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Panic bank runs

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HIGHLIGHTS

- We study bank runs in a sequential setting, where depositors can observe the action of others.
- Observing withdrawals leads to panic behavior and affects the beliefs that a bank run is underway.
- Panic bank runs occur in the absence of fundamental problems and coordination failures.
- Panic behavior is affected by loss aversion but not with risk or ambiguity aversion.

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ABSTRACT

We provide experimental evidence that *panic* bank runs occur in the absence of problems with fundamentals and coordination failures among depositors, the two main culprits identified in the literature. Depositors withdraw when they observe that others do so, even when theoretically they should not. Our findings suggest that panic also manifests itself in the beliefs of depositors, who overestimate the probability that a bank run is underway. Loss-aversion has a predictive power on panic behavior, while risk or ambiguity aversion do not.

1. Introduction

Bank runs have been frequently associated to problems with the fundamentals of the bank (e.g., Calomiris and Mason, 2003) or viewed as a coordination failure among depositors (e.g., Diamond and Dybvig, 1983; henceforth D&D). We consider a sequential version of the coordination problem embedded in D&D and provide experimental evidence that bank runs emerge *even* in the absence of these two problems.

In our setting, depositors observe the decision of others before deciding whether to keep their funds deposited (henceforth *to wait*) or to withdraw. Theoretically, the observability of decisions should prevent bank runs by solving the coordination problem; i.e. depositors without liquidity needs should wait in the unique equilibrium. However, our findings indicate that depositors withdraw upon observing that others do so. In such circumstances, depositors have unreasonable beliefs about the behavior of others. We refer to these runs that occur because of the observability of withdrawals as *panic* bank runs.

Our paper complements empirical (e.g. Iyer et al., 2012; Starr and Yilmaz, 2007) and experimental studies (e.g. Brown et al.,

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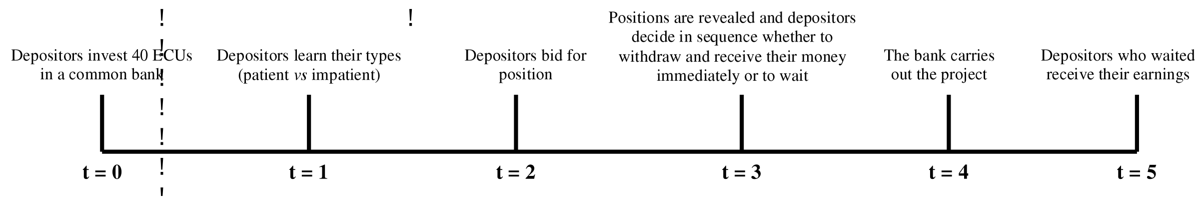

Fig. 1. Timeline of the model.

2016; Chakravarty et al., 2014; Garratt and Keister, 2009; Kiss et al., 2014; Schotter and Yorulmazer, 2009; Davis and Reilly, 2016) that highlight that observing other depositors' decisions affect withdrawal choices. Our contribution is to highlight that panic behavior can be regarded as a new source of bank runs and that observing withdrawals distorts depositors' beliefs. Besides providing clean evidence on the *existence* of panic bank runs, we find that loss-aversion is related with such *panic behavior*.

2. Theoretical framework

2.1. Depositors' types, actions and order of decisions

Three depositors are endowed with 60 ECUs. Depositors invest part of their endowment (40 ECUs) in a common bank that consequently has 120 ECUs. After making their investment decision, depositors realize that one of them needs the money urgently (this *impatient* depositor is going to withdraw the deposit with certainty), while the other two *patient* depositors can wait or withdraw.

Depositors contact their bank to determine the order of decisions; i.e., who will be the first, second and third depositor in making a decision. We model this as a first-price auction in which depositors bid simultaneously what part of their remaining endowment (20 ECUs) they want to spend on arriving early to the bank. These bids are intended to capture the efforts and opportunity costs of depositors to have an earlier position.

Depositors are ordered depending on their bids from depositor 1 (largest bid) to depositor 3 (smallest bid).[4] Once depositors are in the line of decisions and know their position, they choose in sequence whether to wait or withdraw. Depositors who withdraw receive their money *immediately*, while depositors who wait receive their payoff once all depositors decided. This is because the bank carries out a project as in D&D that matures only after the withdrawal decisions (see Fig. 1). Actions (but not types) are observable; i.e., if a patient depositor 2 observes a withdrawal from depositor 1 it could be due to a patient or impatient depositor, whoever arrived first to the bank (after bidding the most).[5]

2.2. Payoffs

There is no uncertainty about the payoffs, thus the bank has no fundamental problems. Depositors who withdraw immediately receive 50 ECUs if the bank has enough funds. That is, depositor 1 and 2 receive 50 ECUs for sure if they withdraw, while depositor 3 receives 20 ECUs if she withdraws after two withdrawals, but earns 50 ECUs if at least one of the predecessors waited. The bank pays 70 ECUs to the patient depositors if both of them wait. A patient depositor who waits alone receives 30 ECUs. Table 1 summarizes the payoffs (further details about the model, including a rationale for the payoffs are presented in Section A1 in the Online Appendix).

Table 1
Payoffs in the bank-run game.

Position	Withdraw	Wait	
		Accompanied	Alone
1	50		
2	50	70	30
3	50 or 20		

Note. The impatient depositor is forced to withdraw because of her liquidity needs. Patient depositors can wait or withdraw. If they wait, their payoffs depend on whether they both wait or one does.

2.3. Equilibrium

Our payoffs resemble the coordination problem in D&D. The two patient depositors earn the maximum payoff (70 ECUs) if they both coordinate and wait, but waiting alone results in 30 ECUs, thus a patient depositor in position 1 or 2 might have incentives to withdraw and immediately receive 50 ECUs.[6] We define a bank run as a situation in which at least one of the patient depositors withdraws. In our setting, sequential rationality guarantees that patient depositors wait in any Perfect Bayesian Equilibrium, regardless of their position and what they observe; i.e., the coordination problem disappears.[7] This is because withdrawal decisions are observable and any patient depositor in positions 2 or 3 waits in equilibrium if she observes a waiting. Anticipating it, a patient depositor in position 1 will wait so as to induce the other patient depositor to follow suit. As a result, rational beliefs imply that any patient depositor in position 2 who observes that depositor 1 withdraws should believe that this was the impatient depositor. Hence, a patient depositor 2 should wait in equilibrium even if she observes a withdrawal to coordinate with depositor 3.[8]

Prediction. *A patient depositor in position 2 waits regardless of what she observes. In addition, she believes that any withdrawal in position 1 is due to the impatient depositor.*

Note that our prediction implies that the order of decisions is not important to our setting (and patient and impatient depositors should bid nothing in equilibrium). This is because there is a unique equilibrium in which both patient depositors wait, so patient depositors do not have any incentives to rush. If a patient depositor 2 withdraws upon observing a withdrawal, then a bank run occurs; and this is not caused because of a fundamental problem or a coordination failure.

3. Experimental design and procedures

A total of 156 subjects participated in our computerized sessions in Spain.[9] We use the strategy method. After making sure

4 In case of ties, the order is randomly determined.

5 Theoretically, if decisions are sequential and depositors are rational, the order is not important as we detail below; that is, it does not matter whether the impatient depositor or one of the patient depositor bids more and decides first.

6 Depositor 3 has a dominant strategy (waiting) if patient. This is common to other bank run models (e.g. Green and Lin, 2003; Ennis and Keister, 2010).

7 Kiss et al. (2014) characterize the equilibrium when depositors have partial information; i.e., not all the choices are observed.

8 For more details, see Section A1 in the Online Appendix.

9 Three sessions were run at LaTEX (Alicante) and two sessions at LINEEX (Valencia). Having detected no significant differences across locations, we pooled the

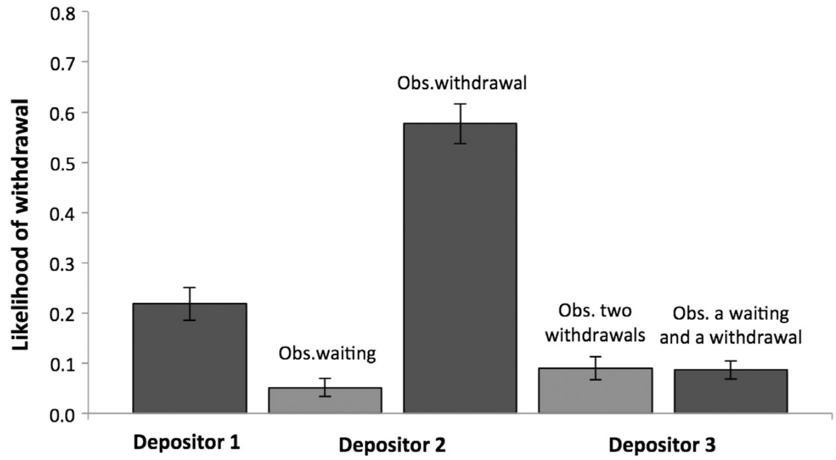

Fig. 2. Likelihood of withdrawal in each possible information setting ($N = 156$).

that subjects understand how payoffs are generated, we explain to them that they will be randomly assigned a group of three at the end of the session and that in each group one of the subjects will be randomly assigned the role of impatient depositor, while the other two subjects will play as patient depositors. Decisions about waiting or withdrawing will be made in sequence, thus subjects had to make a bid in the role of patient and impatient depositors (this will determine their position in the sequence). After submitting their bids, subjects decided what to do as patient depositors in each possible information set; i.e., subjects had to choose whether to wait or withdraw as patient depositors in position 1, in position 2 after observing a waiting/withdrawal, and in position 3 after observing a waiting and a withdrawal or two withdrawals.[10] We also asked subjects whether they believed that a withdrawal in position 1 was more likely due to the impatient, the patient depositor or to any of the types with the same probability.[11,12]

At the end of the experiment, we form groups of three and assign the roles of patient and impatient depositors at random. We use the bids to determine the order of play, and pay participants depending on their strategy. For example, if the impatient depositor has the largest bid in the group, she will be depositor 1. Depositor 2 will be the one with the second largest bid, and we use her strategy for the case in which she observes a withdrawal for depositor 1.

We also elicit risk preferences, loss aversion and ambiguity aversion and collect information on gender, age, income and cognitive abilities. Personality traits are measured using the Big-5 and the Social Value Orientation (SVO). Section A2 in the Online Appendix contains the details on the elicitation procedures. The experiment lasted approximately 1 h. The average earnings were 10.5 Euros.

4. Results

While subjects should bid nothing to contact the bank, we find that subjects bid on average 7.39 ECUs. This is in line with the finding that subjects overbid in first-price auctions. Importantly, the Wilcoxon test suggests no difference between the bids of patient (7.53 ECUs) and impatient (7.25 ECUs) depositors ($p = 0.408$). This, in turn, implies that the order of decisions (i.e., the position of the impatient depositor) does not create different incentives for patient and impatient depositors in our setting, as predicted by our model.

Fig. 2 displays the likelihood of withdrawal for patient depositors in each position. Contrary to the theoretical prediction that depositor 2 waits regardless of what she observes we find that depositor 2 is far more likely to withdraw when a withdrawal is observed (57.7% *vs.* 5.1%, $p < 0.001$, Wilcoxon signed-rank test). We interpret this as evidence of panic behavior.[13]

Result 1. Depositor 2 withdraws when she observes withdrawals.

In the unique equilibrium, depositor 2 should believe that withdrawals in position 1 are always due to the impatient depositor (see "Rational beliefs" in Table 2). However, only 34.52% of subjects have such belief (see "Elicited beliefs" in Table 2).[14] To further illustrate that depositor 2 has distorted beliefs about the behavior of the other patient depositor, we rely on our experimental data. Fig. 1 shows that depositor 1 withdraws 20% of the times if patient, what may suggest that depositor 1 is pessimistic about the behavior of subsequent depositors. We form all the possible banks with 3 depositors and use the bids of subjects to determine the order of decisions. Given the bids, 26.87% of the withdrawals in position 1 would be due to patient depositor (see the last column of Table 2). Statistically, patient depositors in position 2 overestimate the likelihood that patient depositors withdraw in position 1 ($p < 0.001$, test of proportion). The result holds also if we split those who replied that "the withdrawal was due to any of the two types with the same probability" (47.68%) into two groups and update the likelihood that the withdrawal is due to the impatient depositor to be 58.36% ($p = 0.019$).[15,16]

results. Section A4 in the Online Appendix contains a translated version of the instructions.

10 When observing a waiting and a withdrawal, we asked subjects what they would do if depositor 1 waited and depositor 2 withdrew and the other way around. In line with the theoretical prediction, depositor 3 does not react differently to this information (0.090 vs. 0.083, $p = 0.808$), thus we pool the results ("Obs. a waiting and a withdrawal").

11 Beliefs were only elicited at LINEEX ($N = 84$ participants).

12 Note that we needed the bidding stage before the withdrawal decisions so that the sequence of decisions is endogenous. Without it, the order should have been imposed exogenously, but then beliefs would obviously reflect the exogenous line-formation mechanism.

13 Fig. 1 reveals also that depositor 3 withdraws roughly 10% of the times. Because depositor 3 has a dominant strategy, this can be considered as noise or irrational behavior.

14 Depositors are less likely to withdraw when they believe that the withdrawal was due to the impatient depositor, but differences across groups are not statistically significant according to the Wilcoxon rank-sum test ($p > 0.129$).

15 See Section A3 in the Online Appendix for further evidence that depositor 2 does not have rational beliefs about the behavior of other patient depositors.

16 In Section A3 of the Online Appendix we also show that if a depositor believed that other depositors behave as she does as depositor 1, then she should assign 86.54% probability to the case that am observed withdrawal in position 1 is due to the impatient depositor.

Table 2
Beliefs of depositor 2 when depositor 1 withdraws.

	Rational beliefs	Elicited beliefs	Observed (simulations)
The withdrawal is due to the…			
…impatient depositor	100%	34.52%	73.13%
…patient depositor	0%	17.86%	26.87%
…any of the two types with the same probability	0%	47.68%	

Table 3
Marginal effects for withdrawal decisions upon observing a withdrawal in position 2: probit regression.

	(1)	(2)
Risk aversion	−0.115	−0.132
	(0.079)	(0.094)
Loss aversion	0.200**	0.199**
	(0.091)	(0.091)
Ambiguity aversion	0.0002	0.00002
	(0.002)	(0.002)
Age	−0.005***	−0.014***
	(0.003)	(0.004)
Female	−0.004	0.020
	(0.110)	(0.127)
Cognitive abilities	0.033	0.028
	(0.041)	(0.048)
Income (= 1 if above median)	0.051	0.048
	(0.076)	(0.067)
Big-5	No	Yes
SVO	No	Yes
Obs. probability	0.577	0.583
Observations	144	143

Robust standard errors in parentheses clustered at the session level.
** $p < 0.05$.
*** $p < 0.01$.

Result 2. Depositors overestimate the likelihood that a withdrawal in position 1 is due to the patient depositor.

While there are no fundamental problems and depositors should coordinate successfully in our setting, we find that (i) depositor 2 withdraws upon observing a withdrawal, and (ii) they overestimate the likelihood that other patient depositor withdraws, compared with the theoretical prediction and the experimental data. These two findings support the idea of *panic* bank runs.[17]

Next, we use a probit specification and find that more loss averse/younger subjects in position 2 are more likely to withdraw when they observe withdrawals, *ceteris paribus* (see Table 3). These results reinforce the findings in Trautmann and Vlahu (2013) on the explanatory power of loss aversion in a bank run context and suggest that more attention should be devoted to the study of loss aversion during bank runs episodes.

5. Conclusion

While traditional explanations for the occurrence of bank runs are based on fundamentals and coordination problems, we highlight that *panic* bank runs may occur as well. Policies devised to avoid bank runs, such as the deposit insurance or suspension of convertibility, must take into account this possibility.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.econlet.2017.11.014.

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17 In their theoretical paper, Chen and Hasan (2008) refer to panic bank runs as those that occur by changes in depositors' expectations of the bank-specific information process, thus they do not consider the observability of actions as a possible source of ban runs.