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Bank runs and self-insured bank deposits☆

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ABSTRACT

This paper studies bank runs in an extended Diamond and Dybvig model. The model is extended in two ways. One, agents have heterogeneous wealth and two, banks can invest in both liquid and illiquid assets. We argue that the underlying reason for bank runs is ambiguous property rights. Sequential conversion is an example of such ambiguity. Demand deposit insurance eliminates this ambiguity. In this regard, we characterize conditions on the economy where banks can preclude bank runs as an equilibrium by self-insuring their deposits with an FDIC deposit insurance like contract.

1. Introduction

After the 2007 credit crisis, the economics profession has again turned its attention to the study of bank failures, bank runs, and financial bailouts (see Acharya & Yorumazer, 2007; Azrieli & Peck, 2012; Ennis & Keister, 2009, 2010; Green, 2010). This new analysis extends and refines the insights of Diamond and Dybvig (1983), Wallace (1988, 1990), Lin (1996), Green and Lin (2003), Peck and Shell (2003), and Ennis (2003). Our paper adds to this growing literature. The purpose of our paper is to study alternative demand deposit contracts that the bank can offer, independent of government intervention, which can eliminate bank run equilibrium in an extended Diamond and Dybvig (1983) model.

As is well known, the Diamond and Dybvig model (Diamond & Dybvig, 1983) has three essential ingredients useful for studying the existence of banks, demand deposits, and bank runs. One is that potential depositors are uncertain about their time impatience, which becomes private information when realized. This generates the demand for bank deposits to reduce the induced consumption risk in a competitive economy which trades claims for future goods. Two, banks invest in real investment projects that lose value if withdrawn early creating a welfare loss for society if bank runs occur. And three, early liquidation of deposits requires a punitive allocation rule if the bank's assets are over-subscribed. Diamond and Dybvig's allocation rule is sequential conversion, which can be alternatively described as "first come-first serve." Diamond and Dybvig argue that it is this allocation rule that leads to multiple equilibria and bank runs.

In contrast, we argue that the underlying reason for bank runs is not due to sequential conversion, but that it is due to ambiguous property rights of which sequential conversion is an example. We argue the bank runs can be precluded if the ambiguity about depositors' property rights is eliminated. This paper shows how demand deposit insurance removes this ambiguity by assigning seniority among depositors, just as with senior and junior debt issues. Our results document the importance of property rights in the determination of bank run equilibrium supporting the arguments made in Coase (1960).

In order to show that the sequential conversion is not an essential condition to induce a bank run equilibrium, this paper retains the first two ingredients in Diamond and Dybvig's model, but replaces their allocation rule with proportionate payment in the event of over-subscription at liquidation. Our assumption is a plausible alternative to the sequential conversion constraint, and it is

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consistent with the bank having mutual ownership. Moreover, proportionate payment has historical precedence in that it existed in England in the 18th century when bills (claims against deposits) were widely used as money. The following statement is extracted from page 231 of *History of Bank of England: Its Times and Traditions* by John Francis:

> "That in future, whenever the bills sent in for discount shall on any day amount to a larger sum than it shall be resolved to discount on that day, a pro rata proportion of such bills in each parcel as are not otherwise objectionable, will be returned to the person sending the same, without regard to the respectability of the part sending in the bills, or the solidity of the bills themselves."

Proportionate payment rules have again re-emerged following the recent financial crisis. During the crisis some money market funds' assets broke a dollar net asset value (NAV), which caused cash to be withdrawn from these funds analogous to "bank-runs" in our model. Given proportional payoffs when there are limited funds within the bank, our model considers contracts that eliminate such bank (money market fund) runs from occurring. Consistent with our model, the SEC's newly proposed rules[1] allow a money market account's NAV to float thereby effectively implementing a proportionate allocation rule akin to that in our model.

Other differences are that we allow individuals to have heterogeneous wealth, and similar to Peck and Shell (2009), banks can also invest in liquid assets that we call *cash*. Heterogenous wealth is a more realistic structure under which to study bank runs. Of course introducing cash into the original model also facilitates an understanding of capital adequacy regulation (as in Basel I, II, and III with tier 1 capital), which is not available in the original model. In the Basel regulations, capital is not required to be held for cash assets since cash has a zero risk weighting in the determination of the tier 1 capital ratio. Hence, cash assets serve as a substitute for equity capital in protecting depositors liabilities. Similarly, in our model cash is held to insure that sufficient funds are available when needed to meet withdrawals and preclude bank runs.

We study the impact that these two more realistic modifications have on the Diamond and Dybvig model. In contrast to much of the literature following Diamond and Dybvig's original paper (see Ennis, 2003; Green & Lin, 2003; Lin, 1996; Peck & Shell, 2003; Wallace, 1988, 1990), we only investigate economies with no aggregate uncertainty over both the sets of individuals with different types and their aggregate wealth. This purposefully places our model closer to the original paper's structure in order to facilitate analysis, intuition, and understanding.

Not surprisingly, we show that Diamond and Dybvig's results remain qualitatively unchanged. Although a contract that precludes bank run equilibrium is given in Diamond and Dybvig's model, we show that two other types of demand deposit contracts (both with a type of insurance guarantee that clarifies property rights) can prevent bank runs for a larger set of economies. The first demand deposit contract includes a "capped" guarantee, while the second includes an "all-or-nothing" guarantee.

The capped deposit insurance guarantees the return of the initial deposit or a fixed payoff at withdrawal, whichever is smaller. As such, it is the private industry analogue of the FDIC insurance guarantee. The all-or-nothing deposit insurance guarantees complete payment of deposits upon withdrawal for a predetermined set of individuals based on their wealth. The depositors that are fully insured are "senior depositors" because they have a priority claim on the bank's assets and thus never suffer losses. For the complement set of depositors, however, no guarantee is provided. Implementation of the all-or-nothing demand deposit contract would probably be politically infeasible given "equity" considerations. Interestingly, the all-or-nothing insurance contract is superior to capped insurance for preventing bank runs because it entails no efficiency loss. An efficiency loss arises with partial insurance when a patient agent decides to withdraw at time 1. Partial insurance only exists in the capped-deposit insurance, and not the all-or-nothing insurance.

We show that both types of deposit guarantees remove a bank run equilibrium for certain ranges of the model's parameters. This insight is important because it shows that with such contracts the industry can self-regulate against bank runs, thereby eliminating the need for governments to use capital adequacy regulation for this same purpose. It is an open and interesting empirical question as to whether the existing banking industry's structure satisfies these sufficient conditions.

Our demand deposit insurance contracts are as credible as government insurance in Diamond and Dybvig's model. In Diamond and Dybvig's model, in the case of a bank run a government tax retrieves money from those who withdraw at time 1. In our model proportionate payment implicitly assumes that the bank first accumulates all the agents' withdrawal requests and then allocates payments. This aggregation process differentiates our contract from sequential service in that if there are not enough funds, it effectively enables the bank to take money back from those that have already requested time 1 withdrawal.

Without the aggregation process the bank cannot honor its insurance policy because once the uninsured agents withdraw the money, the money is irretrievable. This lack of credibility explains why there is no such privately-provided deposit insurance in practice given sequential service. In order to make deposit insurance credible, aggregation of withdrawal claims is essential. Interestingly, this aggregation mechanism currently exists in certain banking services such as personal checks or internet transfers. The key is a delayed clearing system. For these type of payments, our model argues that proportionate payment prevents bank runs.

Following Diamond and Dybvig (1983), the majority of the papers in the bank runs literature study mechanisms to achieve an optimal allocation while preventing bank runs. As shown in Diamond and Dybvig (1983) and later formalized by Wallace (1988, 1990), suspension of payments is an effective policy tool for preventing bank runs, but it only realizes an optimal allocation when there is no aggregate uncertainty over agent types. In our view, suspension of payments establishes property rights. Suspension of payments, however, fails to prevent bank runs if there is too much uncertainty about agent types as shown in a three-type agent model by Engineer (1989).

Another line of literature using the sequential service constraint studies the importance of extracting information from agents in the queue. As argued by Peck and Shell (2003), banks having information on the queue's composition is essential in precluding bank runs. With a finite number of agents Green and Lin (2003) use the iterated elimination of strictly dominated strategies to prove that bank runs are not an equilibrium. In their model all agents are required to report their types to the bank at date 1, including those who do not wish to withdraw. In equilibrium, the agents report their types truthfully. Andolfatto, Nosal, and Wallace (2007) argue that truth-revealing reporting is no longer an optimal strategy if the agent types are correlated, and hence such a mechanism cannot rule out bank run equilibrium. In response, Cavalcanti and Monteiro (2011) show that if the agents are required to report their types twice, once before withdrawal and once after, then bank runs can still be prevented with a small efficiency loss.

[1] See http://www.sec.gov/News/PressRelease/Detail/PressRelease/1370542347679.