經營論集, 第50卷 統合號 (2016年 12月)

Markets and Banks: A Note on Diamond and Dybvig Model of Banking*

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This paper points out that in the well-known Diamond-Dybvig (1983) model of banking, the full information social optimum cannot be implemented by deposit contracts once trading among agents is allowed. The paper is in stark contrast to Jacklin (1987), which shows that equity trading dominates the banking arrangement. By pointing out the flaw in Jacklin's analysis, we show that neither the banking arrangement nor the equity trading can improve upon the autarky allocation. The ability of the banking system to create liquidity is shown to depend on the possibility of trades among agents.

I. Introduction

Since its publication the seminal paper of Diamond and Dybvig (1983) (DD from now on) has become THE model of banking to use when one is interested in studying financial panic. The model has now become part of textbook expositions (see Bolton and Dewatripont (2005) and Greenbaum and Thakor (2007)). A recent volume of Allen and Gale (2007), who use several variations of the DD model to study financial instability, best illustrates the importance of this model.

Using a model where there are diverse preferences for liquidity or immediate consumption,

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* I would like to thank Kunal Sengupta and Sudipto Dasgupta for numerous discussions on the topic. All errors remain mine. Financial support from the Institute of Management Research and Institute of Finance and Banking of the Seoul National University is gratefully acknowledged.

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DD show that banks help to create liquidity and provide insurance for early consumers. Then they go on to show that while the banking arrangement has a good equilibrium, it also has a undesirable bank run equilibrium, where everyone rushes to the bank to withdraw their deposit early. Their analysis shows that it is the very function of liquidity creation by banks that gives rise to such a bank run equilibrium. DD thus provides the first economic justification for deposit insurance as a preventive measure against pure panic bank runs.

The purpose of this short note is to point out a rather serious theoretical problem with the DD model, which, as far as we know, has not yet been clearly mentioned in the vast literature it spanned. It is that the banking equilibrium described by DD will not be sustainable if trade among agents is allowed. More seriously, there is a profitable deviation strategy each agent can follow that will upset the described banking equilibrium. This line of analysis is first carried out by Jacklin (1987), who shows that equity trading dominates the banking arrangement. However, we will show that Jacklin's analysis depends on his assumption that companies are price-setters, not price takers. If we model companies and agents as price takers, then the difference between the equity market and the banking arrangement will disappear because both will result in the same allocation of resources. In short, both equity trading and the banking arrangement will result in autarky allocation.

The paper is organized as follows. First, the original DD model and its results are reviewed in the first section. The second section describes the profitable deviation strategy available to agents in the economy, which will upset the banking equilibrium. The third section describes the equity trading mechanism and points out the flaw in Jacklin's analysis. The final section concludes the paper.

II. The Model

DD considers an economy with a single, perishable consumption good. The economy has three dates ($T = 0,1,2$). Production technology generates output of $X > 1$ at $T = 2$ for each unit of input at $T = 0$. If production is interrupted at $T = 1$, only one unit of consumption good is produced at $T = 1$, and nothing at $T = 2$. There is no production uncertainty.

There is a continuum of agents of measure one. Each agent is endowed with one unit of the consumption good at $T = 0$ and nothing afterwards. Agents are indistinguishable as of $T = 0$, but at $T = 1$, their type will be realized. A fraction $t \in (0,1)$ of agents will be type 1, who can consume only at $T = 1$, and the remaining $(1-t)$ fraction of agents will be type 2, who can consume both at $T = 1$ and at $T = 2$. For type 2 agents, time 1 consumption is perfect substitute for time 2 consumption. The preferences of each type of agents are given by:[1]

$$U(c_1, c_2) = \begin{cases} u(c_1) & \text{if type 1} \\ u(c_1 + c_2) & \text{if type 2} \end{cases}$$

The type of each agent is his private information. Note that the realized distribution of types is fixed and known.

The *autarky allocation* is such that each agent invests all of his endowment in the production technology and consumes one unit at $T = 1$ if he turns out to be type 1. If he turns out to be type 2, he will continue the production and consume X units at $T = 2$. If c_i^T denotes the time T consumption of type i agent, the autarky allocation is $(c_1^1, c_1^2, c_2^1, c_2^2) = (1, 0, 0, X)$.

1. Full Information Social Optimum

As a benchmark, we compute the full information social optimum. Since it is obvious that at optimum, type i agents consume only at time $T = i$, we write c_i for the consumption of the type i agent that occurs at time $T = i (i = 1,2)$. A social planner with full information will maximize the expected utility $tu(c_1) + (1-t)u(c_2)$ subject to the resource constraint

$$tc_1 + (1-t)\frac{c_2}{X} \leq 1 \tag{1}$$

The full information social optimum (c_1^*, c_2^*) is thus characterized by the first-order condition:

1 Here, we deviate from the original DD model which discounts type 2 agents' preferences at a rate $0 < \rho < 1$. This change has no impact on the results.

$$u'\left(c_1^*\right) = Xu'\left(\frac{\left(1-tc_1^*\right)X}{1-t}\right) \tag{2}$$

The full information social optimum is such that a total tc_1^* of the investment will be liquidated at $T = 1$. DD further assumes that the relative risk aversion is greater than 1($-cu''(c)/u'(c) > 1$). Under this assumption, DD shows that the full information social optimum is incentive compatible.[2] We summarize their main result as follows:

Proposition 1 (Diamond and Dybvig): *If the relative risk aversion is greater than one, the full information social optimum is incentive compatible, and satisfies*

$$1 < c_1^* < c_2^* < X$$

The incentive compatibility condition is satisfied because type 1 agents cannot consume at time 2, and type 2 agents are getting $c_2^* > c_1^*$. The key result here is $c_1^* > 1$; unlike the autarky allocation, a type 1 agent can consume more than one unit at $T = 1$ under the full information social optimum. DD interprets this result as saying that the social optimum provides against liquidity needs of agents.

2. Implementation via Deposit Contracts

Next, DD establishes that the full information social optimum can be implemented as a banking equilibrium with deposit contracts. To see how this works, suppose that a bank is set up and offers a demand deposit contract (c_1^*, c_2^*) characterized by equations (1) and (2). At $T = 1$, each depositor is required to announce his type. If a depositor announces he is type 1, he will

2 Consider the function $(z) = u'(z) - Xu'(\frac{(1-tz)X}{1-t})$. Because the relative risk aversion being greater than 1 implies that the function $cu'(c)$ is strictly decreasing, we have $f(1) = u'(1) - Xu'(X) < 0$. Because $f(z)$ is strictly decreasing and $f\left(c_1^*\right) = 0$, we have $1 < c_1^*$.

get $c_1^* > 1$ at $T = 1$, and nothing at $T = 2$. If he announces he is type 2, he will get nothing at $T = 1$, and $c_2^* > c_1^*$ at $T = 2$. Under the specified allocation, a type i agent can announce his type simply by showing up at the bank at $T = i$ ($i = 1,2$).

It turns out that there are two equilibria for this deposit game. In a good equilibrium, each agent truthfully announces his type. Since the allocation(c_1^*, c_2^*) is incentive compatible, no agent has incentive to misrepresent his type as long as all other agents do not lie. In this equilibrium, a type 1 agent consumes more than one unit thanks to the liquidity created by the bank.

The game has another undesirable *run equilibrium* if the deposit contract comes with the usual *sequential service constraint* of "first-come, first-served". Since $c_1^* > 1$, if the total withdrawal exceeds tc_1^* at $T = 1$, the bank will have to liquidate too much at $T = 1$ to be able to honor its promise to deliver c_2^* at $T = 2$. Therefore, if a depositor believes that a large number of depositors will try to withdraw their deposits at $T = 1$, he will run to the bank as well. If such a belief is widespread, the bank will fail at $T = 1$. As noted, the inequality $c_1^* > 1$ captures the liquidity creation function of the bank. But it is the very liquidity creation function of the bank that gives rise to this bank run equilibrium. While DD shows that a pure panic run is an equilibrium phenomenon, it does not say when and under what conditions such a panic run will occur.[3]

In this paper, we are not concerned about the bank run equilibrium and the related issue of deposit insurance. Instead, *we are going to show that the banking arrangement will not be able to implement the full information optimum* (c_1^*, c_2^*) *as an equilibrium if trading among agents is allowed*.

To see this, suppose that there is a bank offering deposit contracts of (c_1^*, c_2^*). Consider the following arrangement. A large (continuum) number of agents form another coalition and offer a contract (c_1^*, X) to their members; type 1 agents get c_1^* and type 2 agents get X. Since $c_2^* < X$, this coalition contract, if feasible, strictly dominates the bank deposit contract. The alternative coalition can offer (c_1^*, X) by doing the following. First, it will deposit fraction t of its collective endowment with the bank, and invest the remaining $(1-t)$ fraction of its endowment *directly* in the production technology. At time $T = 1$, the coalition withdraws *all* of its deposits from

3 This is because the bank run equilibrium is just one equilibrium in a model with multiple equilibria. One can use the concept of Global games (Morris and Shin (2003)) to show explicitly when the bank run equilibrium occurs.

the bank and gives c_1^* to each type 1 member of the coalition. The remaining type 2 members will get X at T = 2 from the direct investment in the technology. If the coalition is big enough, then the law of large numbers ensure that exactly t fraction of its members turn out to be type 1, so that this arrangement is feasible. Since (c_1^*, X) strictly dominates the banking allocation (c_1^*, c_2^*), the banking equilibrium cannot be sustained.[4] One may consider coalitions of this type as another bank. In this interpretation, for the banking equilibrium to be viable, no interbank deposits should be allowed. Otherwise, the banking equilibrium collapses.[5]

A more serious problem is that an individual agent is better off deviating from the banking equilibrium. Suppose that instead of depositing his endowment with the bank, an agent invests directly in the production technology at T = 0. At T = 1, if he turns out to be type 2, he will wait and consume X at T = 2. If he turns out to be type 1, he can find a type 2 *depositor* and persuade him into buying his investment for c_1^*. Since the type 2 depositor can get $X > c_2^*$ by buying up the deviating agent's investment, he will be willing to withdraw his deposit and pay him *up to* c_1^*. Since there is a continuum of type 2 agents, the deviating agent is virtually guaranteed to get (c_1^*, X) as his allocation. Therefore, a deviating agent is better off than agents depositing their endowments with the bank. Note here that we do not require the deposit contract to be tradable. We only require that the type 2 agent who is holding a bank account to be allowed to withdraw his deposit at T = 1.

One may argue that if enough number of agents invest directly in the production technology, competition among these deviating agents implies that deviating agents will not be able to get c_1^* at T = 1 when they turn out to be type 1, thus lowering the return from deviation.[6] However, the point is that as type 2 depositors try to withdraw their deposits at T = 1, the bank will not be able to honor its contract, and the banking equilibrium collapses. Summarizing our discussion so far, we have:

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4 Suppose that the coalition is of measure $\alpha \in (0,1)$. Then, the bank gets deposits of $\alpha t + (1-\alpha)$ and has to pay out $\alpha t c_1^* + (1-\alpha) t c_1^* = t c_1^*$. This is not possible because of the resource constraint (1).

5 Bhattacharya and Gale (1987) study the interbank deposit market using DD model. They did not consider the possibility of interbank deposits unraveling banking equilibrium.

6 Given the deposit contract (c_1^*, c_2^*), deviation will occur as long as $tu(bX) + (1-t)u(X) = tu(c_1^*) + (1-t)u(c_2^*)$ where b is the time 1 price of the time 2 consumption good.

Proposition 2: *The full information social optimum cannot be implemented by the deposit contract; investing directly in the technology and trading at* $T = 1$ *is more profitable than depositing endowments in the bank.*

The problem with the banking equilibrium is that after deposits are made with the bank, agents have incentives to trade. This is due to the fact that the full information optimal allocation is calculated based on the assumption of no trade among agents. Ex-post trading occurs because while the ex-ante market price implicit in the optimal allocation is $u'(c_2^*)/u'(c_1^*) = 1/X$, the ex-post market price is not equal to $1/X$. If the ex-post market price of time 2 consumption is not equal to $1/X$, agents are better off deviating from the banking equilibrium. In this regard, the problem is similar to the moral hazard problem where the optimal contract gives the agent incentives to go outside and trade (see Holmstrom and Milgrom (1990)).

The bank may design the deposit contract by explicitly considering the possibility of the trade among agents. Under this scenario, the bank will solve the following maximization problem:

$$Max_{(c_1, c_2, \alpha)} \{tu(c_1) + (1-t)u(c_2)\}$$

$$\text{s.t.} \begin{cases} tc_1 + (1-t)bc_2 \le \alpha + b(1-\alpha)X \\ c_1 \le bc_2 \end{cases}$$

Here, b is the price of the time 2 consumption good in terms of the time 1 consumption, and $\alpha \in [0,1]$, the fraction of the project liquidated at time 1. The first constraint is the bank's budget constraint given the bank's liquidation policy α and the market price b. This constraint assumes that the bank itself can and will participate in the market trades.

The second constraint is the incentive compatibility condition that prevents trades we considered above. If $c_1 > bc_2$, all type 2 agents will withdraw their deposits at $T = 1$. They will then get c_1 and trade it for the time $T = 2$ consumption good, getting $c_1 / b > c_2$; they are better off pretending to be type 1 than revealing their type truthfully and withdrawing c_2 at time 2.[7]

One may think that $c_1 < bc_2$ and thus $c_1 = bc_2$ should hold as well to prevent similar trades by type 1 agents. If $c_1 < bc_2$, then type 1 agents would rather consume bc_2 than stick with c_1. He can do that only by pretending to be type 2 and trading his deposit with a type 2 agent. However, that requires the deposit contracts be tradable, so that the buyer (a type 2 agent) should have a way to register the deposit contract under his name. The bank can easily block such a trade by refusing to change the name of the account holder.[8] In contrast, the trade which ensures the constraint $c_1 \le bc_2$ requires only that type 2 agents be able to withdraw their deposits at T = 1, which should be allowed. Thus, when deposit contracts are not tradable, the only relevant incentive compatibility constraint is $c_1 \le bc_2$.

We first consider the maximization problem without the second incentive compatibility constraint to see whether that constraint is binding. Without the second constraint, the first order condition becomes

$$u'(c_1) - \frac{1}{b}u'(c_2) = 0 \tag{3}$$

where $c_2 = \frac{1-tc_1}{(1-t)b}$. There are three possibilities depending on whether b is greater, or smaller than 1. When b = 1, c_1 = c_2 = 1, and the second constraint is satisfied. When $b > 1$, then the first order condition together with the assumption of the relative risk aversion greater than one implies

$$bu'(bc_2) < u'(c_2) = bu'(c_1) \tag{4}$$

7 When all type 2 agents withdraw their deposits at T = 1, then they have no one to trade with and thus will fail to get c_1/b. However, one should not conclude from this that type 2 agents will not withdraw their deposits. When the market price is given by b such that $c_1 > bc_2$, withdrawing at T = 1 is the optimal action by type 2 agents in the competitive market. Whether such a trade occurs or not is a matter of equilibrium condition.

8 If the selling type 1 agent withdraws his deposit and gives the amount to the type 2 agent, the amount will be only c_1, not c_2. So, withdrawing the deposit would not work. In this regard, recall that Jacklin showed that if tradable, bank deposit contracts are equivalent to equity trading.

Therefore, we have $c_1 < bc_2$, and the second constraint $c_1 \le bc_2$ is not binding. In this case, the optimal solution is thus fully characterized by the above first order condition alone. Since $c_2 = \frac{1-tc_1}{(1-t)b}$, $c_1 < bc_2 = \frac{1-tc_1}{1-t}$ implies c_1<1. On the other hand, if $b < 1$, the opposite inequality $bu'(bc_2) > u'(c_2) = bu'(c_1)$ holds, so that $c_1 > bc_2$ holds, and the second constraint becomes binding. Therefore, when $b < 1$, the solution is simply $(c_1, c_2) = (1, 1/b)$.

From this, we can conclude that no matter what the market price b may be, $c_1 \le 1$ holds. In other words, if trading among agents is allowed, the bank demand deposit contract cannot promise to pay more than one unit of time 1 consumption good to type 1 agents. Since the liquidity creation function of banks is identified with the condition $c_1 > 1$, we can say that banks cannot create liquidity when trading among agents is allowed.

Proposition 3: *Once trading among agents is allowed, and if the bank participates in the market trade,* $c_1 \le 1$ *holds irrespective of the market price . In other words, once trading occurs, banks cannot create liquidity.*

What if the bank is not allowed to trade in the market? In this case, the bank is faced with the resource constraint and the incentive compatibility condition. Therefore, the bank will solve

$$Max\{tu(c_1) + (1-t)u(c_2)\}$$

$$\text{s.t.} \begin{cases} tc_1 + (1-t)\dfrac{c_2}{X} \le 1 \\ c_1 \le bc_2 \end{cases}$$

Without the incentive compatibility constraint, the optimum is characterized by

$$u'(c_1) - Xu'(c_2) = 0 \tag{5}$$

Since $X > 1$, we know $c_1 < c_2$. Therefore, if $b > 1$, we have $c_1 < bc_2$. The incentive constraint is not binding. Now, consider the function $h(b) = u'(bc_2) - Xu'(c_2)$ where c_2 satisfies above first order condition. Then $h(b)$ is strictly decreasing and satisfies $h(1) < 0$ and $h(1/X) > 0$. Therefore, there exists a unique $1/X < \hat{b} < 1$ such that $u'(\hat{b}c_2) = Xu'(c_2) = u'(c_1)$. If $b > \hat{b}$, then the incentive compatibility constraint is not binding and the optimal solution is characterized by the condition $u'(c_1)-Xu(c_2)=0$. If $b<\hat{b}$, the incentive compatibility condition is binding and the optimal allocation is $(c_1^*, c_2^*)=\left(\frac{bX}{tbX+(1-t)}, \frac{X}{tbX+(1-t)}\right)$. The bank in this case can create liquidity if $1/X < b$. Summarizing this, we have the following proposition:

Proposition 4: *The bank can create more liquidity only if it does not participate in the market and the market price satisfies* $>1/X$.

In the following section, we will see that the equilibrium market price will be $bX=1$. Therefore, the bank cannot create liquidity whether or not the bank participates in the market. The resulting equilibrium allocation will then be identical to the autarky allocation $(c_1, c_2)=(1, X)$.

III. Equilibrium with Equity Trading

We have seen that when agents of positive measure directly invest in the production technology, the bank will not be viable. Thus, let's suppose that shares of many identical corporations with the same technology are traded in the equity market both at $T = 0$ and $T = 1$. Suppose further that at $T = 0$, shareholders of each corporation set their dividend policy of (d, f), where $d \in [0,1]$ is payable at $T = 1$, and $f = (1-d)X$ is the liquidating dividends payable at $T = 2$. The interim dividend d is necessary to enable agents of different types to trade at $T = 1$. At $T = 1$, type 1 agents would like to sell their equity holdings and type 2 agents are willing to buy them with their share of the $T = 1$ dividends d. This is the setting Jacklin used to compare the banking equilibrium and the equity market equilibrium.

Let b again denote the price of the time 2 consumption good in terms of the time 1 con-sumption good. Then, given the dividend policy d, each type 1 agent will be able to consume $d + b(1-d)X$ at $T = 1$ while each type 2 agent will consume $d/b + (1-d)X$ at $T = 2$. Therefore, at $T = 0$ shareholders of each corporation will set the dividend policy d by maximizing the following function $H(d)$ subject to the constraint $d \in [0,1]$.

$$H(d) = tu\left(d + b(1-d)X\right) + (1-t)u\left(\frac{d}{b} + (1-d)X\right) \quad (6)$$

The market equilibrium occurs when that the total amount type 1 agents get is equal to the total amount type 2 agents have. Or,

$$tb(1-d)X = (1-t)d$$

By differentiating the function $H(d)$, we get:

$$H'(d) = \left(\frac{1}{b} - X\right)\left[tu'(c_1)b + (1-t)u'(c_2)\right]$$

Note that the term in the bracket $[\cdot]$ is strictly positive. If $bX > 1$, then $H'(d) < 0$ so that $d = 0$ is optimal. However, if $d = 0$, type 2 agents have no way to pay for the shares of the type 1 agent, and type 1 agents have nothing to consume ($c_1 = 0$). Since the market clearing condition shows that the only price consistent with $d = 0$ is $b = 0$, this violates the precondition $bX > 1$. Therefore $bX > 1$ cannot be an equilibrium. On the other hand, if $bX < 1$, then $d = 1$ is the optimum. Yet, if $d = 1$, then the market clearing condition $tb(1-d)X = (1-t)d$ cannot be satisfied; in this case type 2 agents can consume nothing, implying $b = \infty$. Thus $bX < 1$ cannot be an equilibrium, either. Therefore, the only possibility is $bX = 1$. In this case, the market clearing condition implies $d = t$, which, in turn, implies $(c_1, c_2) = (1, X)$, or the autarky allocation. In other words, the equity market equilibrium can implement only the autarky allocation. Thus, we have the following proposition.

Proposition 5: *The equity share trading will result in the autarky allocation* $(c_1, c_2) = (1, X)$ *and the unique equilibrium price is* $bX = 1$.

This result is in stark contrast with Jacklin's that equity trading can implement the banking allocation without any possibility of run. To see the difference, we reproduce Jacklin's analysis here. From the market clearing condition, he first derives the equilibrium market price as a function of the dividend policy d. Thus,

$$b=\frac{(1-t)d}{t(1-d)X}$$

By plugging this into the expression $H(d)$, we get the objective function:

$$U(d)=tu\left(\frac{d}{t}\right)+(1-t)u\left(\frac{(1-d)X}{1-t}\right)$$

Shareholders choose the time 1 dividend d that maximizes $U(d)$. If we denote d/t by c, the maximization problem becomes:

$$\max_c\left[tu(c)+(1-t)\left(\frac{(1-tc)X}{1-t}\right)\right]$$

This is exactly the same as the full information social optimum problem. Therefore, in Jacklin's analysis, the equity market equilibrium is exactly the same as that of the banking market, yet it does not suffer from the run equilibrium. This leads Jacklin to conclude that the equity market *dominates* the banking market.[9]

The difference between our analysis and Jacklin's is that corporations in his analysis are not price takers, but price setters. In other words, in his analysis, the optimal dividend policy (d, f) is chosen *after taking into account the impact of dividend policy* (d, f) *on the market price* b.

Thus corporations recognize the impact of their dividend policy on the market price b and choose the best market price for shareholders. In contrast, corporations in our analysis take the market price as given. Therefore, the dominance of the equity market over the banking market is due to this assumption of the price setter.

One may argue that it is only natural for each corporation to realize that its share price depends on the its dividend policy and to set the dividend policy accordingly. However, even if corporations are price setters, Jacklin's equity market equilibrium cannot be sustained because

9 This also seems to be the reason why Diamond (1997) says that equity trading dominates the banking arrangement.

an individual agent can profitably deviate. Once the equity contract offers the full information social optimum (c_1^*, c_2^*), any single agent can do better by investing his endowment directly in the production technology than buying the equity shares. The reason is the same as before. If he turns out to be type 2, he will consume X at $T = 2$. If he turns out to be type 1, then he will be able to sell his holdings at the market price b and get.

$$bX = \left(\frac{d}{t}\right)\left[\frac{1-t}{1-d}\right] > \frac{d}{t}$$

since $c_2^* < X$ implies $(1-d) < (1-t)$. Therefore, this deviant agent is doing better than others who buy equity shares:

$$tu(bX) + (1-t)u(X) > tu\left(\frac{d}{t}\right) + (1-t)u\left(\frac{(1-d)X}{1-t}\right)$$

In other words, a price-taking agent will always find it to be profitable to deviate. If everyone deviates, the equity trading game will result in the autarky allocation. Thus we now can state:

Proposition 6: *Whether or not each corporation is a price taker, trading in equity shares will result in the autarky allocation with a market price of* $bX = 1$.

Note that since the equilibrium price is $b = 1/X < 1$, the banking equilibrium with ex-post trading among agents yields the same autarky allocation of $(c_1, c_2) = (1, X)$. Thus, the difference between banking equilibrium and equity trading equilibrium completely disappears even though deposit contracts are not allowed to be traded. At the same time, since they yield the same allocation, the equity market neither dominates, nor is dominated by, the banking arrangement.

IV. Conclusion

The general picture emerging from this exercise is that trading among agents is harmful to the ability of the banking system to create liquidity. More specifically, we have shown that neither the banking arrangement nor the equity trading can improve upon the autarky allocation. In order to restore the positive role played by banks, one is thus led to consider reasonable restrictions on trading among agents.

In his attempt to explain the sequential service constraint, Wallace (1988) uses the island model of Lucas and utilizes the absence of centralized capital markets. While this is a nice fable, it has limits because it severely constrains the trading possibilities. On the other hand, Diamond (1997) assumes that some type 2 agents who cannot trade in the market, possibly for high transaction cost and shows that both banks and the equity market con coexist. While Diamond's paper is the first to combine banking and trading successfully, more work is obviously needed.

References

Allen, F. and D. Gale (2007), *Understanding Financial Crises*, Oxford University Press.

Bhattacharya, S. and D. Gale (1987), Preference Shocks, Liquidity, and Central Bank Policy," in W. Barnett and K. Singleton eds., *New Approaches to Monetary Economics*, Cambridge University Press.

Bolton, P. and M. Dewatripont (2005), *Contract Theory*, The MIT Press.

Diamond, D. (1997), "Liquidity, Banks and Markets," *Journal of Political Economy*, 105, 928-956.

Diamond, D. and P. Dybvig (1983), "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy*, 91, 401-419.

Greenbaum, S. and A., Thakor (2007), *Contemporary Financial Intermediation* (Second Edition), Academic Press.

Holmstrom, B. and P. Milgrom (1990), "Regulating Trade Among Agents," *Journal of Institutional and Theoretical Economics*, 146, 85-105.

Holmstrom, B. and J. Tirole (1998), "Private and Public Supply of Liquidity," *Journal of Political Economy*, 106, 1-40.

Jacklin, C. (1987), "Demand Deposits, Trading Restrictions, and Risk Sharing," in E. Prsecott and N. Wallace eds., *Contractual Arrangements for Intertemporal Trade*, University of Minnesota Press.

Morris, S. and H. Shin (2003), "Global Games: Theory and applications," in M. Dewatripont, L. Hansen, and S. Turnovsky eds., *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress, Volume 1*, Cambridge University Press.

Wallace, N. (1988), "Another Attempt to Explain an Illiquid Banking System: The Diamond and Dybvig model with sequential service taken seriously," *Federal Reserve Bank Minneapolis Quarterly Review*, 12 (Fall), 3-16.