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Who runs first to the bank?

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Who runs first to the bank?

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Who runs first to the bank?

Hubert János Kiss – Ismael Rodriguez-Lara – Alfonso Rosa-Garcia

Abstract

We study how lines form endogenously in front of banks when depositors differ in their liquidity needs. Our model has two stages. In the first one, depositors choose the level of costly effort they want to exert to arrive early at the bank which determines the order of decisions. In the second stage, depositors decide whether to withdraw or to keep the funds deposited. We consider two different informational environments (simultaneous and sequential) that differ in whether or not depositors can observe the decision of others during the second stage of the game.

We show theoretically that the informational environment affects the emergence of bank runs and thus should influence the willingness to rush to the bank. We test the predictions in the lab, where we gather extensive data on individual traits to account for depositors' heterogeneity; e.g. socio-demographics, uncertainty attitudes or personality traits. We find no significant differences in the costly effort to arrive early at the bank neither across the informational environments, nor according to the liquidity needs of the depositors. In the sequential environment, some depositors rush to the bank because they are irrational and do not recognize the benefits of observability in fostering the coordination on the no-bank run outcome. There is also evidence that some depositors rush to keep their funds deposited and to facilitate coordination on the efficient outcome. Finally, we document that loss aversion is an important factor in the formation of the line.

Keywords: bank runs, coordination problems, endogenous formation of lines, loss aversion, risk aversion, experimental economics, game theory, sequential games, simultaneous games.

JEL classification: C91, D03, D8, G02, J16

Ki rohan a bankba?

Kiss Hubert János – Ismael Rodriguez-Lara – Alfonso Rosa-Garcia

Összefoglaló

Azt tanulmányozzuk, hogy miként alakulnak ki endogén módon a sorok a bankok előtt. A modellünknek két része van. Az elsőben a betétesek megválasztják a költséges erőfeszítés szintjét, ami arra szolgál, hogy korán a bankba érjenek. Ez határozza meg a későbbi döntések sorrendjét. A második részben a betétesek arról döntenek, hogy kivegyék-e a pénzüket a bankból. Két információs környezetet (szimultán és szekvenciális) vizsgálunk, melyek abban különböznek, hogy a betétesek megfigyelhetik-e más betétesek betétkivételi döntését. Megmutatjuk elméletileg, hogy az információs környezet hat a bankrohamok kialakulására és így befolyásolja azt is, hogy ki mennyire szeretne a bankba rohanni. Az elméleti predikciókat laboratóriumban ellenőrizzük, ahol számos egyéni jellemzőről (szocio-demográfiai jellemzők, bizonytalansággal szembeni attitűd, személyiségi jegyek) is adatot gyűjtünk, így figyelembe véve a betétesek heterogenitását. Nem találunk szignifikáns különbséget abban, hogy ki mennyi erőfeszítést tesz, hogy elsőként érjen a bankba sem az információs környezet függvényében, sem a betétesek likviditási igénye alapján. A szekvenciális környezetben néhány betétes azért rohan, mert irracionális és nem ismeri fel a más döntéseinek megfigyelhetőségéből származó előnyöket. Ugyanebben a környezetben arra is találunk bizonyítékot, hogy mások azért rohannak a bankba, hogy aztán ne vegyék ki a pénzüket, így elősegítve a koordinációt a hatékony kimenetelre. Végül, azt is megmutatjuk, hogy a veszteségkerülés fontos tényező a sor kialakulásában.

Tárgyszavak: bankroham, koordinációs probléma, endogén soralakulás, veszteségkerülés, kockázatkerülés, kísérleti közgazdaságtan, játékelmélet, szekvenciális játék, szimultán játék

JEL-kód: C91, D3, D8, G2, J16

Who runs first to the bank?

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Abstract

We study how lines form endogenously in front of banks when depositors differ in their liquidity needs. Our model has two stages. In the first one, depositors choose the level of costly effort they want to exert to arrive early at the bank which determines the order of decisions. In the second stage, depositors decide whether to withdraw or to keep the funds deposited. We consider two different informational environments (simultaneous and sequential) that differ in whether or not depositors can observe the decision of others during the second stage of the game. We show theoretically that the informational environment affects the emergence of bank runs and thus should influence the willingness to rush to the bank. We test the predictions in the lab, where we gather extensive data on individual traits to account for depositors' heterogeneity; e.g. socio-demographics, uncertainty attitudes or personality traits. We find no significant differences in the costly effort to arrive early at the bank neither across the informational environments, nor according to the liquidity needs of the depositors. In the sequential environment, some depositors rush to the bank because they are irrational and do not recognize the benefits of observability in fostering the coordination on the no-bank run outcome. There is also evidence that some depositors rush to keep their funds deposited and to facilitate coordination on the efficient outcome. Finally, we document that loss aversion is an important factor in the formation of the line.

Keywords: bank runs, coordination problems, endogenous formation of lines, loss aversion, risk aversion, experimental economics, game theory, sequential games, simultaneous games.

JEL Class.: C91, D03, D8, G02, J16

1 Introduction

The last financial crisis that started in 2007 has shown that bank runs are existing and important phenomena. In the first two years of the crisis, more than 165 banks failed only in the US. In many instances, the immediate cause of the failure was a bank run. Even large financial institutions like Northern Rock, Bear Stearns, or Washington Mutual experienced runs. Run-like phenomena have also occurred in the repo market (Gorton and Metrick, 2012) or in bank lending (Ivashina and Scharfstein, 2010). These events do not only have noteworthy economic and political consequences (Caprio and Klingebiel, 1999; Laeven and Valencia, 2013; Tooze, 2018), but they are likely to affect the individuals' well-being as well (Montagnoli and Moro, 2018). Governments all over the world took actions to restore the confidence in the financial sector, by increasing the deposit insurance coverage or bailing out failing banks. Understanding bank runs is, hence, of first-order importance to find the right policy responses to deal with them properly in the future.

Since the seminal paper by Diamond and Dybvig (1983) there is an increasing theoretical, empirical and experimental literature that has explored why and how bank runs occur. Some studies highlight the role of policy tools, like suspension of convertibility (Ennis and Keister, 2009; Davis and Reilly, 2016) or deposit insurance (Madies, 2006; Schotter and Yorulmazer, 2009; Kiss et al., 2012; Peia and Vranceanu, 2017), others investigate the importance of individual characteristics (Gráda and White, 2003; Kiss et al., 2014b, 2016b; Dijk, 2017; Shakina and Angerer, 2018). There is, however, a lack of explanations on how the lines are formed in front of the banks. More specifically, we have no evidence on what factors affect the depositors' decisions on *when* to go to the bank. As Ennis and Keister (2010) point out: *"In the Diamond-Dybvig tradition, the order in which agents get an opportunity to withdraw is assumed to be exogenously given (generally determined by a random draw). In other words, agents in the model are not allowed to take explicit actions to change their order of arrival. This assumption is, of course, extreme and, unfortunately, not much is known so far about the case where it is not made."*[1] The current paper is an attempt to fill this void in the literature.

Our study builds on the canonical Diamond-Dybvig framework with two types of depositors: impatient depositors (who are hit by a liquidity shock and need to withdraw immediately) and patient depositors (without urgent liquidity needs and who provoke a bank run if they withdraw

[1] As a result, some theoretical models assume that positions are exogeously determined in a random manner; see, e.g., Green and Lin (2003); Andolfatto et al. (2007); Ennis et al. (2009).

immediately). We rely on two different information environments (simultaneous and sequential) that differ in whether or not depositors can observe the decision of others when making their decisions. The obsevability of actions has been shown to be crucial to depositors' behavior in empirical (Kelly and O Grada, 2000; Starr and Yilmaz, 2007; Iyer and Puri, 2012; Atmaca et al., 2017) and experimental studies (Garratt and Keister, 2009; Schotter and Yorulmazer, 2009; Kiss et al., 2014a, 2018). There is also evidence that observability of actions affects if a bank run becomes contagious (Brown et al., 2016; Chakravarty et al., 2014; Duffy et al., 2016).[2] These papers focus on the reaction of depositors when they observe the action of others, while leaving aside the question on whether (and how) this can affect the willingness to arrive early at the bank.

Our first informational environment, the simultaneous setup is characterized by the lack of information about previous decisions, so depositors decide without knowing the decision of preceding depositors. The second informational environment, the sequential setup represents the opposite, so depositors observe all previous decisions. Both of these informational environments resemble conditions akin to bank run episodes that occurred during the last financial crisis. For example, the US bank Washington Mutual experienced massive online withdrawal in September 2008, a so-called "silent bank run" since the decision of other depositors could not be observed. Arguably, the run on the UK bank Northern Rock in 2007 was not silent as depositors could see the long lines in front of the banks and the media covered extensively the run. Our paper highlights that theoretically the observability of actions is key to understand whether or not bank runs emerge as a coordination problem, and this should affect the way in which lines of depositors are formed.

Altogether, we consider a two-stage game. In the first stage, depositors decide simultaneously their effort level to arrive early at the bank and the line is formed accordingly: depositors who make more costly effort to arrive early at the bank (in form of higher bids as we will see), get a position at the beginning of the line.[3] In the second stage, depositors decide whether to keep their funds in the bank or to withdraw them immediately. When decisions are simultaneous, depositors make their choices without observing the decision of others, as in the traditional Diamond and Dybvig (1983)

[2]For a recent literature review on contagion in financial networks see Glasserman and Young (2016). Duffy (2016), Dufwenberg (2015) and Kiss et al. (2016a) also present recent advances on experimental finance, including a discussion on bank runs.

[3]We are not aware of any other paper that endogeneizes the order of decisions in a bank run model, but there have been other attempts in the literature, including models of herding, war of attrition or investment environments. For instance, Wagner (2018) studies war of attrition, Brindisi et al. (2014) investigate an investment environment, while Ivanov et al. (2013) examine a herding game.

setup. There are multiple equilibria in this setting. In the efficient equilibrium resulting in no bank run, patient depositors keep their funds deposited. In the inefficient equilibrium with a bank run, patient depositors withdraw their funds immediately, which is optimal given that the rest of patient depositors withdraws as well.[4] When decisions in the second stage are sequential, it is possible to observe all previous decisions. In this setting, we show that there is a unique equilibrium without bank runs. This occurs because the observability of actions solves the coordination problem, thus it is possible to coordinate on the efficient equilibrium (Kiss et al., 2012; Kinateder and Kiss, 2014).[5] The rationale for this result is that patient depositors, by keeping their money in the bank when decisions are observable, are able to induce other patient depositors to keep their funds deposited as well. This, in turn, implies that any withdrawal that is observed should be attributed to an impatient depositor who needs the funds immediately.

We rely on backward induction to derive our predictions for the first stage of the game. In the simultaneous setup, beliefs determine which equilibrium is chosen. As a result, depositors (both patient and impatient ones) should only make a costly effort to arrive early at the bank if they expect a bank run, and those who run should withdraw their funds. If no bank run is anticipated, then no costly effort should be made to rush to the bank. In the sequential environment, given the unique no-run equilibrium depositors should make no effort to arrive early at the bank regardless of their types (patient or impatient). However, the observation of withdrawals can perturb the beliefs of depositors about the occurrence of bank runs. Kiss et al. (2018) find that patient depositors tend to run when decisions are observable because they attribute the observed withdrawals to other patient depositors. Kiss et al. (2018) refer to these bank runs that occur after observing previous decisions as *panic bank runs*. Then, if depositors expect a panic bank run, both patient and impatient depositors have incentives to make costly efforts in order to arrive earlier at the bank.[6]

We test these predictions by means of a laboratory experiment. When comparing the behavior in the simultaneous and the sequential environment, our data suggest that decisions on arriving early

[4]Similarly to Diamond and Dybvig (1983), the bank in our setup does not have any fundamental problem, so bank runs arise due to coordination problems among the depositors. Although fundamentally weaker banks are more likely to be affected by bank runs, there is empirical evidence that even fundamentally healthy financial intermediaries suffer bank runs (e.g. Davison and Ramirez, 2014; De Graeve and Karas, 2014). In fact, fundamentals are important but leave unexplained part of the banking failures (e.g. Ennis, 2003; Boyd et al., 2014).

[5]Arifovic et al. (2013) provide experimental evidence that the difficulty of coordination affects the emergence of bank runs.

[6]As we discuss below, the decision of patient depositors will depend on their beliefs regarding the rationality of other patient depositors.

at the bank are not related with the coordination on the bank run equilibrium. This occurs because patient depositors make costly efforts both in the simultaneous and the sequential environments. In the simultaneous environment, we find that the depositors' beliefs about the occurrence of bank runs predicts their withdrawal decisions (i.e., depositors are more likely to withdraw when they expect a bank run). However, these beliefs do not influence their decision on *when* to arrive at the bank (i.e., patient depositors who want to withdraw their funds in the simultaneous setting do not arrive earlier at the bank than those who want to keep their funds deposited). In addition, we do not find differences in the costly efforts to arrive early across liquidity types (patient vs. impatient) in the simultaneous environment. Overall, these findings support the approach used in the theoretical literature that assumes a random formation of the line in the absence of information about the decision of other depositors. In the sequential environment, we find that two factors can explain partly the costly effort made by patient depositors. On the one hand, there is evidence that some patient depositors are irrational and rush to withdraw their deposit even when they know that their withdrawal decision is observable. On the other hand, we find a substantial share of subjects that seem to anticipate that bank runs may occur because of panic. These subjects make costly efforts to arrive early and keep the funds deposited so as to facilitate coordination on the efficient outcome.

We use our experiment to glean some additional insights into the behavior of depositors. Starting with Diamond and Dybvig (1983) most of the theoretical studies on bank runs assume that depositors are homogeneous, except for their liquidity needs. However, depositors in real life differ in a myriad of ways. To account for heterogeneity, we measure a host of individual traits of the participants in the experiment. More concretely, we collect data on the age, gender, attitude toward uncertainty (risk aversion, loss aversion, ambiguity aversion), cognitive abilities, overconfidence, income, trust in institutions, personality traits (Big Five and Social Value Orientation) of the participants. Our strong interest in the attitude toward uncertainty is motivated by the fact that in many countries regulation requires banks to draw a risk profile of the customers (see, e.g., the Markets in Financial Instruments Directive (MiFID) in the EU, Article 25/2 of European Parliament (2014) or Article 30/1 of (European Parliament, 2016).) In our analysis, loss aversion indeed emerges as an important factor to explain depositors' decisions and the formation of the line. This is in line with recent experimental findings (e.g. Haigh and List, 2005; Trautmann and Vlahu, 2013; Rau, 2014; Huber et al., 2017) suggesting that loss aversion is important to financial decisions. Our result suggests that theory should consider to incorporate loss aversion into models of bank runs.

Our results complement empirical studies analyzing how individual traits affect depositors' behavior. Gráda and White (2003) analyze two banking panics in New York in the XIX century. The first one in 1854 was due to contagion and resulted in less wealthy and less sophisticated depositors withdrawing their funds first. In contrast, the bank run in 1857 was due to fundamentals. In this case, the more wealthy and sophisticated depositors began to withdraw their funds first, as they observed that the value of many banking portfolios was declining. Gráda and White (2003) find that gender played a different role in these bank run episodes. During the run in 1854, the share of men and women who panicked was similar, but in 1857 women panicked more than men. Iyer et al. (2016) study two runs on rural banks in India that occurred in 2001 and 2009. The authors find evidence that some factors such as being uninsured, having loan linkages to the bank or the level of education affected depositors' willingness to run differently, depending on whether the bank run was due to contagion or provoked by fundamental causes.

There is a growing body of experimental research that also explores the effect of various individual characteristics on the emergence of bank runs. Previous research (Trautmann and Vlahu, 2013; Kiss et al., 2016b, 2014b; Dijk, 2017; Shakina and Angerer, 2018) has studied, among others, the effect of gender, risk aversion, loss aversion, cognitive abilities or emotions on the willingness to withdraw. These studies, however, remain silent on the effect of individual traits on the formation of the line.

We believe that our findings are relevant to policy as well. In our study, we consider a series of factors that are endogenous (e.g., individual characteristics), while others are exogenous (e.g., the informational environment). Policymakers should try to assess how endogenous factors affect the willingness to run so as to design optimal policies that can prevent bank runs; e.g., deposit insurance depending on the degree of risk aversion of depositors. As for the exogenous factors, these can be more easily influenced by policy. Along these lines, policymakers should strive to promote the informational environment leading to less runs. We show that beliefs of depositors are important. We believe this can be affected for instance by credible policies; e.g., a well-functioning deposit insurance may make depositors believe that other depositors are not likely to withdraw.

The rest of the paper is structured as follows. Section 2 presents our model and the theoretical predictions. Section 3 contains the experimental design and the procedures. In section 4 we present the results. Section 5 concludes.

2 Model and Predictions

We present our theoretical framework in section 2.1. In section 2.2, we derive theoretical predictions on the effect of the informational environments. We discuss the potential influence of individual traits in section 2.3.

To study the effect of the informational environment, we assume that depositors only differ in their liquidity needs (impatient vs patient) and investigate the effect of the observability of actions on their effort choices. To do that, we rely on the three-depositor setting applied in our experiment, which is the simplest one to study the coordination problem embedded in Diamond and Dybvig (1983). We show that bank runs may occur as a coordination problem in the simultaneous environment, that in turn can lead to non-zero efforts to arrive early at the bank. In the sequential environment, no withdrawal by a patient depositor is expected in the second stage, implying zero efforts in the first stage of the game. In Appendix A, we present a detailed theoretical model that generalizes these results.

2.1 The bank run game with line formation

We extend the bank run game in Kiss et al. (2014a) to incorporate a stage in which depositors can make costly efforts (in form of a bid) to obtain a position in the line. The sequence of events is presented in Figure 1.

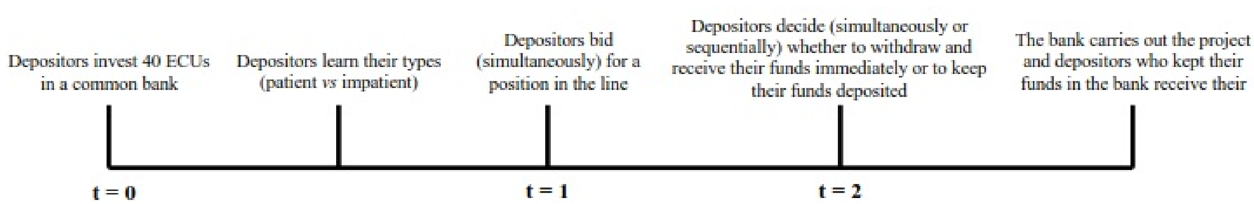

Figure 1: Sequence of events in the game

In our model, there are three depositors, each of them endowed with 60 ECUs. From this initial endowment 40 ECUs are automatically deposited in a common bank at $t = 0$.[7] The bank will invest the total endowment (120 ECUs) in a risk-free project that yields a guaranteed positive net return after $t = 2$. The bank, however, can liquidate any fraction of the investment at no cost before the project is carried out.

[7] As a result, we disregard the pre-deposit game described by Peck and Shell (2003).

Depositors learn their liquidity needs after depositing their endowment in the bank. In particular, one of the depositors is hit by a liquidity shock and is forced to withdraw her funds from the bank. We follow Diamond and Dybvig (1983) and assume that there is no aggregate uncertainty about the liquidity demand; i.e., it is common knowledge that one of the three depositors will need the money and will withdraw with certainty. We refer to this depositor as the impatient depositor, whereas the depositors who can choose to keep their funds deposited or to withdraw are called patient depositors.

When depositor learn their liquidity needs (patient or impatient), they bid (simultaneously) for a position in the line at $t = 1$. We interpret the bid as the level of costly effort to arrive early at the bank. After the bidding, the position of the depositors is determined (the highest / second highest / lowest bidder getting the first / second / third position in the line) and depositors choose between withdrawing their funds from the bank or keeping them deposited. We hereafter refer to depositor i as the one in position i={1,2,3}.

Payoffs depend on the position in the line and on the decisions of the other depositors at $t = 2$ (see Table 1). If a depositor decides to withdraw, she immediately receives 50 ECUs as long as there is enough money in the bank to pay this amount (out of this amount, 40 ECUs correspond to the initial endowment and 10 ECUs are obtained in the form of interest). In our experiment, if depositor 1 or 2 withdraws, she definitely receives 50 ECUs. However, if depositor 3 decides to withdraw after two withdrawals, she only receives 20 ECUs (because the first two depositors who withdrew received 50 ECUs, the bank has only 20 ECUs to pay depositor 3). Nonetheless, if depositor 3 withdraws after less than two withdrawals, the bank pays her 50 ECUs.

Depositors who decide to keep their funds deposited are paid at $t = 2$ once the bank carries out the project. The amount that depositors receive depends on the total number of depositors who keep their money in the bank at $t = 2$. If only one depositor keeps her money deposited, she receives 30 ECUs. If two depositors do so, then their payoff is 70 ECUs. Note that position in the line is only relevant if there is a run (i.e., when a patient depositor withdraws), because then arriving late (that is, in position 3) yields only 20 ECUs instead of 50 ECUs.

Before discussing our predictions, there are some aspects of our setting that are worth mentioning. First, we constrain the bid at $t = 1$ to be an integer number between 0 and 20, both included. This assumption implies that depositors can only bid the part of their endowment that was not deposited in the bank and imposes some form of rationality because depositors cannot have losses in the experiment. Second, the amount not used for bidding adds to the final payoff of the depositor.

		If you keep your money deposited and …	
Your position in the line	If you withdraw	another depositor keeps her funds in the bank	you are the only one who keeps the money deposited
1.	50	70	30
2.	50		
3.	20 or 50		

Table 1: Payoffs of the bank run game depending on the position of depositors and their choices.

For example, if a patient depositor bids 15 and only the impatient depositor withdraws, then she receives (20-15)+70=75 ECUs. Finally, a patient depositor in position 3 should always keep her funds deposited. This is because keeping the funds deposited always entails higher payoffs to a patient depositor 3 than withdrawing for any possible history of decisions; i.e., after two withdrawals, depositor 3 receives 30 ECUs if she keeps her funds deposited and 20 ECUs if she withdraws. If a depositor keeps her money in the bank and only the impatient depositor withdraws, it is better to keep the funds deposited and earn the highest payoff (70 ECUs vs. 50 ECUs).

2.2 Predictions in the bank run game

We focus on the polar situations in which observation of decisions is either absent or complete, corresponding to the simultaneous environment (previous decisions cannot be observed) or the sequential environment (both keeping the money deposited and withdrawal are observable and depositors decide sequentially according to their position in the line).

Simultaneous environment. In the simultaneous environment, in $t = 2$ depositors are playing a minimal version of the coordination problem embedded in Diamond and Dybvig (1983). We attempted to make this setup as close to Diamond and Dybvig (1983) as possible, so depositors do not know neither their position, nor the decisions of the other depositors when deciding whether or not to withdraw. For any possible line, there are two equilibria in pure strategies, one where both patient depositors keep their money in the bank (the efficient equilibrium) and one where both patient depositors withdraw (the bank run equilibrium). If patient depositors are expecting to choose the efficient outcome in $t = 2$ (in other words, a patient depositor expects the other patient depositor to keep her funds deposited), there is no incentive to make a costly effort to arrive early, thus a bid of 0 is the optimal strategy in $t = 1$. If the bank run equilibrium is expected to be played in $t = 2$ (that is, a patient depositor expects the other patient depositor to withdraw), a patient depositor best responds by spending some amount of money in the bidding stage in $t = 1$ to get earlier to the bank than one of the other depositors, so she will bid a positive amount. The patient depositor submits the minimal amount that she considers necessary to arrive in position 1 or 2 at the bank and receive 50 ECUs. The impatient depositor has no incentive to make costly efforts to arrive early at the bank if she expects no withdrawals or only one withdrawal from the patient depositors. If she expects that both patient depositors withdraw, then the same line of reasoning applies to her as to the patient depositor who expects the other patient depositor to withdraw. Thus, in this case she will bid the conjectured minimum positive amount that allows her to arrive early at the bank.

Hypothesis 1 (Simultaneous environment): *In the simultaneous setup, the effort to arrive early at the bank (i.e., the bids) depend on the beliefs about the occurrence of bank runs. If a patient depositor expects the other patient depositor to withdraw, then she will submit a positive bid to arrive early (in position 1 or 2) at the bank. If the impatient depositor expects that both patient depositors withdraw, then she will submit a positive bid to arrive early at the bank. If no bank run is expected, then depositors should submit a zero bid.*

Sequential environment. In the sequential environment, there exists a unique perfect Bayesian equilibrium without bank runs in $t = 2$ (Kinateder and Kiss, 2014; Kiss et al., 2014a). This occurs because any patient depositor who observes that somebody has chosen to keep her funds deposited should do so as well in order to coordinate on the efficient equilibrium. By backward induction and sequential rationality, any patient depositor who arrives first at the bank will keep her money in the bank to induce the other patient depositor to follow suit. As a consequence, any withdrawal in position 1 that is observed should be attributed to the impatient depositor. Then, upon observing a withdrawal a patient depositor should keep her money in the bank, expecting that the other patient depositor in position 3 will do the same. This, in turn, implies that the observability of previous decisions solves the coordination problem in $t = 2$, therefore there is no point to make costly efforts to arrive early at the bank; i.e., depositors should bid nothing in the bidding stage in $t = 1$, regardless of their liquidity needs.

Hypothesis 2 (Sequential environment and bank runs due to coordination problems):

In the sequential environment, bank runs do not occur due to coordination problem among depositors; thus both patient and impatient depositors should make no effort to arrive early at the bank and should submit a zero bid.[8]

Although the sequential environment solves the coordination problem, Kiss et al. (2018) argue that the observation of withdrawals distorts depositors' beliefs that a bank run is underway. More concretely, they find that patient depositors tend to attribute an observed withdrawal to the other patient depositor instead of to the impatient one. As a result, depositors who observe a withdrawal are likely to withdraw as well (see also Garratt and Keister, 2009; Schotter and Yorulmazer, 2009; Kiss et al., 2014a). Kiss et al. (2018) refer to these bank runs that do not occur because of fundamental problems or a coordination problem as *panic bank runs.* These results suggest a different prediction than the previous one. If depositors believe that a panic bank run can take place in $t = 2$, then patient depositors may make costly efforts in $t = 1$ to arrive early at the bank.

Hypothesis 3 (Sequential environment and bank runs due to panic behavior): *In the sequential environment, patient depositors may submit positive bids in the first stage of the game to arrive early at the bank if they believe that there will be a panic bank run.*

In principle, the reason for patient depositors to bid in the sequential environment when a panic bank run is underway is twofold. On the one hand, patient depositors have incentives to make a costly effort to arrive early at the bank in order to keep the money deposited. This way, the other patient depositor will observe her decision and this will facilitate the coordination on the efficient outcome (if the first depositor who acts is the impatient one, the observation of withdrawal may result in a bank run).[9] A second possibility is to bid and withdraw. This is reasonable if the patient depositor thinks that the other patient depositor will withdraw for sure, thus the patient depositor receives a guaranteed payoff of 50 ECUs, rather than 30 ECUs corresponding to keeping the funds deposited alone. When assessing both options, the patient depositor should find it optimal to keep her funds deposited whenever she believes that the other patient depositor will be rational enough and will choose the efficient outcome upon observing that somebody has already kept her money in the bank.

[8] We generalize the theoretical predictions of Hypothesis 1 and 2 in Appendix A.

[9] This idea is somewhat reminiscent of what Choi et al. (2011) call strategic commitment.

2.3 Individual traits

The previous theory is silent about the magnitude of the bids, but it is natural to think that the size of the bid is affected by individual traits.

In the experimental literature on bank runs, there is no consensus on whether women make different choices than men; e.g., Kiss et al. (2014b) do not find gender differences in the withdrawal decisions, while Dijk (2017) reports that women are more likely to withdraw when fear is induced to participants. On the contrary, the experimental evidence on bidding behavior seems to support the hypothesis that men and women bid differently; e.g., Rutström (1998) finds that women exhibit more variance in bidding choices than men do, and Casari et al. (2007) find that women without experience in auctions tend to bid higher. In our game, it is unclear if these result hold when bidding for position in a bank run game, thus we test whether gender affects bidding behavior in our informational environments.

In our experiment, we elicit also elicit risk, loss and ambiguity aversion (see section 3.2 for further details).[10] The more a depositor dislikes uncertainty or loss, the more she is willing to pay to avoid it. However, it may have different effects in the different setups. In the simultaneous setup, a way to secure a payoff is to be in position 1 or 2 and withdraw, that leads to a sure 50 ECUs instead of facing i) the uncertainty of the 70 / 30 ECUs, or ii) a potential loss if she receives only 30 ECUs. Hence, if we consider two depositors in the simultaneous environment, both of them expecting that at least one of the patient depositors withdraws, we conjecture that the one who is more averse to uncertainty or loss will bid more. In the sequential environment, a patient depositor may want to bid high to be the first to make the withdrawal decisions and then she may choose to keep her funds deposited and hence induce the other patient depositor to do so as well, both of them earning 70 ECUs.[11] Thus, here the high bid to be the first would lead to keeping the money in the bank, in contrast to the simultaneous case. However, in both cases, the more averse is a depositor to uncertainty or loss, the more she would bid, *ceteris paribus*.

We measure the rest of the variables (cognitive abilities, income, trust, or personality traits) mainly in order to control for them in the analysis and to avoid confounds. In Appendix B, we speculate briefly on their potential effect.

[10] In our sample risk and loss aversion are negatively and significantly correlated, but none of them is correlated with ambiguity aversion on the individual level.

[11] Such reasoning assumes that the participant believes that the other participants are rational enough to make the optimal decisions.

3 The experiment

3.1 Experimental design and procedures

We recruited a total of 312 subjects (156 for the simultaneous environment and 156 for the sequential one) with no previous experience in coordination problems or experiments on financial decisions. We ran six sessions with 24 subjects each at the Laboratory for Theoretical and Experimental Economics (LATEX) of Universidad de Alicante and four sessions with 42 subjects each at the Laboratory for Research in Experimental and Behavioural Economics (LINEEX) of Universitat de Valencia between October 2015 and February 2016.[12]

The experiment was programmed using the z-Tree software (Fischbacher, 2007). Instructions were read aloud and the bank run game was played twice. The first time served as a trial so that participants can get familiarized with the game and the software. No results were communicated to the subjects after this trial, nor was there any related payment. The second play was relevant for the final payment (see Appendix C for the instructions).

We employed the strategy method (Brandts and Charness, 2011) in each of the two informational environments, where subjects made two different types of choices. The first one concerned a first-price auction, in which subjects decided what amount of their endowment not deposited in the bank (between 0 and 20 ECUs) to bid for a position in the line. Subjects knew that the first / second / third depositor in the line would be the depositor who submitted the highest / second highest / lowest bid. Subjects were asked to bid both as patient and impatient depositors, thus we can use a within-subject approach to test for differences in the bidding behavior of patient and impatient depositors.

After their bidding decision, participants were asked to decide what to do if they arrived at the bank and had the possibility of withdrawing or keeping their money deposited. Recall that impatient depositors are forced to withdraw, thus we were only interested in the decision of the patient depositors. In the simultaneous environment, patient depositors made their choices without any further information apart from knowing their own bids. In the sequential environment, they were asked to make a choice in six different situations:

- If she arrived first to the bank and did not observe anything.

[12]For each treatment, we have 72 participants from Alicante and 84 from Valencia. Having detected no significant differences across locations, we pool the observations.

- If she arrived second and observed that the first depositor had kept her money deposited.
- If she arrived second and observed that the first depositor had withdrawn.
- If she arrived third and observed that the first depositor had kept her funds deposited and the second depositor had withdrawn.
- If she arrived third and observed that the first depositor had withdrawn and the second depositor had kept her funds deposited.
- If she arrived third and observed that the first and the second depositor had withdrawn.

After subjects made their choices in the bank run game, they filled out a questionnaire that was used to collect additional information about a set of socio-economic variables (see section 3.2). In some sessions, we elicited the subjects beliefs' about their position in the line and the decision of other depositors (see section 3.3). To avoid any wealth effect that may distort the behavior of subjects in these subsequent phases, the formation of banks and the realization of payoffs in the bank run game was postponed to the end of the experiment (see section 3.4).

3.2 Elicitation of individual traits

We collect information on individual traits using a questionnaire. Our questionnaire started with the elicitation of age and gender. Then, we elicited risk attitudes using the "bomb risk elicitation task" (BRET) by Crosetto and Filippin (2013). This requires that subjects decide how many boxes to pick from a store, each box being numbered from 0 to 100. Subjects were told that a bomb would be placed in one of the boxes at random, and they had to decide the number of boxes they want to collect. They would receive 0.10 euros for each box, if the bomb was not among the chosen boxes, and 0 if they had chosen the box with the bomb. Crosetto and Filippin (2016) show that this task is appropriate to distinguish subjects according to their risk attitude; in fact, they provide a range for the risk aversion parameter $r \in (r_0, r_1)$ depending on the number of boxes that a subject collects, assuming a CRRA utility function, $u(k) = k^r$. We hereafter use the midpoint of this interval as the risk aversion parameter for each of the subjects; i.e., our risk aversion parameter for each individual is $r = (r_1 - r_0)/2$.

We estimated loss aversion following Gächter et al. (2007). Participants were presented 5 different lotteries. Each of them paid out 4 Euros if the result of tossing a coin turned up tails, while subjects would lose an amount between 1 and 5 Euros if the coin turned up heads. Subjects had to indicate whether or not they would be willing to accept each of the lotteries (see Table 2).

Table 2: Elicitation of loss aversion

	Accept	**Reject**
L1. If the coin turns up heads, then you lose €1; if the coin turns up tails, you win €4	○	○
L2. If the coin turns up heads, then you lose €2; if the coin turns up tails, you win €4	○	○
L3. If the coin turns up heads, then you lose €3; if the coin turns up tails, you win €4	○	○
L4. If the coin turns up heads, then you lose €4; if the coin turns up tails, you win €4	○	○
L5. If the coin turns up heads, then you lose €5; if the coin turns up tails, you win €4	○	○

Note: The modal value was 5 in every single condition.

If we apply cumulative prospect theory (Tversky and Kahneman, 1992) and assume that subjects give the same probability weights to the 0.5-chance of gaining and losing Gächter et al. (2007), then the coefficient of loss aversion λ will be given by the ratio between the utility of the winning price and the losing price, where $\lambda = u(G/L)^r$ under CRRA utility function. In our data, we obtain the degree of risk aversion r from the BRET and define a loss averse agent as the one with $\lambda > 1$.

We followed Halevy (2007) to elicit ambiguity aversion. There were four urns, composed of a different quantity of coloured balls, and participants had to bet on the colour of the ball to be drawn from the urn, earning 2 euros if they guessed correctly (0 euros otherwise). Urn 1 was composed of 5 red and 5 blue balls. Urn 2 had an unknown number of red and blue balls. Urn 3 contained some number (between 0 and 10) of red balls, the rest of balls being blue; this number would be chosen from a bag with 11 balls numbered from 0 to 10. Finally, urn 4 would be filled with 10 red and 0 blue balls, or with 0 red and 10 blue balls depending on if a 0 or a 10 was selected from a bag with these two numbers. After betting for a colour in each urn, participants had the opportunity of selling their bet, asking for a minimal price (in cents) between 0 and 2 Euros. Then, the computer would choose a random number between 0 and 200, and would pay it if the selling price was below. We use the differences in the selling price between urn 1 and urn 2 as a measure of ambiguity aversion.

The next item in our questionnaire was the Cognitive Reflection Test (CRT) by Frederick (2005). This test consists of three questions that have an intuitive answer that is wrong; thus the test measures the tendency to override the spontaneous response and to engage in further reflection to give the correct answer to each question. We use the number of correct answers in the test as a measure of cognitive abilities. Once subjects completed these questions, we asked them to guess their number of correct answers and the number of questions answered correctly by another random participant. These questions were incentivized and are used in our experiment to measure overconfidence (difference between the subject's guess of correct answers and the real number of correct answers) and overplacement (difference between the subject's guess on their number of correct answers and the number of correct answers by others).

Our questionnaire included other self-reported variables that were not incentivized. We asked subjects their income level and their trust in several institutions (monarchy, government, army, banks, police, church and political parties). We were especially interested in the trust in banks so that we can control for the fact that some individuals may not trust banks and this may affect their propensity to run and withdraw their funds. These questions were taken from a questionnaire of the Spanish National Statistics Institute (INE). We also elicited personality traits using a 48-item Big Five test. Finally we measured Social Value Orientation of our participants with the 9-Item Triple-Dominance Measure (Van Lange et al., 1997).

3.3 Elicitation of beliefs

When subjects completed the questionnaire in our experimental sessions in Valencia ($N = 84$ subjects), we elicited their beliefs both regarding position in the line and decisions of the other depositors. More concretely, we asked in both informational environments (simultaneous and sequential) and for both roles (impatient and patient depositor) what position they believed to obtain when they submitted their bids.[13]

We also elicited subjects' beliefs regarding the occurrence of bank runs in each of the informational environments. To do so, we asked impatient depositors their belief regarding the behavior of the patient depositors. More specifically, we asked when in the role of the impatient depositor what the subjects believed about how many of the other depositors (0, 1 or 2) chose to withdraw. In the simultaneous environment, we also asked this question when in the role of the patient depositor. Since the impatient depositor was forced to withdraw, the possible answers were restricted to 1 and 2. Finally, in the sequential environment when in the role of patient depositor we asked the belief upon observing a withdrawal in position 2. More concretely, subjects had to decide which of the following three alternatives was most likely: 1) Depositor 1 who withdrew was the impatient depositor (forced to withdraw), 2) Depositor 1 who withdrew was the one who could choose between keeping the money deposited and withdrawal, or 3) The two previous options are equally likely. This

[13] In principle, subjects could bid without thinking about the position in the line. At the end of the experiment, only 5% of the subjects reported that they did not think about their position when submitting their bids.

is to assess whether participants attribute an observed withdrawal to the impatient depositor (as predicted by rationality and the coordination explanation of bank runs) or to the patient depositor (as suggested by panic bank runs).

3.4 Payment to participants

Once the experiment finished, the computer paired participants randomly to form banks of three depositors and assigned the role of patient and impatient depositors at random. Payoffs were computed according to the bidding behavior and the withdrawal decisions of subjects in the bank run game (given their role).

Subjects were also paid for their choices in the questionnaire. In particular, we selected at random one of the three tasks that were used to elicit risk attitudes, loss aversion and ambiguity. We also paid subjects if they guessed correctly their performance in the CRT or if they guessed correctly the number of questions answered correctly by another random participant. At the end of the experiment, the ECUs earned during the experiment were converted into Euros at the rate 10 ECUs = 1 Euro. The experiment lasted approximately 1 h. The average earnings were 10.5 Euros.

4 Experimental results

We start with some descriptive statistics and statistical tests on the bidding behavior of depositors in section 4.1. This includes an econometric analysis that controls for the variables in our questionnaire to assess whether personal traits affect the decision on when to go to the bank. In section 4.2, we look at the depositors' decisions in the bank run game to show how withdrawal rates depend on their beliefs about the occurrence of bank runs in both environments.

4.1 Behavior of depositors in the bidding stage

The upper panel of Table 3 reports the average bids and the frequency of positive bids for each type of depositor (patient/impatient) in each possible environment (simultaneous/sequential), separately. The lower panel of Table 3 summarizes the bids depending on the depositors' beliefs about their position in the line.

We find that depositors bid around 7.20 ECUs (roughly 36% of their endowment) regardless of their role or the informational environment. Moreover, around 90% of the subjects bid a positive amount to arrive early at the bank, without any distinguishable difference between the simultaneous

	Simultaneous		Sequential	
	Patient	Impatient	Patient	Impatient
Average bid	7.25 (4.87)	7.53 (5.31)	7.15 (5.37)	6.96 (5.21)
% Positive bid	0.88	0.93	0.88	0.88
Believed position				
1	13.68 (4.41)	12.73 (4.44)	11.12 (6.11)	12.79 (5.12)
2	8.83 (3.37)	7.97 (2.28)	8.03 (3.80)	7.09 (2.94)
3	1.48 (1.66)	3.44 (4.32)	2.05 (4.68)	2.06 (2.88)

Table 3: Average bid (std. dev.), unconditional and conditional on the depositors' belief about their position

and the sequential setup. There is no significant difference between the bid of the patient and impatient depositor in any of the two informational environments ($p > 0.26$ in each case), nor is there any significant difference between the bid of the patient and impatient depositor across informational environments ($p >0.35$ in each case).[14] These findings suggest that neither the type, nor the informational environment affects the bids.

At the bottom panel we observe that depositors who believe that they will arrive first to the bank tend to bid more on average than depositors who believe they will arrive second or third. There is indeed a significant correlation between the depositors' bid and their expected position in the line (p-value < 0.0001). The correlation between bids and expected position suggests that participants understood the underlying situation and those who wanted to achieve a better position indeed submitted higher bids.

Finding 1: *Both patient and impatient depositors bid, on average, a positive amount in the simultaneous and the sequential environment. Depositors of different liquidity type do not bid differently in any of the informational environments, and the bids of patient and impatient depositors are undistinguishable across informational environments. Bids and expected positions correlate significantly; i.e., those depositors who believe that they arrive earlier at the bank, bid more.*

Our theory predicts that depositors will run in the simultaneous environment only if they expect

[14] Unless otherwise noted, the reported p-values refer to the Wilcoxon signed-rank test for within-subject comparisons and the Mann-Whitney-Wilcoxon test for the comparison across treatments. We rely on a one-tailed analysis whenever there is a clear ex-ante hypothesis on the depositors' behavior.

a bank run. This, in turn, implies that the impatient depositor should bid more when she expects the two patient depositors to withdraw. Similarly, a patient depositor should bid more if she expects that the other patient depositor will withdraw. Our data, however, reject this hypothesis. We do not find differences in the bids of patient depositors depending on if they expect a bank run to occur or not ($p = 0.97$).[15] Similarly, impatient depositors do not bid differently depending on whether they expect a bank run or not ($p = 0.85$).

Finding 2: *Beliefs on the occurrence of bank runs do not influence depositors' decision to arrive early at the bank in the simultaneous environment.*

A second feature that we conjecture to affect the decision to arrive early at the bank in the simultaneous environment is the intention to withdraw. If a patient depositor plans to keep her funds deposited (believing that there will be no bank run), then she has no incentives to arrive early at the bank. However, if she wants to withdraw (anticipating a bank run), then she should make a costly effort in form of a positive bid.[16] Maybe surprisingly, we do not find any statistical difference in the bids of those depositors who keep the funds deposited (7.54 ECUs) and those who withdraw (7.42 ECUs) in the simultaneous environments ($p = 0.97$).

Finding 3: *The withdrawal decision does not influence the depositors' decisions to arrive early at the bank in the simultaneous environment.*

If bank runs occur because of a coordination problem among depositors, the finding that depositors do not bid differently in the simultaneous and the sequential environment is surprising. Theoretically, the observability of actions should play a major role in determining depositors' bids as it should solve the coordination problem in the sequential environment; in fact, the optimal decision is to bid nothing in the sequential environment. Depositors might bid positive amounts in the sequential environment because they do not anticipate that there will be no bank run in equilibrium; i.e., depositors may believe that the observability of actions will not foster coordination on the efficient equilibrium with no bank runs. We asked impatient depositors to predict how many patient depositors will withdraw their money from the bank in each of the informational environments. Our results are summarized in Table 4.

[15] As we show in section 4.2 beliefs on the occurrence of bank runs affect the withdrawal decisions; e.g., patient depositors withdraw more frequently if they expect a bank run compared to when they do not (0.5 *vs* 0.09).

[16] In fact, any patient depositor who keeps her funds deposited should believe that there will be no bank run, hence the other patient depositor will do so as well. Thus, patient depositors should withdraw more frequently when they expect a bank run. This is confirmed by our data (see section 4.2).

Table 4: Beliefs about the behavior of the patient depositors in each environment

	Simultaneous	**Sequential**
None of the patient depositors will withdraw	36.90%	44.05%
Only one of the patient depositors will withdraw	44.24%	50.00%
Both of the patient depositors will withdraw	17.86%	5.95%

We find that roughly 37% (44%) of depositors expect to see no withdrawals in the simultaneous (sequential) environment, while 18% (6%) of depositors expect that both patient depositors will withdraw in the simultaneous (sequential) environment, respectively. The Kruskal-Wallis equality-of-populations rank test rejects the null hypothesis that depositors expect the same behavior in the two environments ($p = 0.049$). The test of proportion highlights that depositors expect to see more coordination on the bank run equilibrium (i.e., both patient depositors withdraw) in the simultaneous environment ($p < 0.01$). As a result, depositors seem to recognize the importance of observability and expect coordination to be more successful in the sequential than in the simultaneous environment. However, the differences are not substantial and do not affect the bids in a significant manner.

Finding 4: *Depositors believe that bank runs will be less likely in the sequential than in the simultaneous environment.*

We have two plausible explanations related to rationality that may explain at least partly why depositors run in the sequential environment, even though they seem to recognize that the observability of actions can benefit coordination on the efficient equilibrium. First, common knowledge of rationality should lead subjects to understand that it is optimal to bid nothing and then to keep the money in the bank if decisions are observable. However, subjects may not be rational. A very natural way to measure rationality in our sequential environment is to recall that depositor 3 has a dominant strategy and should keep the funds deposited if patient. While the majority of the subjects (129 out of 156, 83%) are rational according to this criterion and keep their money in the bank in position 3, we find that 27 out of the 156 subjects (17%) decided to withdraw (at least once) in the last position. Our data confirm that these irrational subjects make more costly efforts than rational subjects to arrive early at the bank (8.81 vs 6.80, p = 0.029), which indicates that the high bids observed in the sequential environment may be partly due to the irrationality of some depositors. In the sequential environment, we can also identify as irrational depositors those who withdraw in position 2 after observing that somebody kept her funds deposited. If we include them in the definition of rationality, 122 out of 156 (78%) are rational depositors, and the rest (22%) are irrational depositors. Our previous result that irrational depositors bid more than rational depositors in the sequential environment is robust under this classification (8.91 ECUs vs 6.66 ECUs, $p = 0.013$). In order to compare decisions of rational depositors between the simultaneous and the sequential enviroment, a possible way to identify irrational depositors in the simultaneous environment is to look at those depositors who believe to be in position 3 and still withdraw their funds (3 out of 156 subjects, 2%). If we focus on the bidding behavior of rational subjects in the simultaneous and the sequential environment, we find that bids by rational depositors are higher in the simultaneous environment. The difference is statistically significant for patient depositors (7.61 ECUs vs 6.66 ECUs, $p = 0.046$) but not for impatient depositors (7.23 ECUs vs 6.68 ECUs, $p = 0.26$). This seems to support the idea that the high bids in the sequential environment are partially explained because of the behavior of irrational depositors.

Finding 5: *Irrational depositors bid more than rational depositors to arrive early at the bank in the sequential environment.*

A second mechanism that we believe to be of great importance in the sequential environment is the possibility of panic bank runs. Subjects might be perfectly rational but believe that the observation of withdrawals will induce additional withdrawals. This will lead to a bank run if the impatient depositor decides first and a patient depositor observes the withdrawal. A way to counteract such behavior is to bid high in order to be the first in the sequence of decisions and then to keep the funds deposited so as to induce the other patient depositor to do so as well, assuming that the other patient depositor will choose her best response upon observing that another depositor chose to keep her money in the bank. In our data, subjects who decided to keep the money in the bank in position 1 bid higher than those who decided to withdraw in position 1 (7.54 vs 5.73, $p = 0.045$). This, in turn, provides evidence that patient depositors run to keep the funds deposited and *induce* the other patient depositor to coordinate on the efficient outcome with no bank runs.[17] We summarize these results as follows:

Finding 6: *Reaction to panic bank runs and beliefs about the irrational behavior of others urge*

[17] See Masiliunas (2017) or Kinateder et al. (2015) for related evidence that subjects are willing to pay to reveal their types and facilitate coordination on the efficient equilibrium.

some patient depositors to arrive early at the bank. These depositors keep their funds deposited to induce other patient depositors to follow suit.

Up to this point, we have shown that bids do not differ neither across liquidity types, nor across informational environments (Finding 1). We have documented that neither beliefs about bank runs (Finding 2), nor withdrawal decisions (Finding 3) affect the costly effort made to arrive early at the bank in the simultaneous setup. Depositors believe that bank runs will be less likely in the sequential than in the simultaneous environment (Finding 4). The irrational behavior of depositors and their desire to achieve the efficient outcome may explain why depositors rush in the sequential setup (Findings 5 and 6).

As argued before, depositors may display a large degree of heterogeneity. In what follows, we use econometric analysis to see if the previous findings hold when controlling for a wide range of variables and the analysis also allows us to assess the importance of the individual characteristics on the decision to run early to the bank.[18] Table 5 reports the results of a Tobit regression on the amount that depositors bid in the simultaneous environment, depending on their roles as patient or impatient depositors. Table 6 replicates the analysis for the sequential environment. In each case, our first regression controls for risk preferences, loss and ambiguity aversion. We include the demographic variables (Age and Gender) in our second regression. Our third regression controls for income, trust in institutions (especially in banks) and cognitive abilities, while the fourth regression also includes personality traits (Big Five and Social Value Orientation). In our analysis for patient depositors, we consider a dummy variable (Decision) that takes the value 1 when they withdraw their funds from the bank. In the sequential environment this variable indicates whether patient depositors are interested in inducing other patient depositors to wait. To control for the possibility of irrational subjects in the sequential environment, we also include a dummy variable that takes the value 1 for subjects who withdraw in position 3.[19]

[18]For simple correlations between bidding behavior and individual traits see Appendix D.

[19]Our results are robust if we include as irrational subjects also those patient depositors who withdraw upon observing that somebody kept her funds deposited. We note that our regressions do not control for the beliefs of depositors regarding the occurrence of bank runs. This is because such beliefs are highly correlated with the withdrawal decision of depositors, even though they do not affect the bidding decision.

Table 5: Bidding behavior in the simultaneous environment

	Patient depositor allowed to keep the money in the bank or withdraw				Impatient depositor forced to withdraw			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	8.162***	4.583	5.721*	13.68*	8.316***	11.63***	12.34***	9.854*
	(1.4)	(3.552)	(3.06)	(7.914)	(1.448)	(2.72)	(3.584)	(5.862)
Decision	-0.098	-0.263	-0.402	0.078				
	(1.238)	(1.217)	(1.198)	(1.972)				
Risk aversion	1.058	0.97	1.273	1.164	0.99	0.984	0.925	0.903
	(1.576)	(1.484)	(1.497)	(1.622)	(1.008)	(1.014)	(1.078)	(1.2)
Loss aversion	-2.086**	-2.189***	-2.637***	-3.127**	-2.572**	-2.115*	-2.182**	-2.447*
	(0.814)	(0.819)	(0.951)	(1.227)	(1.283)	(1.075)	(1.093)	(1.375)
Ambiguity aversion	0.021**	0.020**	0.011	0.009	0.001	0.002	0.002	0.004
	(0.009)	(0.009)	(0.01)	(0.012)	(0.007)	(0.007)	(0.01)	(0.006)
Age		0.166	0.146*	0.168		-0.124*	-0.140**	-0.137**
		(0.102)	(0.081)	(0.114)		(0.064)	(0.058)	(0.066)
Gender (=1 if female)		0.184	-0.354	0.509		-1.585	-1.632	-1.438
		(1.008)	(1.142)	(0.89)		(1.228)	(1.444)	(1.315)
Controls (income, confidence, CRT)			Yes	Yes			Yes	Yes
Personality (BIG5 and SVO)			No	Yes			No	Yes

Notes. We have a total of 131 observations in the simultaneous setting (10 left-censored, 117 uncensored, and 4 right-censored observations). In the sequential setting, we have 144 observations (19 left-censored, 118 uncensored, and 7 right-censored observations). Robust standard errors in parentheses are clustered at the session level. Significance at the *** p<0.01, ** p<0.05, * p<0.1.

Consider first the simultaneous environment in Table 5. When depositors are in the role of patient depositors, bids are not driven by whether or not subjects want to withdraw their money from the bank as the variable Decision (=1 if withdrawal) is not significant in any of the specifications, confirming Finding 3. Loss aversion seems to be a determinant of their bids. Although this effect was expected, the negative sign of loss aversion indicates that loss-averse subjects tend to bid *less* than those who are not loss-averse. One possible reason to reconcile this finding is that subjects perceive that bidding in the simultaneous environment (where they cannot make visible their decision to subsequent participants) will not help to foster coordination, thus loss-averse subjects prefer to keep their initial endowment of 20 ECUs rather than bidding to decide when to go to the bank.[20]

[20] We also find an effect of ambiguity aversion on bidding behavior, but the effect vanishes when we include additional controls; e.g., overconfidence, cognitive reflection, or personality traits. Among them, the only one that is significant

Hence, loss-averse subjects possibly view as a loss to submit a bid and therefore they bid less. When we consider the decision of impatient depositors (who are forced to withdraw) we confirm that loss aversion has a negative and significant effect on the bidding behavior. The effect of loss aversion for patient and impatient depositor is not statistically different. Our personality measures (Big Five and Social Value Orientation) are not significantly associated with the bid neither for the patient, nor for the impatient depositor.

Finding 7: *In the simultaneous environment, loss aversion plays a role in the bidding decision of depositors. In particular, we find that loss averse depositors are less likely to arrive early at the bank.*

Next, we look at the bidding behavior in the sequential environment in Table 6. If bank runs are due to coordination problems, subjects should bid nothing in this environment. However, we observe positive bids (and these bids are not statistically different from the ones in the simultaneous environment, except when we exclude irrational subjects, as indicated in our Findings 1 and 5). In line with our previous discussion, our econometric analysis lends support to Finding 5, since subjects who withdraw in position 1 tend to bid significantly less than those who keep their money in the bank; i.e., the patient depositor tends to arrive early at the bank to keep her funds deposited and induce the other patient depositor to act in the same way. There is also a significant effect of rationality in that those who are irrational tend to bid more, again confirming Finding 5.[21] Finally, we find that loss-averse subjects in the role of patient depositors tend to bid more than subjects who are not classified as loss-averse. This is in line with the idea that subjects in the sequential environment want to avoid a bank run and prefer to bid to show their choice to other depositors. Seemingly, in the sequential setup subjects see it as a loss if they fail to coordinate on the efficient outcome and a way to avoid this failure is to actively promote coordination. In fact, a loss-averse depositor is more likely to keep her funds deposited in position 1 than a depositor who is not loss-averse (31.2% vs. 21.1%). Our findings for impatient depositors suggest that loss aversion has no effect when depositors are forced to withdraw in the sequential environment. Again, the personality traits show no significant association with the bid.

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is cognitive ability; subjects with higher score in the Cognitive Reflection Test tend to bid less ($p = 0.047$). For the effect of cognitive reflection on financial decisions see Korniotis and Kumar (2010).

[21]The differences in the withdrawal rates of rational (21.70%) and irrational (22.22%) subjects is not statistically significant (p = 0.953), thus we can conclude that irrational subjects do not tend to bid more because they are more likely to withdraw in position 1.

Table 6: Bidding behavior in the sequential environment

	Patient depositor allowed to keep the money in the bank or withdraw				Impatient depositor forced to withdraw			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	7.969***	5.799***	6.171***	8.687*	7.286***	4.788*	3.266	8.402**
	(1.084)	(1.542)	(1.692)	(4.513)	(1.759)	(2.633)	(2.7)	(3.959)
Decision (=1 if withdraw)	-2.035*	-1.814	-2.023**	-2.020*				
	(1.12)	(1.097)	(1.007)	(1.183)				
Irrational subjects	3.621***	3.375***	3.313***	3.744***	2.200*	1.789	2.290*	2.124
	(1.101)	(1.112)	(1.035)	(0.934)	(1.12)	(1.125)	(1.236)	(1.325)
Risk aversion	-0.25	-0.546	-0.432	-0.497	-0.59	-1.069*	-0.772*	-0.435
	(1.118)	(1.083)	(1.196)	(1.249)	(0.683)	(0.613)	(0.464)	(0.644)
Loss aversion	2.558***	2.663***	2.803***	2.899***	1.507	1.603	1.746	1.747
	(0.746)	(0.905)	(0.897)	(0.905)	(1.46)	(1.342)	(1.445)	(1.362)
Ambiguity aversion	-0.009	-0.01	-0.012	-0.009	-0.015***	-0.017**	-0.013*	-0.0148
	(0.011)	(0.013)	(0.012)	(0.01)	(0.006)	(0.008)	(0.007)	(0.009)
Age		0.118*	0.120**	0.126*		0.161**	0.139**	0.137*
		(0.063)	(0.058)	(0.071)		(0.066)	(0.067)	(0.0786)
Gender (=1 if female)		-0.985	-0.858	-0.862		-1.909***	-0.862*	-0.867
		(1.057)	(0.713)	(0.565)		(0.622)	(0.464)	(0.732)
Controls (income, confidence, CRT)			Yes	Yes			Yes	Yes
Personality (BIG5 and SVO)			No	Yes			No	Yes

Notes. We have a total of 131 observations in the simultaneous setting (10 left-censored, 117 uncensored, and 4 right-censored observations). In the sequential setting, we have 144 observations (19 left-censored, 118 uncensored, and 7 right-censored observations). Robust standard errors in parentheses are clustered at the session level. Significance at the *** p<0.01, ** p<0.05, * p<0.1.

Finding 8: *In the sequential environment, loss aversion plays a role in the bidding decision of patient depositors. In particular, loss-averse depositors bid more in order to arrive earlier at the bank.*

4.2 Behavior of depositors in the bank run game

For the sake of completeness, we report in Table 7 the withdrawal rates of patient depositors in the simultaneous and the sequential environment.[22] In this section, we also discuss the importance of beliefs and rationality on the depositors' behaviour.

	Withdrawal rate
Simultaneous environment	15.4%
Depositor expects a bank run	50%
Depositor expects no bank run	9%
Sequential environment	
Depositor 1 (Obs. nothing)	21.8%
Depositor 2 (Obs. withdrawal)	57.7%
Depositor 2 (Obs. waiting)	5.1%
Depositor 3 (Obs. a waiting and a withdrawal)	8.6%
Depositor 3 (Obs. two withdrawals)	9%

Table 7: Withdrawal rates of patient depositors in each informational environment.

We observe in Table 7 that the withdrawal rate is slightly over 15% in the simultaneous environment. Theoretically, beliefs on the occurrence of bank runs are the key variable to explain the behavior of patient depositors in this environment. Empirically, we find support for this prediction; e.g., the test of proportion suggests that patient depositors are more likely to withdraw when they expect a bank run compared with the case in which they do not expect a bank run (50% vs 9%, $p = 0.003$).[23]

Finding 9: *Beliefs on the occurrence of bank runs affect the withdrawal decisions of patient*

[22]When observing that a depositor kept her funds in the bank and another one withdrew, we asked subjects what they would do if depositor 1 kept the money in the bank and depositor 2 withdrew and the other way around. In line with the theoretical prediction, depositor 3 does not react differently to this information (9% vs. 8.3%, p = 0.808), thus we pool the results ("Obs. that a depositor kept her funds in the bank and another one withdrew"). In addition, we note that most of the subjects are rational in that the withdrawal rate of depositor 3 is rather low (less than 10%).

[23]The likelihood of withdrawal in the simultaneous environment does not seem depend on the depositor's belief regarding her position in the line, according to the Kruskal-Wallis test ($p = 0.89$). These findings are robust to an econometric approach.

depositors in the simultaneous environment in the expected way.

The sequential environment allows depositors to observe what other depositors have decided. Theoretically, this should facilitate coordination in that *i*) any patient depositor should keep her funds deposited, regardless of what she observes, and *ii*) any withdrawal from depositor 1 should be assigned to the impatient depositor. Although we expect no bank runs due to coordination problems because of these reasons, we find that panic bank runs emerge when choices are observable, as reported in Kiss et al. (2018). Hence, the test of proportion suggests that depositor 2 is more likely to withdraw upon observing a withdrawal than observing that a depositor kept her money in the bank (57.7% vs. 5.1%, $p < 0.001$). In addition, depositors believe that withdrawals from depositor 1 are not always due to the impatient depositor; e.g., 66% of depositors believe that the withdrawal was due to the patient depositor or any of the two depositors (the patient and the impatient) with the same probability. When depositor 2 observes a withdrawal, she tends to withdraw regardless of whether she believes that the observed withdrawal was due to the patient or the impatient depositor ($p = 0.29$) which suggests that the observation of the withdrawal distorts the beliefs that a bank run is underway and provokes panic behavior (see Kiss et al., 2018, for further discussion on this topic). Beliefs on the rationality of others are also important to withdrawal decisions in the sequential environment. When depositor 1 believes that there will be more than one withdrawal, she withdraws more frequently than when she expects only one withdrawal (the one of the impatient depositor) (34.4% vs. 16.2%, $p < 0.032$)

Overall, our findings highlight that beliefs on the occurrence of bank runs affect withdrawal decisions in the simultaneous and the sequential environment. In the former setting, depositors tend to withdraw when they expect a bank run, even though their intention to withdraw does not affect their willingness to arrive early at the bank. In the sequential environment, depositors should keep their funds deposit regardless of what they observe, and this should prevent them from rushing early to the bank. Arguably, we find that depositors believe that panic bank runs may occur in the sequential environment. Depositors react to these beliefs by making costly effort to arrive early at the bank.

5 Discussion and conclusion

This study was motivated by the paucity of theoretical and empirical evidence regarding how lines of depositors form in front of banks. Theoretically, researchers generally assume that lines form randomly, reflecting their lack of knowledge about who rushes to the banks. Empirically, it is hard to address this question. Even if we observe the line, we ignore the liquidity needs of the depositors and the information they use when choosing if to withdraw or not. Covering this gap, to our best knowledge we are the first to study the formation of the line.

To achieve our objective, we build a theoretical model that yields useful predictions about the formation of lines, depending on the informational environment. A basic assumption behind the model is that the willingness to pay for position in the line in the form of a bid is a good proxy for the costly effort that an individual would make to arrive early at the bank. Theory predicts that when decisions of withdrawing or keeping the money deposited are observable, then we should not observe any bank runs for any line that may arise and as a consequence no effort is needed to achieve the first best. In contrast, when these decisions cannot be observed, then beliefs about the decision of other depositors determine both the bids and also the subsequent decisions.

We designed an experiment to investigate both the effect of the informational environment and liquidity type. We also posit some conjectures about how individual characteristics may affect our theoretical predictions. Interestingly, the descriptive statistics show no significant differences between the bids (and hence in our interpretation the efforts to arrive early at the bank) neither across liquidity types (patient vs. impatient), nor across informational environments (simultaneous vs. sequential). Beliefs reveal that participants expected less bank runs in the sequential setup, but they did not believe that no coordination failure would arise there. We observe that both irrational behavior and the desire to coordinate on the efficient equilibrium play a role. More precisely, some participants were not fully rational (as they did not recognize dominant strategies in some information sets) and irrationality led to higher bids, *ceteris paribus*. Moreover, we document that some participants in the role of the patient depositor seemed to bid high to be the first in the sequence of decision to keep her funds deposited, thus inducing the other patient depositor to do the same (and prevent a panic bank run). Possibly, this wish to coordinate with other depositors by making visible the decision to keep the funds deposited could be harnessed by banks or regulators.

When considering a wide range of individual traits, we find that among the uncertainty measures, loss aversion seems to play an important role even if we control for the personality traits captured by the Big Five and the Social Value Orientation (that in turn do not affect bids). In the simultaneous setup loss-averse subjects seem to perceive money spent on the bid as a loss, so they submit significantly lower bids. However, in the sequential setup loss-averse subjects in the role of patient depositors submit significantly higher bids, *ceteris paribus*. This is in line with the desire to coordinate on the efficient equilibrium. Possibly, subjects as patient depositors in this setup perceive as a loss if they fail to achieve the highest payoff related to the no-bank-run outcome, and are willing to make costly effort to obtain those payoffs. Note also that in the sequential setup loss aversion does not influence the bids submitted by the impatient depositor.

Even though we do not find that the informational environment affects bids and only document some evidence that individual characteristics influence who runs first to the bank, this seeming non-result is a contribution to the literature in our view. On the theoretical front, our results suggest that the assumption that lines form randomly in front of banks is not wrong, at least it does not contradict our findings. Furthermore, theorists should consider using utility functions that captures loss aversion. Regarding policy recommendation, our findings indicate that information about other depositors decisions does not affect how lines form in front of banks and among a battery of personality traits and preferences only loss aversion seems to play some role. However, in line with the existing literature we document that beliefs affect withdrawal decisions, that is the action that depositors undertake once the line is formed. The policy governing financial stability has an important role in affecting these beliefs, because if depositors believe that others will not withdraw their funds, then they will not withdraw either. For instance, a credible deposit insurance scheme may prevent inefficient bank runs even if decisions of other depositors is not observable.

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Appendix A: Theoretical prediction - The role of observability of withdrawal decisions

We modify the workhorse model in Diamond and Dybvig (1983) by adding a bidding stage before the withdrawal decision of depositors. We also allow for the observability of actions in the sequential environment.

A.1 Depositors

There are three time periods denoted by $t = 0, 1, 2$. Period 1 is divided into subperiods as will be detailed later. There is a finite set of depositors denoted by $I = \{1, ..., N\}$, where $N > 2$. The consumption of depositor $i \in I$ in period $t = 1, 2$ is denoted by $c_{t,i} \in \mathbb{R}^0_+$, and her liquidity type by θ_i. It is a binomial random variable with support given by the set of liquidity types $\Theta = \{0, 1\}$. If $\theta_i = 0$, depositor i is called *patient*, that is, she only cares about consumption at $t = 1$. If $\theta_i = 0$, depositor i is called *patient*. Depositor i's utility function is given by

$$u_i(c_{1,i}, c_{2,i}, \theta_i) = u_i(c_{1,i} + (1 - \theta_i)c_{2,i}).$$

Similarly to Diamond and Dybvig (1983), we assume that depositors are sufficiently risk-averse and the Inada-conditions are met. The number of patient depositors is assumed to be constant and given by $p \in \{1, ..., N\}$ and the remaining depositors are impatient. The number of patient and impatient depositors is common knowledge. The liquidity type is private information.

A.2 The bank

At $t = 0$, each depositor $i \in I$ has one unit of a homogeneous good which she deposits in the bank. The bank offers a simple demand deposit contract to the depositors that stipulates that upon withdrawal in period 1 depositors receive $c_1 > 1$ unless the funds available to pay that amount decrease to very low levels or zero. We assume that an optimization exercise in the spirit of Diamond and Dybvig (1983) determines c_1. The first best allocation solves

$$\max_{c_1,c_2}(N - p)u_i(c_{1,i}) + pu_i(c_{2,i})$$

$$\text{s. t. } (N - p)c_1 + \tfrac{p}{R}c_2 = N.$$

The solution to this problem is

$$u'(c_1^*) = Ru'(c_2^*),$$

which, as in Diamond and Dybvig (1983)), implies that $R > c_2^* > c_1^* > 1$. In the first best allocation, all impatient depositors consume c_1^* at $t = 1$, and all patient ones c_2^* at $t = 2$. Hence, patient depositors receive a higher consumption than impatient ones.

Let $\eta \in \{0, ..., p\}$ be the number of depositors who keep their money deposited at $t = 1$.[24] Following the Diamond-Dybvig model it is assumed that all players who keep their money in the bank at $t = 1$, obtain the same consumption at $t = 2$, namely,

$$c_2(\eta) = \max\{0, \tfrac{R(N-(N-\eta)c_1^*)}{\eta}\}.$$

If $\eta = p$, only impatient depositors withdraw at $t = 1$, and $c_2(\eta) = c_2^* > c_1^*$. Then, patient depositors enjoy a higher consumption than impatient ones. Given p, N and c_1^*, it is possible to determine how many patient depositors have to keep their funds deposited in order for doing so to be an optimal strategy for each of them. Second-period consumption is higher than consumption received after withdrawing at $t = 1$ if the following holds

$$\frac{R(N-(N-\eta)c_1^*)}{\eta} > c_1^*.$$

This condition is equivalent to

$$\eta > \frac{RN(c_1^* - 1)}{c_1^*(R-1)}.$$

Since η is a natural number so the previous condition becomes

$$\eta \geq int\left[\frac{RN(c_1^* - 1)}{c_1^*(R-1)}\right] + 1.$$

Given p, N and c_1^*, there is a unique $\bar{\eta}$ such that $1 \leq \bar{\eta} \leq p$, and for every patient depositor i who keeps her funds deposited receives $c_2(\eta) \leq c_1^*$, for all $\eta \leq \bar{\eta}$, and $c_2(\eta) > c_1^*$, for all $\eta > \bar{\eta}$.[25]

The bank is able to pay c_1^* to $int\left[\frac{N}{c_1^*}\right]$ depositors. After $int\left[\frac{N}{c_1^*}\right]$ withdrawals the bank has possibly some funds left over (it is strictly less than c_1^*) that it can pay to the next withdrawing depositor. We denote this sum c_1^{low}. All subsequent depositors who want to withdraw receive zero.

[24] Note that η is restricted to be equal to p or smaller since an impatient depositor has a dominant strategy to withdraw, and thus, not more than p depositors keep their funds deposited.

[25] We use "wait" and "keep the money deposited / in the bank" in an interchangeable manner.

A.3 Strategies and equilibrium

Period 1 is divided in two parts in which the two stages of the underlying game are played. In the first one, depositors submit a bid that determines their position in the sequence of decision. In the second stage, depositors decide sequentially whether to wait or to withdraw their funds from the bank. We assume that bids are not publicly observable. Regarding the information that depositors have in the second stage, we consider two setups: i) simultaneous and ii) sequential. In the simultaneous setup depositors know their position in the sequence, but actions of other depositors are not observed. In the sequential setup, previous decisions are observed.

We assume that bids are bounded from above, so nobody can bid more than a certain amount that we denote by b_{max}. For simplicity, we assume that every depositor has an endowment b_{max} that can be used for bidding. We denote by $b_i \in [0, b_{max}]$ the amount submitted by depositor i in the first stage. The ranking of bids determines the sequence of decision, so for instance the depositor who submitted the highest bid is the first to decide in the second stage. If more than one depositor submits the same bid, then each has the same probability of being the first to act. Let $b = (b_1, ..b_i, ..b_N)$ be the vector of all bids. Function $r(b_i, b) : b_i \times b \to [1, N]$ ranks the bids and determines the sequence. We denote by r_i the position of depositor i.

The decision in the second stage is binary, $s_i \in \{0, 1\}$ where 0 denotes keeping the money deposited, while 1 represents withdrawal. Impatient depositors' decision in stage 2 is always to withdraw ($s = 1$), but it depends on their bids when they get the chance to do so. The strategy of a patient depositor i is $(b_i; s_i)$. Any depositor's final payoff is the consumption received from the bank (which depends on whether the depositor withdraws and on the other depositors' choices) plus the endowment for bidding minus the actual bid. To sum up, the final payoffs are as follows:

$$c_{1,i} = \begin{cases} c_1^* + (b_{\max} - b_i), & \text{if } s_i = 1 \text{ and } \sum_{j=1}^{r_i - 1} s_j < int\left[\frac{N}{c_1^*}\right], \\ c_1^{low} + (b_{\max} - b_i), & \text{if } s_i = 1 \text{ and } \sum_{j=1}^{r_i - 1} s_j = int\left[\frac{N}{c_1^*}\right], \\ 0 + (b_{\max} - b_i), \text{ if } s_i = 1 \text{ and } \sum_{j=1}^{r_i - 1} s_j > int\left[\frac{N}{c_1^*}\right] \end{cases}$$

$$c_{2,i} = \left\{ \; c_2(\eta) + (b_{\max} - b_i), \quad \text{if } s_i = 0 \right.$$

The first row says that if the bank has enough funds (that is, the number of previous withdrawals is sufficiently low) and depositor i decides to withdraw, then she receives c_1^*. However, if previous withdrawals depleted the funds of the bank in such a way that it has less than c_1^*, then the bank pays whatever is left to the withdrawing depositor (c_1^{low} in the second row). And if a depositor who attempts to withdraw comes too late, then she receives zero. For simplicity, we assume that $c_1^{low} = 0$. In the last line that describes second-period consumption for those who keep their funds deposited, $c_2(\eta)$ is given by (5).

A.4 Equilibrium

We solve the game using backward induction. Thus, first we determine how depositors decide in the second stage given the available information. Then, we see how the optimal bids are in the first stage. In equilibrium, nobody would like to deviate unilaterally, that is given the bid and the decision of others nobody would like to change her bid and decision.

A.4.1 Sequential setup

We begin with the second stage that is complicated since decisions can be based now also on what is observed. Hence, a strategy for a patient depositor specifies what the depositor should do at any position and given any sequence of previous decisions that she might observe. Kinateder and Kiss (2014) show in an equivalent setup that for any possible sequence of decisions patient depositors do not withdraw. This result applies to our paper as well. Given the unique equilibrium in the subgame played in the second stage no depositor has incentives to submit a positive bid.

Proposition 1: Given the payoffs, depositors submit zero bids in stage 1 and in stage 2 patient depositors wait and impatient depositors withdraw.

A.4.2 Simultaneous setup

Again we start with the second stage. Since previous decisions cannot be observed, decisions can be conditioned only on type (patient vs. impatient) and the belief about the other depositors' decisions. Note that we do not impose that these beliefs cannot depend on position. The important thing is what a patient depositor believes about the number of patient depositors (other than her) who choose to wait. We denote the belief of depositor i by β_i. Clearly, if $\beta_i \geq \bar{\eta}$, then her optimal decision is to wait also. Otherwise, the optimal decision given the payoffs is to withdraw.

$$BR_i(\beta_i) = \begin{cases} 1 & \text{if } \beta_i < \bar{\eta}, \\ 0 & \text{otherwise} \end{cases}$$

Theoretically, if there is a mechanism that coordinates beliefs of the depositors (as the sunspots in Diamond and Dybvig (1983)), then there should be two equilibria for any given sequence of decision: either a full-fledged bank run or an equilibrium in which no patient depositor withdraws.

Given these best responses, how should a depositor bid in the first stage? If depositors are rational and take into account the structure of the game, then their bidding depends on what they expect to happen in stage 2. If any depositor (patient or impatient) believes that at most $N - \bar{\eta}$ depositors withdraw, then there is no point in bidding any positive amount in order to be at the beginning of the line. Otherwise, if a depositor believes that there will be a bank run in stage 2, then it pays off to submit a positive bid if in expected terms it yields a higher utility than bidding zero. That is,

$$\Pr{}_i(b_i) * u_i(c_1^* + b_{\max} - b_i) + (1 - \Pr(b_i))u_i(0 + b_{\max} - b_i) > u(0),$$

where $\Pr_i(b_i)$ is a function that maps b_i into a subjective probability of being among the first $int\left[\frac{N}{c_1^*}\right]$ according to the bidden amount. Thus, $\Pr_i(x) = 0.8$ means that individual i believes that if she bids x, then with 80% probability she will be among the first $int\left[\frac{N}{c_1^*}\right]$ depositors and receives c_1^*.

What is the optimal amount to bid if a depositor believes that there will be a run? It solves the following optimization problem

$$\max_{b_i} \Pr{}_i(b_i)u_i(c_1^* + b_{\max} - b_i) + (1 - \Pr{}_i(b_i))u_i(0 + b_{\max} - b_i)$$

$$s.t.$$

$$\Pr{}_i(b_i) * u_i(c_1^* + b_{\max} - b_i) + (1 - \Pr{}_i(b_i))u_i(0 + b_{\max} - b_i) > u(0)$$

$$b_i \leq b_{\max}$$

Notice that we deliberately denote the utility function as u_i attempting to express that the way depositors value the utility derived from consumption may vary from individual to individual according to individual traits.

Unless we impose a specific functional form the utility we cannot solve the problem. It is not important for us to derive an exact solution. We are satisfied with more general predictions that rely on the beliefs of the depositors.

Proposition 2:

- If a patient depositor believes that the number of withdrawals in stage 2 of period 1 will be less or equal to $\bar{\eta}$, then she bids zero in stage 1. If a patient depositor believes that the number of withdrawals in stage 2 of period 1 will be more than $\bar{\eta}$, then she bids a positive amount up to $b_{\max}$.

- If an impatient depositor believes that the number of withdrawals in stage 2 of period 1 will be less or equal to $int\left[\frac{N}{c_1^*}\right]$ depositors, then she bids zero in stage 1. If an impatient depositor believes that the number of withdrawals in stage 2 of period 1 will be more than $int\left[\frac{N}{c_1^*}\right]$, then she bids a positive amount up to $b_{\max}$.

Proof. If a patient depositor expects the number of total withdrawals to be less than $\bar{\eta}$, then she expects the bank to have enough funds in period 2 so that her consumption will be larger than c_1^*. In this case, she does not want to waste resources on bidding. In the opposite case, it does not pay off to wait until period 2, as the payoff will be lower, than the payoff in period 1 if she obtains a sufficiently good position in the line. The amount to bid depends on how many other patient depositor she expects to withdraw. In the worst case, she may expect all other patient depositor to withdraw also. In this case, she may bid a high amount, but never higher than $b_{\max}$.

If an impatient depositor expects the number of total withdrawals to be less than or equal to $int\left[\frac{N}{c_1^*}\right]$, then she believes that by withdrawing she will receive c_1^*, so there is no point in spending resources on bidding. If she believes the number of withdrawals to be higher, then she bids what she deems necessary to have a positive utility, her maximum bid being $b_{\max}$. □

Note that the previous proposition is not about equilibrium, but individual decisions. Clearly, if many depositors hold pessimistic beliefs (that may be affected by individual traits) about decisions in stage 2, then a bank run occurs. In the opposite case, bank run may not occur. However, it is possible that more depositors withdraw than the number of impatient depositors. Since there are no coordination devices (as the sunspots in the original Diamond-Dybvig study), it is possible that miscoordination happens. Beliefs govern what happens in this setup. In the experiment we control for beliefs as we ask the participants what they think how many of the other depositors chose to withdraw.

Appendix B: Conjectures on the effects of individual traits

In this Appendix we formulate some conjectures on the potential effect of some variables that we measure in the experiment on the bidding of the participants.

We start with cognitive abilities. In Kiss et al. (2016b) we investigated to some extent the effect of cognitive abilities (measured by the Cognitive Reflection Test) on decisions in some information sets with dominant strategies in a bank run experiment. We found that individuals with better cognitive abilities chose the dominant strategy more often in the presence of strategic uncertainty. In general, we may expect individuals with better cognitive abilities to make better choices. Regarding withdrawal decisions, it implies that in the sequential setup they would keep their funds deposited if being the first to decide or if observing that somebody has already kept her money in the bank. In the simultaneous setup, beliefs determine what is the best response. Turning to bidding choices, note that in the simultaneous setup it is a dominated strategy to bid high and then keep the funds deposited. Hence, we expect a participant with a high CRT score either in the role of a patient or impatient depositor to bid high and then to withdraw. Things are less clear in the sequential setup, because participants as patient depositor may want to bid high to arrive early to the bank and then by keeping their money deposited they could try to induce the other patient depositor to follow suit. This signaling behavior has been observed by Kinateder et al. (2015). However, in the case of the impatient depositor who lacks any incentive to show others that she does not withdraw we expect that individuals with better cognitive abilities will bid low. Note that these conjectures are often complex as they relate bidding and withdrawal decisions or are dependent on the information environment and / or the liquidity type of the depositor.

We consider next the effect of income and the trust in institutions. As seen in the literature review, more wealthy individuals tend to be more sophisticated, so they usually make better decisions. In this sense, the predictions for higher income correlate with those related to better cognitive abilities. Trust in institutions and especially in banks implies that a participant who trusts institutions is less likely to withdraw in the second stage in both setups. Therefore, she is less worried about arriving early at the bank, so she would bid lower, *ceteris paribus*.

To measure personality traits we use the Big Five. *Openness to experience* that reflects intellectual curiosity and creativity *a priori* does not seem to be related to bidding behavior in our experiment. Individuals are described by *conscientiousness* if - among others - they prefer planned rather than spontaneous behavior. These planning may be related to bidding decisions that correspond to the theoretical predictions. *Extraversion* reflects energy, positive emotions, assertiveness and sociability, traits that do not seem to imply a clear bidding behavior. *Agreeableness* expresses the tendency to be compassionate and cooperative, and is also a measure of trusting and helpful behavior. It may affect the beliefs an individual has about the other patient depositor's decision. The less agreeable a participant is, the more she may believe that there will be a bank run that in turn implies higher bids in the simultaneous setup. Individuals exhibiting *neuroticism* tend to experience unpleasant emotions (such as anger, anxiety and depression) easily. Related to bidding behavior in our experiment, the more neurotic a participant is, the more she may want to avoid having to be concerned about the other patient depositor's decision and may submit a higher bid.

Related to personality traits we also measured social preferences that were elicited using the 9-Item Triple-Dominance Measure of a Social Value Orientation (SVO) (see Van Lange et al., 1997) that is widely used to measure such preferences in social psychology (see Murphy and Ackermann, 2011). More concretely, the test classifies individuals as *prosocial*, *individualistic* or *competitive* if she makes at least 6 choices that correspond to that category in 9 allocation tasks.[26] Since receiving the highest payoff depends on the choice of the other patient depositor, so it requires coordination, we expect that individuals classified as prosocial tend to attempt to achieve those payoffs by waiting in the second stage. That in turn implies that in the simultaneous setup these individuals would bid lower, *ceteris paribus*. In the sequential setup, their behavior is less clear as they may bid high to be the first to decide and then keep the money in the bank and induce the subsequent patient depositor to do so as well. Following similar arguments, individualistic participants may tend to care only for themselves and try to receive the sure payoff related to withdrawal. Therefore, in both treatments we expect them to bid high and withdraw, *ceteris paribus*.

[26]Note that an individual is not classified if her choices do not correspond consistently with one of the categories.

Appendix C: Instructions

Here we reproduce the instructions, translated from Spanish.

Simultaneous treatment

Welcome to this experiment!

In this experiment, we study how individuals solve decision-making problems, and we are not interested in your particular decision, but in the average behavior of individuals. That is why you will be treated anonymously during the experiment and nobody in this room will ever know the decisions that you make.

Next, you will see the instructions that explain how the experiment goes. These instructions are the same for all participants and it is of utmost importance that you understand them well because your earnings will depend to a large extent on your decisions.

At the end of the experiment we will ask you to complete a long questionnaire that contains several games that allow you to earn extra money. The objective of the questionnaire is to get to know your tastes and preferences (that are not obviously the same as those of the rest of the participants) and for this reason there are no correct answers to the questions that we raise. During the questionnaire it is important that you state your preferred option in each case because your earnings from the questionnaire depend to a large degree of your decisions.

Remember that all the decisions that you make during the experiment are anonymous and will not be linked to you. If you have any doubt or question during the experiment, raise your hand and we will come to you. Remember also that you are not allowed to speak during the experiment.

What is the experiment about?

At the beginning of the experiment you will receive 60 ECUs:

- Part of the money (**20 ECUs**) is your **initial endowment**.
- The rest of the money (**40 ECUs**) is **deposited in a bank**.

The bank where your money is deposited is composed of three depositors who are in the lab. Thus, the bank has a total capital of 120 ECUs (40 ECUs from each depositor).

How can you earn money in this experiment?

In each bank, one of the depositors is chosen randomly and she will be forced to withdraw her deposit. The rest of the depositors may decide if they **withdraw their funds** from the bank or **keep them deposited** until the bank carries out a project. In any case, your earnings will depend not only on your decision, but also on how the other depositors of your bank have decided. Moreover, the position in the line may affect your earnings as we explain next.

Position in the line

To determine the sequence in which depositors make their decision, we carry out an auction. Each depositor of the bank (the one that will be forced to withdraw and those who can choose if to keep their money deposited or withdraw it) can submit a bid from her initial endowment (0, 1, 2, ..., 20 ECUs) that determines her position in the line. The depositor with the highest bid will be the first in the line, the one with the intermediate bid will be the second, and the depositor with the lowest bid will be the third. If there is a tie in the bids the positions will be determined randomly. The amount of money used for bidding is deducted from your initial endowment of 20 ECUs. You will receive the amount not used for bidding at the end of the experiment as part of your earnings.

What happens if you withdraw your deposit?

The depositor who is forced to withdraw or any other depositor who chooses to withdraw will receive 50 ECUs whenever the bank has enough funds to pay that amount. Therefore, if you are the first or the second depositor in the sequence of decision and you choose to withdraw (or you are forced to do so), then you earn 50 ECUs (this amount corresponds to your initial deposit of 40 ECUs + 10 ECUs in form of interests earned). If you are the third depositor in the line and you choose to withdraw (or you are forced to do so), then your earnings depend on what the other two depositors before you have decided:

- If only one of the previous two depositors (or none of them) chose to withdraw, then you also receive 50 ECUs, because the bank has no problems to pay that amount.
- If both of the depositors who have decided before you chose to withdraw, then your earnings amount to 20 ECUs (the amount of money that the bank has after two withdrawals).

To sum up,

What happens if you keep your money deposited?

Your position in the line	Your earnings if you withdraw
1.	50 ECUs
2.	50 ECUs
3.	20 ECUs (if the first and the second have withdrawn) 50 ECUs (if only one or none of the previous depositors has withdrawn)

After paying the depositors who chose to withdraw, the bank carries out a project and pays dividend to those depositors who decided to keep their funds in the bank.

- If two depositors choose to keep their funds deposited, then each of them earns 70 ECUs, independently of their position in the line.
- If one depositor chooses to keep her funds deposited, then she earns 30 ECUs, independently of her position in the line.

To sum up,

Your position in the line	Your earnings if you keep your money in the bank
1.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)
2.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)
3.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)

As you see, it is not possible that all three depositors of the same bank decide to keep their funds deposited. This is the case because in each bank there will be a depositor who will be forced to withdraw her funds. This depositor (as the others) can submit her bid that determines her position in the line, but she cannot choose between keeping the money deposited or to withdraw.

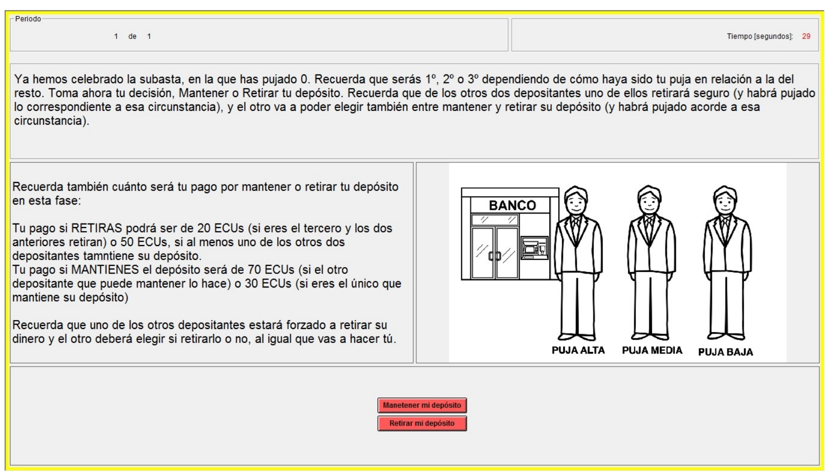
How many decisions do I have to make in this experiment?

In this experiment we ask you to submit a bid as a depositor forced to withdraw and also as one who can choose between keeping her funds deposited or withdrawing. In both cases, you may submit a bid from your initial endowment (between 0 and 20 ECUs). Furthermore, we ask you to tell us what decisions (to withdraw or to keep your funds deposited) you would make as a depositor who can decide whether to withdraw or keep her money in the bank.

In this experiment you do not know anything about the bids and the decisions (to withdraw or to keep the funds deposited) of the other depositors of your bank. You do not even know your position in the line (which depends on your bid and on the bids of the other depositors of your bank). Having in mind this information, we ask you what you would do with your deposit (keep it in the bank or withdraw it).

What information will I have in this experiment?

Next we show you one of the screens of the experiment so that you can see the way that we provide you the information.



(The Spanish text is the following: Period 1 of 1, Time (seconds):

We completed the auction, your bid was 0. Remember that you will be the first, the second or the third in the line depending on how your bid was relative to the bids of the others. Please, decide now if you want to keep your money in the bank or you want to withdraw. We remind you that one of the other two depositors will surely withdraw (and she submitted her bid knowing this), and the other one will choose between keeping her money in the bank and withdrawing (and she submitted her bid knowing this).

Remember also your payoff related to keeping your funds deposited and to withdrawal in this stage:

- If you withdraw, then your payoff may be 20 ECUs (if you are the third depositor in the line and the previous two depositors have withdrawn) or 50 ECUs if at least one of the other depositors keeps her funds deposited.
- If you keep your money deposited, then your payoff will be 70 ECUs (if the other depositor who can also keep her funds deposited does so) or 30 ECUs (if you are the only one who keeps her funds deposited).

Remember that one of the other depositors will be forced to withdraw and the other one has to choose if to withdraw her money or not, like you.

(Red buttons:) Keep the deposit in the bank

Withdraw the deposit from the bank

(In the Picture the text below the first / second / third person is High / Intermediate / Low bid.))

Note that in the upper panel we remind you of your bid and we tell you that you are one of the depositors who can choose between keeping her funds in the bank and withdrawing. On the right-hand side, in the picture you see the three depositors of the bank, ranked according to their bids (that you do not know). On the left-hand side we remind you your payoffs related to withdrawal and keeping the money deposited. Your decision can be made by clicking the corresponding button in the lower pane.

What determines your final earnings?

At the end of the experiment, the computer will choose randomly one of the three depositors of the bank to be the depositor forced to withdraw. The other two will be the depositors who can choose between keeping their funds in the bank and withdrawing. All depositors have the same probability of being chosen as the depositor forced to withdraw.

Once the depositor forced to withdraw is selected, the computer uses the submitted bids to determine the sequence of decision and deducts the bids from the initial endowments of 20 ECUs.

Next, the computer tells the decision of each depositor in function of the decisions given for all possibilities.

If you are the depositor forced to withdraw, then we deduct from your initial endowment of 20 ECUs your bid submitted as the forced depositor. And you will earn a payoff in function of your position in the line and the decision of the other depositors:

Your position in the line	Earnings
1°	50
2°	50
3°	20 or 50

In case that you are a depositor who can choose between keeping her funds in the bank and withdrawing, we deduct from your initial endowment of 20 ECUs your bid submitted as a depositor who can choose between keeping the money in the bank and withdrawal. And you will earn a payoff in function of your position in the line and the decision of the other depositors:

		If you keep your money deposited and …	
Your position in the line	If you withdraw	another depositor keeps her funds in the bank	you are the only one who keeps the money deposited
1°	50	70	30
2°	50		
3°	20 or 50		

At the end of the experiment you will receive your earnings in Euros (10 ECUs = 1 Euro).

Next, we provide some examples so that you can see how the payoffs are calculated. Before starting the experiment, there will be a trial round where you will be able to see the decision screens for the bidding and the decision if to withdraw or keep the money deposited. This trial round will not affect your final payoff. We will call your attention when the phase that determines your payoff begins.

Thanks for participating!

Example 1

Imagine depositors A, B and C and assume that the computer selects B as the depositor forced to withdraw. Here are the bids:

	Bid if you are forced to withdraw	Bid if you can choose between keeping the money or withdrawing
Depositor A	8	5
Depositor B	6	2
Depositor C	0	10

These are then the bids that determine the position:

Bid of depositor A: 5 ECUs

Bid of depositor B: 6 ECUs

Bid of depositor C: 10 ECUs

Therefore, depositor C will be the first, depositor B the second and depositor A the third in the line. These bids will be deducted from the initial endowment, so from there depositor A will receive 15 ECUs, depositor B will receive 14 ECUs and depositor C will have 10 ECUs. This amount will add to the earnings related to withdrawing or keeping the funds deposited.

For instance, assume the following decisions (ranked according to the sequence of decision)

1. - Depositor C: Keep the money deposited
2. - Depositor B: Withdraw (Forced)
3. - Depositor A: Keep the money deposited

Depositor C and A will receive 70 ECUs and depositor B receives 50 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 85 ECUs (15 initial endowment + 70 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 80 ECUs (10 initial endowment + 70 decision).

Now assume the following decisions:

1. - Depositor C: Withdraw
2. - Depositor B: Withdraw (Forced)
3. - Depositor A: Keep the money deposited

Then depositor C and B will receive 50 ECUs and depositor A receives 30 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 45 ECUs (15 initial endowment + 30 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 60 ECUs (10 initial endowment + 50 decision).

Assume the following decisions:

1. - Depositor C: Withdraw
2. - Depositor B: Withdraw (Forced)
3. - Depositor A: Withdraw

Then depositor C and B will receive 50 ECUs and depositor A receives 20 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 35 ECUs (15 initial endowment + 20 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 60 ECUs (10 initial endowment + 50 decision).

Example 2

Imagine depositors A, B and C and assume that the computer selects C as the depositor forced to withdraw. Here are the bids:

These are then the bids that determine the position:

Bid of depositor A: 5 ECUs

Bid of depositor B: 3 ECUs

Bid of depositor C: 1 ECUs

	Bid if you are forced to withdraw	Bid if you can choose between keeping the money or withdrawing
Depositor A	15	5
Depositor B	7	3
Depositor C	1	3

Therefore, depositor A will be the first, depositor B the second and depositor C the third in the line. These bids will be deducted from the initial endowment, so from there depositor A will receive 15 ECUs, depositor B will receive 17 ECUs and depositor C will have 19 ECUs. This amount will add to the earnings related to withdrawing or keeping the funds deposited.

For instance, assume the following decisions (ranked according to the sequence of decision)

1. - Depositor A: Keep the money deposited
2. - Depositor B: Withdraw
3. - Depositor C: Withdraw (Forced)

Then depositor B and C will receive 50 ECUs and depositor A receives 30 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 45 ECUs (15 initial endowment + 30 decision), depositor B receives a total of 67 ECUs (17 initial endowment + 50 decision), depositor C receives a total of 69 ECUs (19 initial endowment + 50 decision).

Assume the following decisions

1. - Depositor A: Keep the money deposited
2. - Depositor B: Keep the money deposited
3. - Depositor C: Withdraw (Forced)

Then depositor A and B will receive 70 ECUs and depositor C receives 50 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 85 ECUs (15 initial endowment + 70 decision), depositor B receives a total of 87 ECUs (17 initial endowment + 70 decision), depositor C receives a total of 69 ECUs (19 initial endowment + 50 decision).

Assume the following decisions

1. - Depositor A: Withdraw
2. - Depositor B: Withdraw
3. - Depositor C: Withdraw (Forced)

Then depositor A and B will receive 50 ECUs and depositor C receives 20 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 65 ECUs (15 initial endowment + 50 decision), depositor B receives a total of 67 ECUs (17 initial endowment + 50 decision), depositor C receives a total of 39 ECUs (19 initial endowment + 20 decision).

Sequential treatment

Welcome to this experiment!

In this experiment, we study how individuals solve decision-making problems, and we are not interested in your particular decision, but in the average behavior of individuals. That is why you will be treated anonymously during the experiment and nobody in this room will ever know the decisions that you make.

Next, you will see the instructions that explain how the experiment goes. These instructions are the same for all participants and it is of utmost importance that you understand them well because your earnings will depend to a large extent on your decisions.

At the end of the experiment we will ask you to complete a long questionnaire that contains several games that allow you to earn extra money. The objective of the questionnaire is to get to know your tastes and preferences (that are not obviously the same as those of the rest of the participants) and for this reason there are no correct answers to the questions that we raise. During the questionnaire it is important that you state your preferred option in each case because your earnings from the questionnaire depend to a large degree of your decisions.

Remember that all the decisions that you make during the experiment are anonymous and will not be linked to you. If you have any doubt or question during the experiment, raise your hand and we will come to you. Remember also that you are not allowed to speak during the experiment.

What is the experiment about?

At the beginning of the experiment you will receive 60 ECUs:

- Part of the money (**20 ECUs**) is your **initial endowment**.
- The rest of the money (**40 ECUs**) is **deposited in a bank**.

The bank where your money is deposited is composed of three depositors who are in the lab. Thus, the bank has a total capital of 120 ECUs (40 ECUs from each depositor).

How can you earn money in this experiment?

In each bank, one of the depositors is chosen randomly and she will be forced to withdraw her deposit. The rest of the depositors may decide if they **withdraw their funds** from the bank or **keep them deposited** until the bank carries out a project. In any case, your earnings will depend not only on your decision, but also on how the other depositors of your bank have decided. Moreover, the position in the line may affect your earnings as we explain next.

Position in the line

To determine the sequence in which depositors make their decision, we carry out an auction. Each depositor of the bank (the one that will be forced to withdraw and those who can choose if to keep their money deposited or withdraw it) can submit a bid from her initial endowment (0, 1, 2, ..., 20 ECUs) that determines her position in the line. The depositor with the highest bid will be the first in the line, the one with the intermediate bid will be the second, and the depositor with the lowest bid will be the third. If there is a tie in the bids the positions will be determined randomly. The amount of money used for bidding is deducted from your initial endowment of 20 ECUs. You will receive the amount not used for bidding at the end of the experiment as part of your earnings.

What happens if you withdraw your deposit?

The depositor who is forced to withdraw or any other depositor who chooses to withdraw will receive 50 ECUs whenever the bank has enough funds to pay that amount. Therefore, if you are the first or the second depositor in the sequence of decision and you choose to withdraw (or you are forced to do so), then you earn 50 ECUs (this amount corresponds to your initial deposit of 40 ECUs + 10 ECUs in form of interests earned). If you are the third depositor in the line and you choose to withdraw (or you are forced to do so), then your earnings depend on what the other two depositors before you have decided:

- If only one of the previous two depositors (or none of them) chose to withdraw, then you also receive 50 ECUs, because the bank has no problems to pay that amount.
- If both of the depositors who have decided before you chose to withdraw, then your earnings amount to 20 ECUs (the amount of money that the bank has after two withdrawals).

To sum up,

Your position in the line	Your earnings if you withdraw
1.	50 ECUs
2.	50 ECUs
3.	20 ECUs (if the first and the second have withdrawn) 50 ECUs (if only one or none of the previous depositors has withdrawn)

What happens if you keep your money deposited?

After paying the depositors who chose to withdraw, the bank carries out a project and pays dividend to those depositors who decided to keep their funds in the bank.

- If two depositors choose to keep their funds deposited, then each of them earns 70 ECUs, independently of their position in the line.
- If one depositor chooses to keep her funds deposited, then she earns 30 ECUs, independently of her position in the line.

To sum up,

Your position in the line	Your earnings if you keep your money in the bank
1.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)
2.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)
3.	70 ECUs (if the other depositor keeps her funds deposited) 30 ECUs (if you are the only depositor who keeps the money deposited)

As you see, it is not possible that all three depositors of the same bank decide to keep their funds deposited. This is the case because in each bank there will be a depositor who will be forced to withdraw her funds. This depositor (as the others) can submit her bid that determines her position in the line, but she cannot choose between keeping the money deposited or to withdraw.

How many decisions do I have to make in this experiment?

In this experiment we ask you to submit a bid as a depositor forced to withdraw and also as one who can choose between keeping her funds deposited or withdrawing. In both cases, you may submit a bid from your initial endowment (between 0 and 20 ECUs).

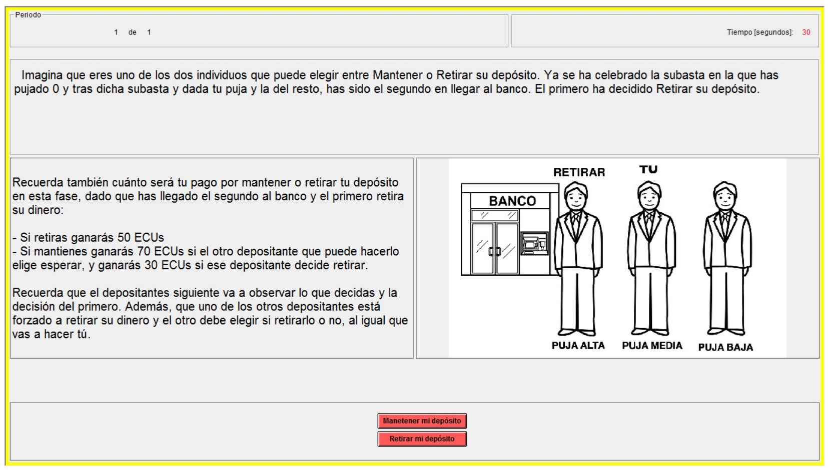
In this experiment, you do not know anything about the bids submitted by the other depositors, but you can condition your decision of withdrawing or keeping the money in the bank on what the other depositors decided to do with their deposits, if they decided before you. Thus, we ask you to tell us what you would like to do with your deposit (keep it deposited or withdraw it) if after the auction you are in the first, second or third position of the sequence of decision. Since you can condition your choice on the decisions of the other depositors of your bank, you have to make a decision in six potential scenarios:

- What do you do with your deposit if you are the first in the line
- What do you do with your deposit if you are the second in the line and the first depositor chose to keep her money in the bank
- What do you do with your deposit if you are the second in the line and the first depositor chose to withdraw her funds
- What do you do with your deposit if you are the third in the line and the first depositor chose to withdraw her funds and the second chose to keep them deposited
- What do you do with your deposit if you are the third in the line and the first depositor chose to keep her funds in the bank and the second chose to withdraw them
- What do you do with your deposit if you are the third in the line and the two previous depositors chose to withdraw their funds

Keep in mind when submitting your bid and making your decision, that the other depositors of your bank can also condition their decision on what you decided. That is, if you are the first in the line and decide to keep your money deposited or to withdraw it, the other depositors of your bank may condition their decision on what they observe.

What information will I have in this experiment?

Next we show you one of the screens of the experiment so that you can see the way that we provide you the information.



(The Spanish text is the following: Period 1 of 1, Time (seconds):

Suppose that you are one of the depositors who may choose between keeping her funds deposited or withdrawing them. We have completed already the auction, your bid was 0 and after the auction given your bid and those of the rest you are the second to arrive at the bank. The first depositor decided to withdraw her deposit.

Remember also your payoff related to keeping your funds deposited and to withdrawal in this stage given that you are the second in the line and the first one withdrew her deposit:

- If you withdraw, then you earn 50 ECUs.
- If you keep your money deposited, then your payoff will be 70 ECUs if the other depositor who can also keep her funds deposited does so or 30 ECUs if that depositor decides to withdraw.

Remember that the next depositor will observe your decision and also the decision of the first depositor. Remember also that one of the other depositors is forced to withdraw and the other one has to choose if to withdraw her money or not, like you.

(Red buttons:) Keep the deposit in the bank

Withdraw the deposit from the bank

(In the Picture the text below the first / second / third person is High / Intermediate / Low bid, and the text above the first / second person is Withdraw / You.))

Note that in the upper pane we tell you that you are one of the depositors who can choose between keeping her funds in the bank and withdrawing. We also tell you your position in the line and the decisions of the previous depositor. You can see it also on the right-hand side in the picture where you can see that you are the second in the line and that the first one has decided to withdraw. On the left-hand side we remind you your payoffs related to withdrawal and keeping the money deposited. Your decision can be made by clicking the corresponding button in the lower pane.

What determines your final earnings?

At the end of the experiment, the computer will choose randomly one of the three depositors of the bank to be the depositor forced to withdraw. The other two will be the depositors who can choose between keeping their funds in the bank and withdrawing. All depositors have the same probability of being chosen as the depositor forced to withdraw.

Once the depositor forced to withdraw is selected, the computer uses the submitted bids to determine the sequence of decision and deducts the bids from the initial endowments of 20 ECUs. Next, the computer tells the decision of each depositor in function of the decisions given for all possibilities.

If you are the depositor forced to withdraw, then we deduct from your initial endowment of 20 ECUs your bid submitted as the forced depositor. And you will earn a payoff in function of your position in the line and the decision of the other depositors:

Your position in the line	Earnings
1°	50
2°	50
3°	20 or 50

In case that you are a depositor who can choose between keeping her funds in the bank and withdrawing, we deduct from your initial endowment of 20 ECUs your bid submitted as a depositor who can choose between keeping the money in the bank and withdrawal. And you will earn a payoff in function of your position in the line and the decision of the other depositors:

Your position in the line	If you withdraw	If you keep your money deposited and …	
		another depositor keeps her funds in the bank	you are the only one who keeps the money deposited
1°	50		
2°	50	70	30
3°	20 or 50		

At the end of the experiment you will receive your earnings in Euros (10 ECUs = 1 Euro).

Next, we provide some examples so that you can see how the payoffs are calculated. Before starting the experiment, there will be a trial round where you will be able to see the decision screens for the bidding and the decision if to withdraw or keep the money deposited. This trial round will not affect your final payoff. We will call your attention when the phase that determines your payoff begins.

Thanks for participating!

Example 1

Imagine depositors A, B and C and assume that the computer selects B as the depositor forced to withdraw. Here are the bids:

	Bid if you are forced to withdraw	Bid if you can choose between keeping the money or withdrawing
Depositor A	8	5
Depositor B	6	2
Depositor C	0	10

These are then the bids that determine the position:

Bid of depositor A: 5 ECUs

Bid of depositor B: 6 ECUs

Bid of depositor C: 10 ECUs

Therefore, depositor C will be the first, depositor B the second and depositor A the third in the line. Remember that when depositor B decides (the second in the line), she will observe the decision of depositor C (who decides first) and depositor A (the last one to decide) observes both the decision of depositor C and that of depositor B. The bids will be deducted from the initial endowment, so from there depositor A will receive 15 ECUs, depositor B will receive 14 ECUs and depositor C will have 10 ECUs. This amount will add to the earnings related to withdrawing or keeping the funds deposited.

For instance, assume the following decisions (ranked according to the sequence of decision)

1. - Depositor C: Keep the money deposited

2. - Depositor B: Withdraw (Forced)

3. - Depositor A (after observing that the first one keeps the money in the bank and the second withdraws): Keep the money deposited

Depositor C and A will receive 70 ECUs and depositor B receives 50 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 85 ECUs (15 initial endowment + 70 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 80 ECUs (10 initial endowment + 70 decision).

Now assume the following decisions:

1. - Depositor C: Withdraw

2. - Depositor B: Withdraw (Forced)

3. - Depositor A (after observing two withdrawals): Keep the money deposited

Then depositor C and B will receive 50 ECUs and depositor A receives 30 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 45 ECUs (15 initial endowment + 30 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 60 ECUs (10 initial endowment + 50 decision).

Assume the following decisions:

1. - Depositor C: Withdraw
2. - Depositor B: Withdraw (Forced)
3. - Depositor A (after observing two withdrawals): Withdraw

Then depositor C and B will receive 50 ECUs and depositor A receives 20 ECUs for their decisions.

These earnings add to the earnings resulting from the bid, so depositor A receives a total of 35 ECUs (15 initial endowment + 20 decision), depositor B receives a total of 64 ECUs (14 initial endowment + 50 decision), depositor C receives a total of 60 ECUs (10 initial endowment + 50 decision).

Example 2

Imagine depositors A, B and C and assume that the computer selects C as the depositor forced to withdraw. Here are the bids:

	Bid if you are forced to withdraw	Bid if you can choose between keeping the money or withdrawing
Depositor A	15	5
Depositor B	7	3
Depositor C	1	3

These are then the bids that determine the position:

Bid of depositor A: 5 ECUs

Bid of depositor B: 3 ECUs

Bid of depositor C: 1 ECUs

Therefore, depositor A will be the first, depositor B the second and depositor C the third in the line. These bids will be deducted from the initial endowment, so from there depositor A will receive

15 ECUs, depositor B will receive 17 ECUs and depositor C will have 19 ECUs. This amount will add to the earnings related to withdrawing or keeping the funds deposited.

For instance, assume the following decisions (ranked according to the sequence of decision)

1. - Depositor A: Keep the money deposited
2. - Depositor B (after observing that the first kept her funds deposited): Withdraw
3. - Depositor C: Withdraw (Forced)

Then depositor B and C will receive 50 ECUs and depositor A receives 30 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 45 ECUs (15 initial endowment + 30 decision), depositor B receives a total of 67 ECUs (17 initial endowment + 50 decision), depositor C receives a total of 69 ECUs (19 initial endowment + 50 decision).

Assume the following decisions

1. - Depositor A: Withdraw
2. - Depositor B (after observing that the first withdrew): Withdraw
3. - Depositor C: Withdraw (Forced)

Then depositor A and B will receive 50 ECUs and depositor C receives 20 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 65 ECUs (15 initial endowment + 50 decision), depositor B receives a total of 67 ECUs (17 initial endowment + 50 decision), depositor C receives a total of 39 ECUs (19 initial endowment + 20 decision).

Assume the following decisions

1. - Depositor A: Keep the money deposited
2. - Depositor B (after observing that the first kept her funds deposited): Keep the money deposited
3. - Depositor C: Withdraw (Forced)

Then depositor A and B will receive 70 ECUs and depositor C receives 50 ECUs for their decisions. These earnings add to the earnings resulting from the bid, so depositor A receives a total of 85 ECUs (15 initial endowment + 70 decision), depositor B receives a total of 87 ECUs (17 initial endowment + 70 decision), depositor C receives a total of 69 ECUs (19 initial endowment + 50 decision).

Appendix D: Individual characteristics and bids

We move now to see how individual traits affect the size of the bid. We begin with Figure 2 that shows raw correlations between individual traits and bids in the different informational environments as impatient and patient depositors.[27]

		Impatient		Patient	
		Simultaneous	Sequential	Simultaneous	Sequential
Demographics	Age	-0.0560	0.2530***	0.1525*	0.1941**
	Female	-0.1687**	-0.1465*	-0.0456	-0.0984
Uncertainty attitudes	Risk aversion	0.1260	-0.0237	0.0913	0.0031
	Loss aversion	-0.1696**	-0.1495*	-0.1384*	-0.1175
	Ambiguity aversion	0.0268	-0.0741	0.1083	-0.0328
Other factors	Cognitive abilities	0.0585	0.2019**	-0.1670**	-0.0033
	Overconfidence	-0.0217	-0.2332***	0.1396*	-0.1622**
	Income	0.0909	0.0620	0.0171	-0.0828
	Trust in banks	0.1134	-0.0284	0.0152	-0.0422
Big Five categories	Openness to experience	0.0452	-0.1181	-0.0052	0.0152
	Conscientiousness	-0.0364	0.0279	0.0079	0.0000
	Extraversion	0.0679	-0.0723	0.0128	-0.0638
	Agreeableness	-0.0638	0.0633	-0.0157	0.0476
	Neuroticism	-0.0661	-0.0697	-0.0998	-0.0500
Social value orientation	Individualistic	-0.0068	-0.0315	-0.0318	-0.0406
	Competitive	-	-0.0303	-	-0.0622
	Prosocial	0.0752	0.1025	0.0539	0.0555

Figure 2: Raw correlations between individual traits and bidding as impatient / patient depositors in different information setups (*/**/*** denotes significance at the 10/5/1% level.)

Starting from the bottom of Figure 2, we can observe that in case of Social Value Orientation and the Big Five personality traits the (absolute value of the) correlations is rather low and none is significant at conventional significance levels. Therefore, it seems that the individual traits captured by these measures are not related to the bids submitted either as an impatient or a patient depositor in the simultaneous or sequential setup.

The same is true about family income and trust in banks (and in general in institutions). Interestingly, uncertainty attitudes measured by our risk and ambiguity aversion measures show no significant correlation with the bids in any role and in any informational environment.

[27]We do not correct here for multiple testing because we just wish to have a first look at the data and we do not want to draw too far-fetched conclusions.

The rest of the variables exhibits at least some significant correlation with the bids in some cases. Age is positively correlated with bids in 3 out of 4 cases, indicating that older depositors tend to bid higher amounts (mostly in the sequential setup).[28] As impatient depositors females tend to submit significantly lower bids. Loss aversion is weakly negatively correlated with bids, suggesting that more loss-averse depositors tend to bid less, contrary to our conjecture. Cognitive abilities correlate positively / negatively with bids submitted as the impatient / patient depositor, and in two cases these correlations are significant. We have no good story why the effect of cognitive abilities should vary with the type of the depositor. The effect of overconfidence is also somewhat ambiguous, though it seems to reduce bids in the sequential setup.

[28]Age in our sample ranges from 18 to 63, with an average of 22.7, so we have a rather young pool with some older participants, so this result should be taken with a pinch of salt.