observations		60
Socio-economic controls		Yes
R-squared		0.30
Model		OLS

Results: Followers; beliefs => withdrawals

Treatment	No-Linkages
<u>Dependent variable</u>	<i>Withdraw</i>
Leaders withdrawal	
Belief other withdraw	0.695*** [0.166]
Belief bank strong	-0.188 [0.219]
Observations	72
Socio-economic controls	Yes
R-squared	0.27
Model	OLS

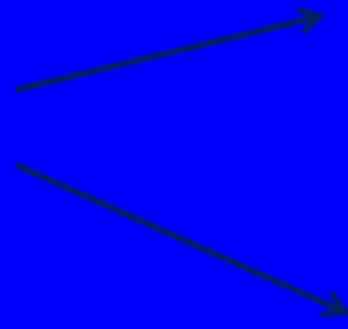
Results: Followers; beliefs => withdrawals

Treatment	Linkages		
	<i>Belief other withdraw</i>	<i>Belief bank strong</i>	<i>Withdraw</i>
Dependent variable			
Leaders withdrawal	0.223*** [0.0750]	-0.117** [0.0472]	
Belief other withdraw			1.053*** [0.132]
Belief bank strong			-0.0413 [0.203]
Observations	72	72	72
Socio-economic controls	Yes	Yes	Yes
R-squared	0.14	0.12	0.51
Model	OLS	OLS	OLS

Transmission channel

with linkage

Observed withdrawal



Belief about other person

Belief about bank



Withdrawal decision

some unexplained portion

no linkage

Observed withdrawal

Belief about other person

Belief about bank



Withdrawal decision

Chakravarty et al. (2014)

Similar setup:

- one group of “leaders” (know that there exist followers)
- one group of “followers”
- linkages vs. no linkages

But different design:

- banks’ strength evolves over time (i.e., within-bank info)
- larger groups of 10 (5 trivial), minimum effort game
- no beliefs measured

Results:

- also find contagion
- find contagion also in no-linkages condition, but weaker
- find stronger effect of bank fundamentals (for leaders & followers) => “strong bank stronger; weak bank weaker”

remark: bank fundamentals can become more relevant

‘**super** strong bank’

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	50, 40
withdraw deposit	40, 50	20, 20

unique eq.

‘weak bank’

<i>Depositor B</i>	keep deposit	withdraw deposit
<i>Depositor A</i>		
keep deposit	60, 60	0, 59
withdraw deposit	59, 0	29.5, 29.5

very likely to withdraw

back to current paper:

within-bank behavior after contagion

Depositor game of followers repeated once:

- same bank
- same (or rather: no new) info about Leaders withdrawals
- new info about first round
- different partner depositor

Question: How does direct experience amplify/buffer against observed behavior?

within-bank behavior after contagion

Treatment	Baseline	
	Yes	No
Leaders withdrawal		
Withdrawal round 1		
Withdrawal frequency	57%	24%
# obs	n=14	n=46

note: first round 23% => only negative effect of experience

within-bank behavior after contagion

Treatment	No-Linkages				Baseline	
Leaders withdrawal	Yes		No			
Withdrawal round 1	Yes	No	Yes	No	Yes	No
Withdrawal frequency	33%	18%	14%	16%	57%	24%
# obs	n=6	n=22	n=7	n=37	n=14	n=46

modest, even when compared to baseline

within-bank behavior after contagion

Treatment	Linkages				Baseline	
	Yes		No			
Leaders withdrawal						
Withdrawal round 1	Yes	No	Yes	No	Yes	No
Withdrawal frequency	68%	22%	0%	5%	57%	24%
# obs	n=25	n=23	n=3	n=21	n=14	n=46

- slight amplification (52% => 68%)
- positive experience strongly reduces withdrawals (52% => 22%)

Sum up

Experiment

- clear evidence that coordination problems can be contagious
- no contagion if effect on beliefs is not triggered by observed withdrawals
- local experience may buffer against contagious effect

Systemic risk?

- Panics and panic contagion seem reasonable options (only?) if banks “look similar”
- Lack of diversity may lead to systemic risk (Acharya (2009), Ibragimov *et al.* (2011), Wagner (2010))
- Overall strong tendency to keep deposit; requires strong belief effect to initiate run