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# Herding and bank runs

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**Abstract**

Traditional models of bank runs do not allow for herding effects, because in these models withdrawal decisions are assumed to be made simultaneously. I extend the banking model to allow a depositor to choose his withdrawal time. When he withdraws depends on his consumption type (patient or impatient), his private, noisy signal about the quality of the bank's portfolio, and the withdrawal histories of the other depositors. Some of these runs are efficient in that the bank is liquidated before the portfolio worsens. Others are not efficient; these are cases in which the herd is misled.
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## 1. Introduction

In the classic bank runs model of Diamond and Dybvig [13], individual withdrawal decisions are made simultaneously. The lack of detailed dynamics of withdrawals makes it difficult to explain some observed features of bank runs. In reality, at least some withdrawals are based

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on the information about the previous withdrawals of others.[2] During the 1994–1995 Argentine banking crisis, large depositors were responsible for most of the deposit outflows at the beginning of the crisis. Small depositors began to make substantial withdrawals two months later.[3] In their analysis on the runs on Turkish special finance houses (SFHs)[4] in 2001, Starr and Yilmaz [24, p. 1114] find that depositors made sequential withdrawals influenced by the history of the withdrawals of others. The authors argue that the "increased withdrawals by moderate-size account holders tended to boost withdrawals by [their] small counterparts, suggesting that the latter viewed the former as informative with respect to the SFH's financial condition."

In the present paper, I build a model in which the timing of individual withdrawals is determined by the depositor's consumption type (*patient*, which means he does not need to consume early, or *impatient*, which means he needs to consume early), his noisy signal about the quality of the bank's portfolio, and the withdrawal history of other depositors. The signals are received in an exogenously determined sequence, but the timing of withdrawal is determined endogenously.[5] Because a depositor's simple withdraw-or-not action does not reveal perfectly to others the pair of private signals that he receives, other depositors can only imperfectly extract the depositor's private signals from his action. They update their beliefs about the quality of the bank's portfolio accordingly.

This paper does not focus on the panic-based bank runs of Diamond and Dybvig [13].[6] (See also Peck and Shell [22].) I focus instead on bank runs that occur as a result of depositors trying to extract information about bank portfolio quality from the withdrawal histories of others. Because signals about the fundamentals are imperfect, and because signal extraction from the observed withdrawal history is also imperfect, a bank run can occur when the bank fundamentals are strong. In particular, it can occur when "too many" depositors receive early liquidity shocks. A bank run due to imperfect signal extraction only occurs in a setting with non-simultaneous withdrawal decisions. Bank runs in this sense are not purely fundamental-based.[7,8]

I show that there is a perfect Bayesian equilibrium in which a depositor withdraws if his expected utility is below his threshold level, and otherwise he waits. A depositor's expected utility depends upon his beliefs about the quality of the bank's portfolio. These beliefs are updated recursively by the observed withdrawal history of the other depositors. If a depositor's beliefs are in an intermediate range, he follows his private signals: He withdraws if he is impatient or the portfolio signal is unfavorable; he waits otherwise. A bank run occurs as a result of a herd of withdrawals when all depositors withdraw due to unfavorable signals and/or unfavorable observations on withdrawals. If a depositor's belief becomes sufficiently favorable, the private signal

[2] Brunnermeier [5, p. 214] says that "Although withdrawals by deposit holders occur sequentially in reality, the literature typically models bank runs as a simultaneous move game."

[3] See Schumacher [23].

[4] Special finance houses are like commercial banks, but their deposits are not insured.

[5] Chamley and Gale [8] and Gul and Lundholm [19] were the first to introduce models of herding in investment decisions with endogenous timing. Such a setup has not been applied to the bank deposit game, where payoff externality is important.

[6] The view of panic-based runs argues that the bank and bank runs are inherently intertwined because bank contracts provide short-term liquidity, whereas the portfolio matures only in the long term.

[7] The view on fundamental-based bank runs argues that bank runs are driven by deteriorating economic fundamentals, such as a decline in the bank's portfolio returns. See Allen and Gale [1,2], Gorton [15], and Calomiris and Gorton [7], among others, for theoretic models and empirical evidence on fundamental-based runs.

[8] Goldstein and Pauzner [14] construct a model in which depositors receive i.i.d. signals on fundamentals and determine whether to run on the bank simultaneously.

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