Journal of Economic Behavior & Organization 71 (2009) 300–317

Contents lists available at ScienceDirect

Journal of Economic Behavior & Organization

journal homepage: www.elsevier.com/locate/jebo

Bank runs as coordination failures: An experimental study☆

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ARTICLE INFO

Article history:
Received 13 October 2006
Received in revised form 13 March 2009
Accepted 16 March 2009
Available online 26 March 2009

JEL classification:
C92
G21
C72

Keywords:
Experimental coordination games
Banking panics
Bayesian updating
Demand deposits

ABSTRACT

We use experimental methods to investigate what factors contribute to breakdowns in coordination among a bank's depositors. Subjects in our experiment decide whether to leave their money deposited in a bank or withdraw it early; a bank run occurs when there are too many early withdrawals. We explore the effects of adding uncertainty about fundamental withdrawal demand and of changing the number of opportunities subjects have to withdraw. Our results show that (i) bank runs are rare when fundamental withdrawal demand is known but occur frequently when it is stochastic, and (ii) subjects are more likely to withdraw when given multiple opportunities to do so than when presented with a single decision. For the multiple-opportunity case, we evaluate individual withdrawal decisions according to a set of simple cutoff rules. We find that the cutoff rule corresponding to the payoff-dominant equilibrium of the game, which involves Bayesian updating of probabilities, explains subject behavior better than other rules.

1. Introduction

Bank runs are an important economic phenomenon. They were frequent events in the United States before the mid-1930s and have occurred more recently in a wide range of countries. A widespread run in Argentina, for example, resulted in the temporary closure of the banking system in 2001. The banking system in Russia experienced a partial run in the summer of 2004. The September 2007 run on Northern Rock in the U.K. lead to its rescue by the Bank of England and eventual nationalization. Observers have also described some events in modern financial markets as being fundamentally similar to a run on a bank; the collapse of the U.S. investment bank Bear Stearns in March 2008 is one of several recent examples.

A sizable theoretical literature has attempted to shed light on the underlying cause of these runs. One of the leading explanations that has been offered is that a run results from a coordination failure. The seminal paper of Diamond and Dybvig (1983) showed how the game played by a bank's depositors naturally has multiple equilibria. In one equilibrium, the level of withdrawal demand is "normal" and depositors withdraw their funds only if they need to. In the other equilibrium,

☆ We thank the staff of the CASSEL experimental laboratory for the use of their facility and for their assistance in running the experiments. We acknowledge the programming work of Raj Advani. We are also grateful to Kelly Bedard, Ted Bergstrom, Gary Charness, Sangeeta Pratap, Jon Sonstelie, participants at the 2004 Experimental and Behavioral Economics Workshop in Calgary and the 2005 World Congress of the Econometric Society in London, as well as the co-editor and two anonymous referees for helpful comments and suggestions. This work was funded by UC-MEXUS-Conacyt grant No. CN-02-77, and was completed while Keister was at the Instituto Tecnológico Autónomo de México (ITAM), whose support is gratefully acknowledged. The views expressed herein are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.

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0167-2681/$ – see front matter. Published by Elsevier B.V.
doi:10.1016/j.jebo.2009.03.009

however, all depositors rush to withdraw because they fear the bank will run out of funds. These actions cause the bank to fail, fulfilling the original beliefs. A bank run can then be interpreted as a switch from the good equilibrium to the bad one.[1]

We use experimental methods to test the extent to which breakdowns in coordination can lead to bank runs. Our goal is to determine the plausibility of this explanation in a laboratory setting, as well as to investigate what factors make failures in coordination more or less likely to occur in this context. The subjects in our experiment play the role of depositors in a bank; each chooses between withdrawing her money early and waiting to withdraw. We begin with a pure coordination game in the spirit of Diamond and Dybvig (1983). If everyone waits to withdraw, they will each receive their initial deposit plus a profit. However, if too many subjects withdraw early, the bank will run out of funds and all remaining depositors will receive nothing. The experiment is designed so that the bank can absorb a certain number of early withdrawals before it becomes unable to meet its obligations to the remaining depositors. We then explore variations of the model that involve randomly forcing some subjects to withdraw and changing the number of opportunities subjects have to withdraw.

The possibility that some subjects will be forced to withdraw is intended as a proxy for macroeconomic conditions; in bad times, more depositors need to withdraw funds from their banks, which places a "squeeze" on the amount of liquidity available to meet further withdrawals. Models with a random number of forced withdrawals have been studied extensively in the theoretical literature (see Wallace, 1988, Green and Lin, 2003, and Peck and Shell, 2003). However, the theory does not offer any guidance as to whether or not depositors would behave differently in this situation since the set of equilibria is qualitatively similar (both a "run" and a "no-run" equilibrium exist) with and without random forced withdrawals. Our interest is in whether the existence of these shocks, which involve aggregate uncertainty, makes coordination failure more likely.

The answer turns out to be tightly linked to our second treatment variable: the number of opportunities subjects have to withdraw. In half of our experimental sessions, subjects played a simultaneous-move coordination game. Each subject decided whether to withdraw early or to wait, and then the game ended and payoffs were assigned. In the other half of the sessions, however, we gave subjects three opportunities to withdraw before the game ended, informing them of the total number of withdrawals after each opportunity. This treatment gave subjects the option of waiting and observing some information about the actions of others and the aggregate shock before making a final decision. The information they received this way was partial since they were not told if an observed withdrawal was forced or voluntary. It was also not costless since the bank could run out of funds while they waited if too many other subjects withdrew early. This treatment adds a realistic feature of banking: depositors have a period of time during which they can choose to withdraw their funds, and they are able to observe some information about the actions of other depositors, for example, by noticing if a line is forming outside the bank. They cannot, however, observe the reason why another depositor is withdrawing (whether she "needs" to withdraw or is panicking); motives for withdrawing are private information.

The theory is silent on how both of our treatment variables should affect play as the set of equilibria is qualitatively similar under any combination of the number of withdrawal opportunities (multiple or single) and the presence or absence of forced withdrawals. However, our empirical findings are unambiguous. In the absence of forced withdrawals, voluntary withdrawals are rare and subjects effectively coordinate on the no-run outcome. Adding forced withdrawals has a positive, but small, initial effect on voluntary withdrawal rates regardless of the number of withdrawal opportunities. Over time, the interaction of forced withdrawals and multiple withdrawal opportunities leads to high withdrawal rates and almost total bank failures, something that does not happen with forced withdrawals alone.

The difference in the occurrence of bank failures across treatments is traced to differences in subjects' reactions to their exposure to bank runs across treatments. With forced withdrawals, some bank runs occur even when voluntary withdrawal rates are low. Occasionally, an unfortunate combination of a high realization of the number of forced withdrawals and, possibly, a few voluntary withdrawals depletes the bank's assets. In the treatment with a single withdrawal opportunity, exposure to such a bank run has a limited effect on future withdrawal behavior. As a result, the total number of bank runs observed over time is low and relatively constant. In the treatment with multiple withdrawal opportunities, on the other hand, exposure to a bank run has a "snowballing" effect that leads to future bank failures. These results show that bank runs are more likely to occur in environments where (i) there is significant uncertainty about fundamental withdrawal demand and (ii) depositors receive information about the behavior of other depositors while there is still time to withdraw.[2]

In order to understand the forces generating the observed group outcomes in the treatment with multiple withdrawal opportunities better, we evaluate individual withdrawal decisions according to various simple cutoff rules. Interestingly, we find that the cutoff rule corresponding to the payoff-dominant equilibrium of the game, which involves Bayesian updating

[1] There is a sizable literature based on the Diamond–Dybvig model. See, for example, Wallace (1988, 1990), Cooper and Ross (1998), Green and Lin (2003), Peck and Shell (2003) and Ennis and Keister (2006, forthcoming). Another explanation of bank runs is based on the release of negative information about the value of the portfolio of an individual bank or of the entire banking system (see, for example, Gorton, 1988, and Saunders and Wilson, 1996). It is unclear which of these explanations is better supported by historical data (see Ennis, 2003). Hence, investigating the plausibility of the coordination failure explanation in the laboratory is an important exercise.

[2] This finding is loosely connected to the theoretical work of Gale (1995), which studies a dynamic game in which players decide when to make an investment. In Gale's setting, the coordination problem vanishes as the period length shrinks to zero. This resembles our finding that groups experience a lower run frequency in the treatment with a single withdrawal opportunity.