A LITERATURE REVIEW FOR EXPERIMENTAL STUDIES OF BANK RUNS

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Abstract

With the bank runs experienced in different western countries during and after the 2007-2008 global financial crisis, bank run phenomena can be seen as the awakening of a ghost in financial markets, which is a definite call for research for the fundamental factors that derive bank runs. Prior to the global financial crisis there were only two experimental researches of bank runs. Parallel with the experimental methods being popular in finance and the latest global financial crisis, the number of papers in the field has risen sharply. This paper reviews the state of art for the experimental researches of bank runs. The results of the literature review indicate that some papers are approaching to the issue in a more individual level by taking into account psychological factors, while other papers are mostly interested in macro impacts of bank runs, such as contagion effects.

Keywords*: Bank Runs, Depositor Game, Experimental Finance, Game Theory, Financial Crises*

BANKA HÜCUMLARINA İLİŞKİN DENEYSEL ÇALIŞMALARA AİT BİR LİTERATÜR TARAMASI

Öz

2007-2008 küresel finansal krizi boyunca ve sonrasında farklı batı ülkelerinde yaşanan ve eski hayaletin uyanması olarak da değerlendirilebilen banka hücumlarının görülmesi ile bu banka hücumlarının oluşumu ve bunları etkileyen temel faktörler için yapılan çalışmalara duyulan ihtiyaç artmıştır. Küresel finansal krizden önce, banka hücumları hakkında sadece iki adet deneysel araştırma vardı. Bankacılık ve finans alanında deneysel yöntemlerin popülerleşmesi ve son küresel finansal krizin sonucu olarak bu alandaki makale sayısı son on yılda hızla artmıştır. Bu makale, banka hücumları ile ilgili deneysel araştırmaları analiz ederek bu alana ilişkin bir literatür taraması yapmaktadır. Literatür taramasının sonuçları, iki yol ayrımını ortaya koymaktadır. Literatürdeki çalışmaların bir kolu, psikolojik faktörler dikkate alınarak konuya daha bireysel bir düzeyde yaklaşırken, diğer makaleler çoğunlukla bulaşıcılık etkileri gibi banka faaliyetlerinin makro etkileriyle ilgilenmektedirler.

Anahtar Kelimeler*: Banka Hücumları, Mevduat Oyunu, Deneysel Finans, Oyun Teorisi, Finansal Krizler*

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1. Introduction

The banking industry might be considered as one of the most important industries in an economy and has great importance for macroeconomic stability. Leaven and Valencia (2020) states that 151 banking crises are experienced around the world from 1970 to 2017, and the burden of these crises is not negligible. Therefore a well operating banking system signals the soundness of an economy and it may not be possible to achieve economic growth and stability with a poorly managed banking industry. Poorly managed banks can bring crises since the failure of a bank may trigger runs for other banks, causing a negative thoughts about the liquidity of the banking system, resultantly the run on a single bank might lead to a banking and/or financial crisis. Thus banking sector can be said to have a crucial role in the flow of money in the real and financial economy.

At this point the reader should notice that the terms bank run and banking crisis are closely related but different phenomena. Although nowadays rare, countries experienced many severe banking panics in history. Gilbert (1988) defines the term bank run as "*a panic environment that depositors suddenly withdraw currency from their accounts because of concern about the safety of their deposits since they expect the bank to fail.*" The unexpected withdrawals can make a bank to sell its assets at a loss and eventually to fail. The world history witnessed 16 bank runs within the last 2 decades. In 1999, Malaysia experienced one in which US$4.49 billion has withdrawn. Argentine economy witnessed a bank run while the economic crisis of 1999 and 2002 was going on. This run spread to Uruguay during the 2002 Uruguay banking crisis and caused further bank runs. In 2007 £2 billion GBP was withdrawn within 4 days from Northern Rock run in UK. The last bank run in World history was experienced very recently on May 13, 2019 to Metrobank, in London. This last run was a result of a rumor that was spread over WhatsApp.[2]

The reasons of bank runs can be classified in two groups. In the first class, bank runs are evaluated as random events which are caused by panic environment as the seminal paper of Diamond and Dybvig (1983) modeled. Second group stresses that these runs have informational basis, which depends on business cycles. During a panic environment even sound and liquid banks can fail depending on the severity of rumors and panic. Moreover bank runs are believed to be contagious. Diamond and Dybvig (1983) implies that the deposit insurance make banks more sound to runs. In addition to insurance, suspension of convertibility and state guarantee can also be useful tools to prevent and mitigate bank runs.

Before the experimental finance become this much popular, there were only four papers on bank runs that use experimental methods ten years ago (Madies, 2006; Klos and Sträter, 2008; Garratt and Keister, 2009; Schotter and Yorulmazer, 2009) As of today the number of papers especially those are published in prestigious journals are rising day by day.[3] The aim of this paper is to evaluate the state of art

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[2] *Visit en.wikipedia.org/wiki/List_of_bank_runs for more information on the history of bank runs around the World.*

[3] *See Kiss, Rodriguez-Lara, Rosa-Garcia (2016); (2018); Dijk (2017); Peia and Vranceanu (2019); Arifovic and Jiang (2019); Shakina (2019).*

for the researches of bank runs that use experimental methods. Prior to our research, Heinemann (2012) provides a literature review for experimental studies of financial crises. Since bank runs are considered as a part of financial crises, Heinemann (2012) reviews the results of experimental papers of bank runs. In addition to Heinemann (2012), Dufwenberg (2015) draws the roadmap for future papers. However the literature witnessed many new papers within a four-year period, which can be interpreted as a call for a new roadmap.

The rest of the paper is structured as follows: section two introduces a typical bank run game both in simultaneous and sequential forms. The next section shortly discusses the experimental studies that include coordination problems. The following section provides a literature review of the experimental studies on bank runs. Finally the last section concludes and detects directions for the future research papers.
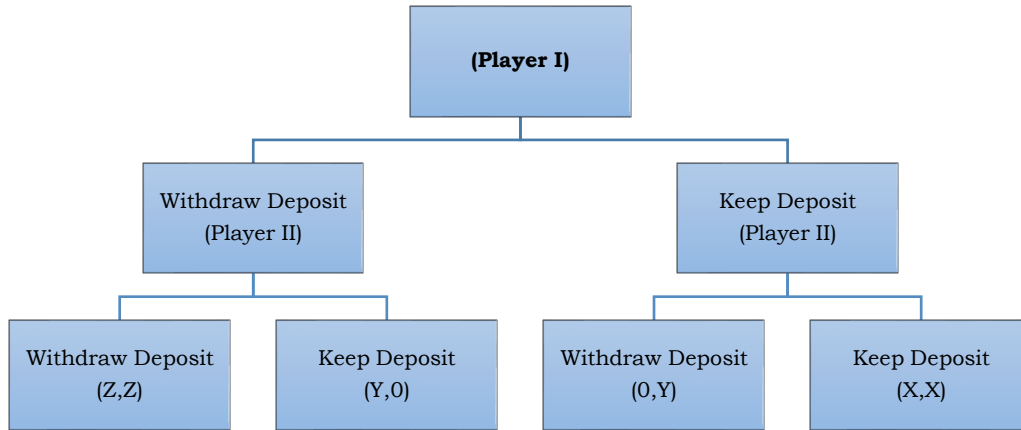
2. Bank Run Games

A typical simultaneous two player bank run game is given in the Table 1 and the extensive form of the game is given in Figure 1. In this game both players (Player I and II) have two possible strategies: keep the deposit at the bank, withdraw the deposit from the bank. Four possible payoffs are available for both players where $X > Y > Z > 0$.

Table 1. Simultaneous Form of the Bank Run Game

		Column Player (Player II)	
		Keep Deposit	**Withdraw Deposit**
Row Player (Player I)	**Keep Deposit**	X, X	0, Y
	Withdraw Deposit	Y, 0	Z, Z

If both players keep their deposits at the bank they get the highest possible payoff which is X. If the Player I withdraws, while the player II does not, the player I receives Y and player II gets 0. If the Player II withdraws, while the player I does not, the player II gets Y and player I gets 0. Finally if both players withdraw their deposits from the bank they get Z.

Figure 1. Bank Run Game in Extensive Form

Since X>Y>Z and Y>0, as an example for coordination games, the bank run game has two Nash Equilibria: (1) both players withdraw their deposits, and (2) both players keep their deposits at the bank. The first equilibrium is known as the "*panic equilibrium*" in which no depositor choose keep their money in the bank. The second equilibrium where depositors coordinate on the "*payoff dominant*" or so called "*pareto optimum*" equilibrium. For bank runs, game theory does not tell which equilibrium will occur, but it just tells us that a bank run can occur. This is so even though we assume all depositors to be rational and even though a bank run makes all depositors worse off. A bank can fail in a panic environment, even though everybody knows it is solvent.

3. Coordination Failures in Experiments

As explained above, coordination games are characterized as the games with multiple pure strategy Nash equilibria and one of these equilibria may be a social optimum or so called payoff dominant equilibrium which yields higher pay off than the other pure strategy Nash equilibrium.

The concept of panic equilibrium is considered as a coordination failure. The coordination failure phenomenon is described as the failure to end up on one of the equilibria or failure to choose the socially optimum equilibrium which yields the highest payoffs for both players. The second definition of the failure is widely seen in the studies on macroeconomic coordination games[4] (Devetag and Ortmann, 2007). The bank run is interpreted as a coordination failure.

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[4] *See Duffy (2008) for detailed literature on macroeconomic experimental studies. Duffy (2008) includes a part on the experimental studies of bank runs in which Garratt and Keister (2009) and working paper version of Schotter and Yorulmazer (2009) are reviewed in a detailed manner.*

Experimental studies frequently report coordination failures. However Devetag and Ortmann (2007) argues that the coordination failures are less common than they are perceived. Focusing mainly on the order-statistic games (minimum and median games) and stag-hunt games Devetag and Ortmann (2007) analyzes the reasons of such failures in laboratory environment in two main groups:

A. Structural Factors Which Are Under the Control of the Experimenter

- Comparison of the enchantment of the maximum strategy and the risk level of the other options: the findings of the studies indicate that the lower attractiveness of the maximum strategy compared to the risky equilibrium and low deviation costs can be regarded as the factors that motivates the subjects to choose the pareto optimum.

- Order statistic and group size: a smaller group size or a less stringent order statistic means higher probability of resulting in pareto optimum solution.

- Experiences of sharing, interaction, and informational feedback: information feedbacks seem to bring higher coordination probability in "small" groups. Higher levels of communication, and common information, can be regarded as factors that motivate coordination.

B. Cognitive and behavioral reasons: subjects' perception about the payoffs, the potential effects of negative payoffs on decisions of subjects. Loss avoidance and pre-play may bring efficient solution to the problem.

4. Experimental Studies on Bank Runs

Some papers in the field focus on the microeconomic determinants of bank runs such as the effects of learning, history, depositor psychological or the effect of social environment. These papers present depositor level solutions to the problem as they approach to bank runs from the depositors' side. Another strand of literature is more policy oriented as the studies in this field are concentrated on macroeconomic/banking system level problems and solutions such as contagion of bank runs and deposit insurance. Although the literature is dominated by policy oriented papers, we observe a growing interest in psychological or social factors that derive bank runs.

At this point, we should underline the existence of an educational strand of literature on bank run experiments. This literature imposes that the bank run experiments can be used for educational purposes as Balkenborg, Kaplan, and Miller (2011) and Kassis, Hazlett, and Battisti (2012) do. These two papers explain how the experimental methods can be used in classrooms in order for students of economics to understand the role of banks as financial intermediaries and the occurence of bank runs. Balkenborg, Kaplan, and Miller (2011) explains hand run and computerized ways of teaching bank runs, by doing so Balkenborg, Kaplan, and Miller (2011) shows how seemingly irrational behaviours can be understood in a rational way. Without using hand-run experiments without a computerized environment, Kassis, Hazlett, and Battisti (2012), on the other hand, uses double auction setting to help students to understand the functioning of banks.

Psychological and Sociological Factors

Klos and Sträter (2008) investigates bank runs experimentally. Adopting global games view of bank runs they highlight the importance of the use of threshold strategies and the repayment rate in withdrawal decisions. Klos and Sträter (2008) let their subjects to get private information about the health of the banking system. More explicitly subjects withdraw their money if their signal is under a certain point and keep their deposit when the signal is bigger than the threshold. This behavior of the subjects are attributed to strategic uncertainty. Thanks to the private signal that the subjects received, the subjects make inferences about the strategies of the other players. If the banking sector is not operating efficiently, subjects expect other depositors to close their accounts early. Accordingly, it is optimal to withdraw also if the banking sector operates inefficiently. Second, they test whether higher repayment rates in the case of early withdrawals rises the certain point or not. The logic behind this hypothesis is that a higher repayment rate makes early withdrawals more likely. Another interesting result of this study is the nearly non-significant effect of learning. Subjects' thresholds are found to be stable over time which means they do not learn from the past. Madiès (2006) reports that there are subjects who choose not to withdraw their money in any circumstances. This situation is explained by social preferences. The increase in the coordination failure among individuals as the rounds go by indicates persistence of self-fulfilling runs.

Focusing on the pure coordination game structure of the problem Garratt and Keister (2009) investigates the reasons of bank runs. In their experimental setup five subjects learn the number of withdrawer players following each round of the game. This design makes subjects to wait and observe the other players' decisions. An important different characteristic of Garratt and Keister (2009)'s design is the variation in the number of withdrawal opportunities. They imply that the subjects are more likely to withdraw their money if they are given more than one chance. In the single withdrawal treatment, a bank run does not have an important effect on future withdrawal behavior. Accordingly, only a small and constant numbers of bank runs are observed. In case of having multiple withdrawal opportunities, on the other hand, occurrence of a bank run has a "*snowballing*" effect that brings higher numbers of bank failures.

The second important distinguishing property of their design is their allowance for the forced withdrawals. The other subjects are not informed about whether the randomly selected player was forced to withdraw or not. The non-forced subjects were not told whether one withdrawer "*needs*" to withdraw or is panicking. Including forced withdrawals in the scenario affects the voluntary withdrawal rates positively when we do not take the number of withdrawal opportunities into account. However this positive effect remains small in magnitude.

Arifovic, Jiang and Xu (2013) takes the effect of coordination parameter into account in coordination failures. Assuming the fundamental bank variables fixed, the coordination parameter is the only thing that varies in their experiments they were able to test the effect of coordination parameter on bank runs. Kiss, Rodriguez-Lara and Rosa-Garcia (2014) introduces the social networks into the Diamond and

Dybvig (1983)'s model. In its three player model Kiss, Rodriguez-Lara and Rosa-Garcia (2014) uses a sequential procedure rather than a simultaneous framework to examine the bank runs. Its 48 subjects come from Universidad de Alicante.

Dijk (2017) takes the emotional situations of the individuals into account while examining the bank runs experimentally. The 122 subjects that Dijk (2017) are paid with respect to their performance in the bank run game. Before running the experiment Dijk (2017) conducts a survey in order to determine the emotional state of the subjects, i.e. fear, happiness, baseline and sadness. Moreover, in each round of the experiment, the subjects are also asked about their opinion about the action of the other player. Therefore Dijk (2017) also contributes to the literature about reciprocity.

Kiss, Rodriguez-Lara and Rosa-Garcia (2018) applies Diamond and Dybvig (1983)'s model in an experimental setting with 156 subjects from Spain. Kiss, Rodriguez-Lara and Rosa-Garcia (2018) underlines that bank runs can occur as a consequence of panic behavior of investors even if there is no fundamental and coordination problems.

Policy Oriented Literature of Bank Runs

Shotter and Yorulmazer (2009) is one of the most popular and pioneer papers in the experimental literature of bank runs. In Schotter and Yorulmazer (2009)'s setup, a run will definitely occur if the bank is not able to pay its liabilities. Schotter and Yorulmazer (2009) is firstly interested in the speed of withdrawal of the deposits once a crisis occurred and secondly in the effectiveness degree of policies related to informational problems and deposit insurance. They investigate the effect of certain information, such as information about the secureness of payments to depositors in case of panic. Briefly, they investigate the effect of asymmetric information. In their experimental setting, some players are "*insiders*" who are given information about the liquidity of the bank as the other players are not. In these asymmetric-information experiments the authors observe that the observation of bank run is delayed, when insiders are introduced in the experimental setting.

It is widely accepted that deposit insurance is an important policy tool to prevent bank runs and to reduce the damage that is created by the panic environment. At this point it should be noticed that there exists a literature on the negative relationship between the existence of deposit insurance mechanism and likelihood of bank failure (see Wheelock, and Wilson, 1994; Demirgüç-Kunt and Detragiache, 2002; Hoggarth, Jackson, and Nier, 2005). The common result of these studies is that the deposit insurance encourages banks to rely more heavily on deposits to finance their activities. In the case of deposit insurance banks are said to be willing to accept a lower rate of return on their deposits. This situation is known as "*moral hazard*". This literature reveals that banks that have deposit insurance were more risky and, hence, more likely to fail than their uninsured competitors. So the deposit insurance and its optimal level is an important research topic in banking literature. Following these debates, Schotter and Yorulmazer (2009) introduced a 50%, a 20% and 0% deposit insurance rates in their experimental design, that is, no player can loose more than 50%, 80% or all of their money, respectively.

Schotter and Yorulmazer (2009)'s experimental design consists of 21 rounds, which includes 20 times higher stakes in the first round compared to the remaining rounds. In many countries, bank runs are not observed or very rare events and considering the fact that some professionals are more experienced in bank runs, they wanted to test the effect of learning behavior by 20 more rounds. In the first round of the experiment the decisions of subjects were affected by the existence of partial insurance, while the subjects were not affected by the changes in interest rates in the low-information treatment.

Madiès (2006) is one of the earliest papers that studies the occurrence of the self-fulfilling banking panics in an experimental context. Presenting results about the social preferences, Madiès (2006) mainly studies panic-based runs and does not include the effects of information into its model. Madiès (2006) indicates that panics can be persistent and sometimes unavoidable. If it is the case bank runs can be easily mitigated by a deposit insurance mechanism. Therefore bank runs are considered to be easier to stop, while it is more difficult to prevent them. After the occurrence of a bank run, if subjects are given time to re-think before their final decisions, bank runs can be stopped. Contrary to Schotter and Yorulmazer (2009), another important finding of the Madiès (2006) indicates the great importance of a full deposit coverage in preventing bank runs. Moreover Madiès (2006) indicates that a partial deposit insurance even up to 75% seem to be useless. Schotter and Yorulmazer (2009) also highlights that the consistent signals received by the depositors help them coordinate on the non-panic environments. If deposit availability has been limited and a lower deposit coverage rate is valid, the severity of bank run rises.

There are several recent papers that deals about the effects deposit insurance. Kiss, Rodriguez-Lara, and Rosa-Garcia (2012) explores the effect of deposit insurance on preventing bank runs. Employing 192 students, Kiss, Rodriguez-Lara, and Rosa-Garcia (2012) underlines the importance of observability. Kiss, Rodriguez-Lara, and Rosa-Garcia (2012) implies that observability can be partially replaced by deposit insurance.

Peia and Vranceanu (2019) examines bank runs in a partial and uncertain deposit insurance scenario. The uncertainty in Peia and Vranceanu (2019)'s experiment refers to the size of the deposit insurance coverege and lack of information about the number of withdrawals.

Research questions of some papers are related to the effects of a run occured on a single bank for the other banks/banking system. A run on a single bank may cause a positive or a negative effect on the other banks. Some papers deal with the contagion effects while some papers examine how swithching from one bank to another occurs. One of the interesting papers of this literature is Brown, Trautmann, and Vlahu (2012)[5]. The contribution of this paper stems from the fact that it explores the bank run contagions in an experimental setting for the first time. Brown,

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[5] *Brown, Trautmann, and Vlahu (2017) is the published version of Brown, Trautmann, and Vlahu (2012).*

Trautmann, and Vlahu (2012) indicates strong contagion effects even if the linkages between banks are not visible, or no linkage at all. Their experimental results indicate that once withdrawals started in a bank, the other banks are also subject to deposit withdrawals.

Similar to Brown Trautmann, and Vlahu (2017) rather than examining the reasons of bank runs as coordination failures in an experimental setting, Chakravarty, Fonseca, and Kaplan (2014) tries to understand the reasons of bank run contagions. Thus Chakravarty Fonseca, and Kaplan (2014) modifies the Diamond and Dybvig (1983)'s model by adding two banks into their problem. The results of the study indicates that even if the liquidities of banks are not linked to each other's, the collapse of a bank significantly affects the other bank's default. Shakina (2019) examines the effect of switching deposits from one bank to another in case of a two bank scenario. Shakina (2019)'s results indicate that the first bank is subject to runs more intensely than the second bank. Therefore rather than withdrawing their money from the banking system entirely, the depositors choose to move their deposits from one bank to another. The originality of Shakina (2019) stems from the non-exogenous structure of panics.

5. Conclusion

This literature review reveals that the existing experimental studies on bank runs represent different aims, designs and different results. Within these studies, Klos and Sträter (2008) adopts global games approach to bank runs they stresses on the importance of the use of threshold strategies and the repayment rate in withdrawal decisions. In addition to Madies (2006), Klos and Sträter (2008), and Garratt and Keister (2009) don't deal with severity but rather focus on their existence, while Schotter and Yorulmazer (2009) deals with the factors that affect the severity of a run. In their setup, run is unavoidable since the bank is insolvent. Their interest is in how quickly deposits are taken back from the banks once a crisis occurred and in how various factors (deposit insurance and informational structure) affects its severity. With the variation in the number of withdrawal opportunities and the forced withdrawals Garratt and Keister (2009) obtains a situation closer to the real life.

On the other hand, Madies (2006), Schotter and Yorulmazer (2009), Peia and Vranceanu (2019) seem to be more policy oriented than the other papers. They present policy suggestions such as suspension of deposit convertibility and partial/full deposit insurance on preventing and mitigating the effects of runs. Most studies refer deposit insurance as an effective policy tool however they reach contradictory results on the ratio of deposit insurance.

The more recent papers written in the field underline more individual level emotional and psychological factors, such as fear, beliefs, and panics (Djik, 2017; Kiss, Rodriguez-Lara, Rosa-Garcia, 2018). While most of the papers in the literature concentrates on macro effects such as contagion of bank runs (Brown, Trautmann, and Vlahu, 2017; Chakravarty, Fonseca, and Kaplan, 2014). Taking into account the persistent and devastating effects of the recent global financial crisis and accordingly rising number of researches conducted in the field, the experimental literature of bank runs seems to grow as more research is needed in order to understand the occurrence of bank runs and their prevention methods.

Notification

In this study, the rules of publication ethics and research ethics were followed. The study was subjected to plagiarism control.

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