How to make a run-proof bank
Achieving maturity transformation without fractional reserves

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Section 1: Introduction

The defining characteristic of FRB is the mismatch between a bank’s short term liabilities and its long term assets. (See Figures 1a and 1b.) Indeed, the term “fractional reserve” refers to the ratio (fraction) of cash reserves to current deposit liabilities that a bank is required to maintain in order to meet withdrawals. This mismatch comes about because banks make long term loans, and fund them by creating current deposits. This is a simple accounting book entry – debit loans, credit current deposits. However, since bank deposits are readily transferrable and readily accepted as payment in lieu of cash (because, in all but the most exceptional times, they can be exchanged at the bank at any time for cash), deposits are effectively money: hence fractional reserve banks create money.

This process is also known as maturity transformation: the bank creates a loan (classified in its books as an asset) with a maturity of perhaps several years, and finances this by also creating a liability for itself – a deposit – which has an immediate maturity because, once the loan is granted, the borrower can then immediately redeemed this deposit for cash.

Once a loan has been granted and funded, the borrower can then withdraw that deposit (ie ask the bank to exchange his deposit for cash) and further exchange the cash for goods and services. Usually the seller of the goods and services will take the cash she has received to a bank and deposit it – exchange the cash for a bank deposit – so that the amount of physical cash in the economy need not be great. Even if the deposit is made into a different bank, and even if the original bank suffers a regular net withdrawal of cash, the cash can be recycled back to the original bank via interbank loans, provided of course the other banks are comfortable in its capacity to ultimately meet its obligations: comfortable with the quality of the loans it is writing. (See Figure 2.) Typically, however, banks seek to attract cash in the cheapest possible way, which usually is to pay depositors interest.

When a bank makes a loan, it performs two key functions. Firstly, it takes on the risk of the borrower defaulting. Secondly it takes on the timing risk arising from the time-difference between when the borrower is due to pay back the cash, which may be years, and when the bank may be called upon to provide cash to its other depositors. In essence, it buys paper from an uncreditworthy party that may not be claimable for years, and sells “paper” (once these were banknotes; nowadays they are current deposits) that is unquestioningly accepted as creditworthy and is immediately claimable for cash.
In creating money this way, the bank is not creating cash, it is simply increasing the number of claims that exits on a given amount of cash. Because of this, there is a risk: that the bank will be inundated with claims for cash, which it will not be able to meet. The bank’s ability to create money is premised on a false expectation – that all depositors are able, simultaneously, to redeem all their deposits for cash.

At this point it may be worthwhile to reflect on what is meant by the term cash. Up until a hundred years ago, cash specifically referred to gold and silver coins. Paper money and the token coins that we use today were not cash but represented claims on cash. Cash was the fundamental medium of exchange. While gold was the most widespread fundamental medium of exchange in the years leading up to 1914, there have been many other fundamental media of exchange – many other forms of cash – over the centuries, including silver, bronze, cowrie shells, cattle, sheep and other exotic commodities.

Since 1971, there is no link between currencies and any commodity. Today we live in a “fiat” currency world. Fiat currencies are those which come into being at the whim or fiat of the state. The state can back up its right to produce fiat currencies by declaring them to be legal tender, so that a debt is legally discharged upon the appropriate amount of fiat currency being provided to the creditor. In particular, the state will honour the discharge of a debt owed to it through the provision of fiat currency. In essence then, the commodity underlying fiat currency is “the state’s obligation to recognize the discharge of a debt”. Hence, nowadays “cash” means liabilities of the central bank, either as pieces of paper, token coins, or Exchange Settlement Accounts held at the central bank to clear interbank obligations.

The profound implication of fiat currency is that cash can now be manufactured. Whereas in the past the amount of cash available was a function of the prospector’s luck in finding a new gold or silver seam, it is now possible to create by fiat as much cash as is deemed necessary for the economy to operate efficiently.

The ratio of cash to deposits has declined over time, as the preference for it over bank deposits declines: cash is becoming a less necessary part of society. Currently the ratio of cash to deposits in Australia is around 5%; in the United States in the 1800s, the ratio was set at 25% (Sykes, 1905). Partly, this decline is the result of an improvement in the public’s confidence in banks’ ability to redeem deposits with cash (whereupon they do not feel the need to), and partly it is a function of the ever-increasing ease with which deposits can be transferred between banks without resorting to cash: such transfers used to be effected using cheques, which took several days to clear, but electronic transfers now make the process virtually instantaneous. In the extreme situation where all payments were made by electronic funds transfer, cash would only be needed to settle the resulting net interbank payments each night.

From time to time, however, depositors can lose faith in the banking system’s ability to redeem their deposits for cash. Since banks in fact hold very little cash – only enough to meet demand in normal circumstances – these runs can become self-fulfilling disasters. The chief difficulty is because of the

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1 This begs the question: Why is it still considered appropriate for banks to create money – given the inherent riskiness of this process – when the state can create as much money as it deems necessary for the economy to function efficiently? This paper is not the place to address this question, but I hope to do so in subsequent work.
bespoke and illiquid nature of bank assets, which are predominantly loans. Loans are illiquid because they have been granted for a longer period of time and are not expected to be repaid (in cash) for several years. Furthermore, their bespoke nature makes them difficult to sell on a secondary loan market. Hence the bank cannot, if it needed to, quickly raise cash against these loans, as it can neither call them in nor sell them. (For a broad review of the literature relating to the causes of banking crises, see Gorton and Winton (2002)).

There are various provisions, of course, to ensure that a general loss of confidence in the banking system is a very rare occurrence. Banks are required to hold a minimum level of reserves of cash or very liquid assets (meaning assets whose market value is unlikely to be in doubt and which are therefore readily exchangeable for cash, such as short term treasury bonds) and hold standby lines with other banks; moreover commercial banks have the capacity to sell high quality assets to the central bank, which, since it is the monopoly supplier of cash, has unlimited capacity to provide support (but is in practice limited by the quantity of suitably creditworthy assets the bank can offer to sell.)

Another means of allaying shareholder concerns is deposit insurance. The premise of this approach is that, if depositors know that the state ultimately guarantees their deposits, then they will not feel compelled to withdraw (Diamond and Dybvig, 1983). For example, after the introduction of deposit insurance in the United States in 1934, that country experienced a 40 year hiatus in significant bank failures (see Figure 3 below), broken by the collapse of Continental Illinois in 1983. However, it has been increasingly recognized that deposit insurance does come with an implicit cost – a moral hazard cost, since depositors no longer need to care about the riskiness of the bank’s lending practices, and bank managers are incentivized to take on more risk. Tobin calls deposit insurance “a delegation to private enterprises of the government’s sovereign right to coin money.” (Tobin, 1987). Demirgüç-Kunt and Detragiache (2002) find evidence that deposit insurance actually leads to banking system instability, particularly if the institutional framework is weak. Under deposit insurance the onus for regulating the bank’s activities is transferred from depositors to the state, thus leading to a plethora of regulations and supervisory platforms, and leaving depositors blithely unconcerned about their bank’s financial health.

Nevertheless, there are still times when there are runs on bank which even the central bank is unable to counteract. This is especially true when a nation’s banking system is heavily reliant on foreign depositors who suddenly panic and withdraw their deposits en mass, as happened throughout Asia in 1997. Banks are forced to do whatever they can to obtain the necessary cash – call in what loans they can, stop making loans, sell loans or other assets, often at a heavy discount. If they are thus forced to write down assets their equity is directly impacted, so they could easily become insolvent as well as illiquid. Laeven and Valencia (2012) identify 147 banking crises in the period 1970-2011.

The sudden evaporation of finance and liquidity has a heavy economic impact. Measuring this cost is somewhat problematic, because of the difficulties in establishing start and end dates for the crisis, and estimating the counterfactual of no financial crisis. Figure 4 illustrates the economic impact of the 1997 Asian financial crisis on Thailand, Malaysia, Indonesia and Korea, showing several estimates of the counterfactual economic growth. Boyd et al (2005) and Cerra and Saxena (2008) argue that economies may never fully recover from a crisis, implying a perpetual cost.
The economic fallout from these events has compelled a notable group of economists to advocate other forms of banking. The most frequently cited of these alternatives has involved the abolition of the fractional reserve process, whereby banks are required to hold 100% of reserves against their current deposits. Indeed, there may be no greater contentious issue on which so many Nobel Prize laureates have been in agreement, with Allais (1987), Tobin (1987), Friedman (1960) and Merton (1993) all advocating this, as well as Fisher (1935) and the Chicago School of Knight, Simons and Mints (see (Phillips, 1995)). Ricardo’s (1823) banking reform proposals effectively amounted to 100%-reserve banking.

This paper is structures as follows. Section 2 surveys the literature, focusing on the maturing mismatch nature of FRB. Section 3 outlines a proposal for a new form of banking, which I have named “bond-banking”. I outline the features of this form of banking and show that it can have all the benefits of FRB, without its inherent fragility. Section 4 outlines some of the benefits arising from his form of banking.

**Section 2: Literature review**

The form of banking that the Nobel laureates suggested was 100%-reserve banking, also know as narrow banking. Under this system, as current deposits require 100% cash backing, banks are not able to effectively swap a long term loan for a current deposit, meaning they cannot create money and they cannot engage in the maturity transformation process. Other proponents include Karaken(1986), Rothbard (2008), Litan (1987), Spong(1993).

In “narrow banking”, banks can participate in the payment system, that is the transfer of deposits (entirely backed by cash) from bank to bank, but do not participate in making loans. Rather, the credit-creation function (ie the making of loans) is relegate to non-bank entities, typically referred to as investment trusts, which raise funds for lending by issuing securities. See Figures 5a and 5b.

Specific criticisms of narrow banking in the literature are relatively rare. Wallace (1996) reveals narrow banking to be a form of autarky, but his broader argument against it is weakened by his model not allowing any form of financial market other than a fractional reserve (FR) bank. Bossone (2001) uses simple regressions to examine the relationship between measures of bank narrowness and the price and availability of credit. He finds evidence that narrowness increases the price and decreases the availability of credit. A nominal price increase would be expected, but may not exist once the inflationary effects of money creation are considered.

Selgin and White (1996) argue against the implication that FRB is inherently fraudulent because it implicitly offers a promise it cannot keep – that all depositors can withdraw all their savings at once (see Rothbard (1995)). Selgin and White contend that the banknote is fundamentally different to a gold deposit receipt, not least because the former does not involve warehousing fees; moreover, FR banks offer depositors interest. Hence they conclude that depositors would not be deceived, but rather be aware from the lack of warehousing fees and the offer of interest, that their funds were being lent out and not simply being kept in the vault. This argument does not however address the assertion that FRB is based on a false premise (as distinct from a false pretence) which depositors from time to time attempt to exploit, with potentially significant perverse economic consequences.
Kashyap Rajan and Stein (2002) suggest that the co-existence of lending (or more specifically, lending commitments) and deposit-taking allows for FR banks to exploit synergies between these two activities, relating to the demand for cash, which narrow banking would destroy. This argument is built on banks providing short term (eg for working capital) lending commitments to potential borrowers, since both potential borrowers and depositors may require cash. The bank is a cash-broker, collecting it from those who have no present need for it, and lending it to those who are temporarily in need of it. However, there is no sense of why this transaction need occur without the timing factor being explicitly recognized in the process: if the borrower needs the funds for 90 days, why can’t the bank raises these funds from those who are prepared to lend it for 90 days?

However, although there are only a relatively small number of papers that explicitly criticize narrow banking, nevertheless such criticism is implied in much of the literature on banking. This literature starts from the (usually unacknowledged) premise that FRB is the natural state for banking to evolve to, and aims to discover why this is, in spite of its inherent fragility. This literature follows several important strands.

Diamond and Dybvig (1983) (hereafter “DD”) model FRB as a form of insurance against an unexpected need for liquidity. In this model, the FR bank gives depositors the ability to achieve the greater benefit of long-term investments without being locked into them. It operates as a special form of insurer over three periods, where deposits are made at t=0, agents discover at t=1 if they have a liquidity need and withdraw funds, and at t=2 returns from a long term (two period) project are realized and paid out. However, the returns from the project are smoothed out over both periods. Hence the early consumer, despite having the handicap of being unable to remain invested in the project until maturity, nevertheless achieves some benefit from the project. But this insurer has a weakness: the benefit is paid (by way of a higher return in period 1) before the premium is due (by way of a lower return in period 2). Because of this feature, agents can size up the relative cost of the premium against the benefit before the premium is paid. If some agents believe there will be too few other agents who are prepared to stay in the scheme until t=2 and pay the premium, they will themselves withdraw at t=1, even though they do not need to. If too many agents act this way, the bank will be forced to liquidate the long term project, and will be unable to meet all its commitments.

However, Jacklin (1984) showed that this model of FRB can operate only in the absence of financial markets. When markets are present, depositors can game the bank: they can withdraw their deposit at t=1 even though they don’t need to, pocket the benefit, and buy into the project directly at parity. Then at t=2 they can claim the entire return from the long term project. Thus, where financial markets exist, the DD bank’s capacity to improve welfare is constrained by the markets, and is limited to the extent of welfare-enhancement achieved by the markets.

Moreover, the DD model is not greatly reflective the role of cash as the facilitator of trade. There is no sense of the cyclical nature of cash, which will be exchanged by the early consumers for goods and subsequently re-deposited. Even the money lent to the long term project will be recirculated through the economy as the project is built. As Gorton and Winton (2002) comment, “there is no notion of exchange in the model . . . no trade with other agents where ‘money’ buys goods . . . Agents trade only with the bank.” (p.21). Further, the model is not reflective of how banks operate: unlike in the DD model, banks do not collect deposits and lend them out for a long term project.
Rather, they create the money that is needed to fund the long term project, by creating deposit liabilities which can be traded for goods or exchanged for cash (and then traded for goods). In this context, the model does not provide an obvious motive for depositors to prefer cash over deposits, or some other tradeable claim.

A second strand of the literature focuses on the agency control aspects of deposits in FRB. Calomiris and Kahn (1991) posit that a demand deposit funding structure provides an incentive to the banker to be disciplined. They state that “Without the ability to make early withdrawals, depositors would have little incentive to monitor the bank.” (p.497). That may be true in the case of long-term depositors, who are soley dependent on the bank and have no alternative but to wait for their deposits to mature, but it is not true where there is a secondary market. For example, if the bank were to be funded by listed bonds, in the event of undisciplined behaviour, a bondholder has the capacity to sell, and hence has an incentive to monitor the bank.\(^2\) Pozdena (1991) denies that long-term debt holders can act quickly enough to exert influence effectively, but he overlooks the possibility of exchange-traded bonds: a sell-off of a bank’s bonds, where bonds are its only source of funding, would be debilitating for it, as it could only raise new funds at a disadvantageous rate of interest. Diamond and Rajan (2001) posit that a fragile funding structure provides a signal to depositors that a relationship banker will commit to a long-term project, since, were she to walk from the project, depositors will run the bank and she will receive no rents. However, this explanation abstracts from the possibility of the banker suspending conversion of deposits into cash – an abstraction which is inconsistent with their broader argument, where everything is renegotiable. Flannery (1994) argues that the bank’s short term liability structure enables debt to be quickly repriced (without a loss to depositors) to reflect any change in the nature of the bank’s portfolio. However, it is not clear that the benefits of this outweigh the costs of the fragility it creates, and in any case is not the only way of mitigating against such a development. I return to this later in the paper.

In summary, these strands of the literature appear to have trouble finding a satisfactory explanation to justify their presumption that FRB is the “natural” state of banking.\(^3\) The “liquidity insurance” motivation of DD could be rationalized if trading of financial claims was impossible – but the fact is, it is possible. The “monitoring” motivation can be achieved by means other than demand deposits, such as exchange-traded bank bonds.

A further strand explores banks’ role as creators of liquidity. Gorton and Pennacchi (1990) posit banks as providers of a means of insuring small investors against better informed insiders. The existence of a riskless asset, the bank deposit, enables uninformed investors to trade without the possibility of being exploited by informed investors. However, this function could be readily provided by an intermediary that does not make risky loans, but invests in riskless securities such as short-term government debt. Holstrom and Tirole (1998) model a bank as a coalition of borrowers, any of

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\(^2\) To be fair, the authors emphasize that their model aims to explain the historical importance of demandable debt, and note that, in modern financial markets, trading of equities (and, by extension, bonds) could provide a superior form of discipline.

\(^3\) Other strands of the literature focus on aspect of banks other than their fractional reserve characteristic. See Appendix I for a summary.
whom may experience a sudden unexpected need for liquidity. Interestingly, in contrast to the DD model of a bank, the Holstrom and Tirole bank has long-term liabilities and short-term assets, since it is the borrowers who are needing the liquidity, rather than the depositors.

The fact that a system of “narrow banking” has not evolved comes down to two reasons: firstly, a concern that the suggestion doesn’t really resolve the problem, as the investment trusts themselves would begin to borrow short and lend long, so that their deposits would eventually be taken as near-money, and there could be runs on these entities just as there are currently runs on banks, with similar economic consequences. [Diamond and Dybvig (1986) state (p.57): “. . . new firms that move in to fill the vacuum left by banks may inherit the problem of runs.”] Secondly, and more practically, such a system could be easily and readily implemented, via money market mutual funds with cheques for example, but the fact FRB continues to exist, despite its inherent fragility, suggests there is something about it that outweighs the demand for a safer alternative.4 One of the key benefits cited for FRB (and perhaps the reason why 100% reserve banking hasn’t proved to be popular) is its ability to pay interest on current deposits funds. Under the alternative system, deposits must be backed by cash or near-cash assets which, since they cannot be lent out other than for very short periods, are unable to be charged interest. Hence the interest payable on current deposits in the alternative system is zero.

But it is possible to arrange a bank that does enable investments to be retrievable at parity on demand, and pay interest, without resorting to fractional reserves? I demonstrate how such a system could be constructed below.

Section 3: Creating a run-proof bank with withdrawable deposits that earn interest

As previously mentioned, the salient feature about FRB – the feature that gives it both its strengths and its weaknesses – is the maturity mismatch between the long term assets and the short term liabilities. If a bank were to be created without this feature, it would need to match the maturity of its assets and its liabilities. So long term loans would need to be funded by long term deposits, or bonds. (This system of intermediation was suggested by Allais (1987), although he quarantined it to non-bank investment trusts, with banks restricted to the payments function. I posit that no split is necessary.) Usually such a bank is derided as being impractical, because there are far less people who are prepared to deposit their money in the bank for say 3 years than there are those who would deposit their money overnight: hence the interest rate on three year loans would be driven up enormously, with significant economic costs.

But this assumes that such long term depositor funding can only be derived from a bilateral and non-negotiable bank time deposit. If the bank rather derived its long term funding from the issue of bonds, and the amount of bonds on issue was large enough to create a liquid market5, then our long

4 White (2003) cites the case, reported in Banker’s Magazine in 1858, of efforts to establish the “Bullion Bank of New York”, whose deposits “are not to be used, any part of them, by the bank; but are to be retained always in actual cash to the order of the several depositors; the deposits will consequently be always, to the full amount, on hand in cash”. White can find no evidence of the bank actually opening its doors.

5 Total liabilities of Australia’s largest bank, Commonwealth Bank of Australia Limited (CBA) at 30th June 2012 were A$677bn, about six times larger than the market capitalization of the largest listed Australian company.
term “depositor” (who, rather than depositing, would buy a small quantity of the bank’s bonds) is not necessarily bound to hold onto his deposit until it matures, but could liquefy by selling it through the bond market. Moreover, the depositor receives interest on the bond.

The benefit of this system is that the depositor has options regarding to whom he can sell his deposit. The FRB deposit is essentially a bilateral put option – the depositor cannot sell his current deposits at the bank to anyone other than the bank, as there is not a market for current deposits. But this alternative system, which for convenience I will call the “bond-bank” system (since the banks are largely funded by bonds), offers the depositor a secondary market for his deposit, and thus alleviates the bank of the responsibility for accepting the deposit.

Figure 5 illustrates the differences between fractional reserve banking, narrow banking and the bond-bank system. All banks are involved in the facilitation of payments, but the extent to which the various forms of banks are involved in the facilitation of investment varies. FR banks facilitate investment in two ways:

1. Credit transformation: the exchange of bespoke paper (e.g., a mortgage) for paper issued in the bank’s name. The bank takes on the credit risk of the mortgagor defaulting.

2. Maturity transformation: The exchange of long term paper for immediately claimable paper. The bank takes on the timing risk of being asked to redeem funds now which it has on-lent for repayment in the future.

The dual nature of this process is not generally appreciated because banks do both things together – they exchange a) bespoke and b) long term paper for a) paper issued in the bank’s name and b) immediately claimable. A bond market facilitates investment by intermediating between borrowers and savers, but FRB goes further by also creating the money to fund the loan – creating a short term deposit which can be traded for goods or exchanged for cash.

The table below summarizes the faculties of the various forms of banks. All types of banks are involved in the facilitation of payments. For Narrow banks, that’s as far as it goes: they play no role in the investment process. Central banks create money but do not create credit: they take risk-free long term government bonds and exchange these for its own circulating liabilities, which is legally enforceable as cash in a fiat monetary system. The Bond-bank allocates credit to worthy borrowers, but does so without the capacity to create its own money: it relies on others’ savings to provide the funds. The FR Bank both allocates credit and creates its own money to fund this credit.

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The liabilities of Bank of Queensland, a small regional bank, were $38bn, around the size of Australia’s 10th largest company by market capitalization.
A bond-bank would issue bonds which are traded on the exchange. This implies a variability in the price, which is something depositors are not used to, and which is also held up as one of the benefits of FRB – a $1 deposit is always worth $1. On this issue, there are several points worth mentioning:

- There is also value-uncertainty in the FRB system: while the nominal value of a FRB deposit is held steady at $1, the interest rate that applies to it varies, so that the future value of a current deposit including accumulated interest is also unknown.
- The price volatility can be minimized, essentially to zero, if both the borrower and the lender are paid in variable interest rates.
- As I will outline below, a bond bank can profitably sell bond-holders put options, thus providing them a deposit-like predetermined exit price.

To explore the characteristics of bond-banking, I have modelled the behaviour of a hypothetical bond-bank’s bond portfolio. To do this, I have assumed such a bank issued bonds of two different maturities, 3 years and 5 years, every month from January 1970. I then calculated the value of each bond over the course of its life, and derived histograms plotting the distribution of these values.

A key consideration in this process is modelling the prevailing yield curve, to determine the value of the outstanding bonds each month. In a bond-bank system, the yield curve has a special feature: it is always positive. This is because overnight deposits can only be backed by cash, which pays 0% interest. Hence, in a bond-bank system, the yield curve always passes through the origin.

This feature gives one point on the yield curve. Another point can be derived from the Treasury Constant Maturity Rate series published by the US Federal Reserve, which gives the interest rate that was prevailing for bonds of various duration (eg 3 and 5 years). However, this information does not say anything about the steepness of the yield curve that would be prevailing in a bond-bank system. Accordingly I have modelled the bond values twice: once using a relatively steep exponential yield curve, and again using a relatively gradual exponential yield curve.

The graphs in Figure 6 summarize the results. Figure 6a gives US Treasury yield curve for 3 and 5 year constant maturity rates since 1970.

Figure 6b pertains to 3 year bonds assuming a gradual yield curve. The first graph gives three examples of the yield curves used, with each point at the 3 year mark corresponding to 3 year Treasury Constant Maturity rate prevailing at that time. Each curve asymptotes to a 10 year rate that is 2.64% higher than the 3 year rate (2.64% being the greatest difference between the 3 years rate and the 10 year rate observed over the 42 years since 1970). The second graph provides a histogram of individual bond prices over the course of their life. In determining this, I have assumed that a 3 year bond of $1 was issued at the beginning of each of the 518 months from January 1970 to February 2013, with the coupon of each of these being set at the prevailing 3 year treasury constant maturity rate. The value of each bond was then calculated for each month of its life, using a discount rate as determined by the prevailing yield curve. The histograms summarize the movements in bonds’ prices over that time. A skewness to the right is evident, meaning the bond is typically valued at above $1. This is due to the positively sloping yield curve: the coupon payment of

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6 Karaken (1986) recognised the trade-off between certainty of value and certainty of repayment: “It is beyond me why having a contract for a known dollar sum, which, however, may not be honoured, is necessarily better than having an account balance the future value of which is uncertain” (p.42)
the bonds increases in value as the appropriate discount rate falls towards zero. Bond prices of less than $1 are associated with sharp spikes in the 3 year interest rate, since the coupon streams from existing bonds are worth less when the prevailing discount rate rises sharply. Conversely, the higher values are associated with prolonged falls in interest rates. Of the more than 18,000 observations, the average is $1.0226, the mode is $1.0075 and 84.4% of values are above $1.

The last graph in this row shows the value of the bank’s total bond portfolio. It can be seen that the bank’s bond portfolio is typically valued at above $1. The mean value is in fact $1.0226. The rare occasions when the portfolio dips below $1 are associated with sharp spikes in the 3 year interest rate. Conversely, higher values of the bond portfolio are associated with prolonged falls in interest rates.

Figure 6c pertains to 3 year bonds assuming a steeper yield curve. This curve assumes that the 3 year Treasury Constant Maturity Rate is only 0.01% less than the 10-year rate. The histogram of bond prices is also skewed to the right, but is generally worth less, as the prevailing discount rate is generally higher. The mean value of this portfolio is still above $1, but only slightly at $1.0065. The mode remains the same, but now 66.1% of values are above $1. The third graph, showing the bank’s portfolio is also worth less, albeit still more likely to be over $1.

Hence, were a bond portfolio to be set up, there is a good likelihood that were a person wishing to sell a bond, they would achieve more than $1 for it. In a bad case scenario, the bond is likely to be only slightly less than $1.

Figures 6d and 6e repeat the exercise for five year bonds. In this case the more gradual yield curves asymptotes towards an interest rate that is 1.46% higher than the five year bond rate (1.46% being the maximum difference between the 5 and 10 year rates since 1970, observed in July 2011).

The results remain broadly in line with those obtained for 3-year bonds, but have a) a slightly higher mean, and b) a slightly greater variance.

The extreme bond values are associated with extreme volatility in interest rates. For example, the highest value achieved (in both the 5 year steep and gradual yield curves) occurs for the bond issued in June 1984 at a coupon of 13.27%, when 22 months later the 5 year constant maturity rate had fallen to 7.05%. With the steep yield curve this bond rises to a value of $1.189, with the gradual yield curve it rises to $1.227.

Likewise, the lowest value occurs (for both yield curves) with the bond issued in June 1980 at a coupon of 9.21% when 15 months later the 5 year rate had risen to 15.93%. With the steep yield curve this bond falls to $0.809, and with the gradual yield curve it falls to $0.838.

These graphs illustrate that a bond-bank, combined with a liquid market for the bank’s bonds, is a viable alternative method of financing long term projects while still providing investors access to their funds with little volatility in value.

Given these characteristics of bond pricing, it is eminently plausible for a bond-bank to be able to offer its more risk-averse depositors a guaranteed buy-back price on their deposits (effectively a put option) of $1. Hence we have achieved a withdrawable “deposit” that pays interest without resorting to fractional reserves.
Alternatively, a bank could buy put options over its own bonds, thus making itself even more invulnerable. Moreover, the price of the put options would give a market indicator of the bank’s creditworthiness – the less creditworthy the bank, the more expensive the put options.

Various authors (eg Allais (1987) Fisher(1935)) have suggested that a banking system without the fragility of fractional reserves would be less volatile. Reduced volatility in the interest rates would also reduce the likelihood that bond values would be negative. In the extreme, assuming a never-changing (and positively sloping) yield curve, bonds would never have a value less than one. (See Figure 7.)

Section 4: Advantages of the bond-bank

A key advantage this form of banking has over the FR bank is that it allows management time to resolve problem loans as they arise. When a FR bank gets into difficulties, it may have very little time to resolve them before a run becomes a possibility. Whereas if a bond-bank were to get into difficulties, there would be a sell-off of its bonds but no hasty withdrawal of funds; rather management would have time to take remedial action, such as taking on more collateral or issuing new equity. For example, if a problem arose in a loan maturing in two years’ time, since the loan is funded by bank bonds that also mature in two years then management has this time to resolve the problem. The improved manageability of problem loans would again lead to less volatility of bond prices.

Flannery (1994) argues that demand deposit acts as a protection mechanism for depositors, since they can be withdrawn at any time, thus giving bank managers a strong incentive to lend prudently. Any increase in the riskiness of the bank’s loan portfolio can be quickly repriced. The bond-banking system has a range of similar protection mechanisms in the event of a change in a bank’s credit profile.

1. Assuming a bank makes loans of approximately equal tenor, existing bondholders in a bond-bank are protected by the time-seniority of their claim. For example, assume a bank makes only 5 years loans, and periodically issues 5 year bonds to fund these loans. If it decided to raise the level of risk in its loan portfolio, the new bonds would need to be costlier to reflect the higher default risk, but the existing bonds are protected because they would be paid off before any defaults from the riskier loans are realized.

2. A bank that gets into difficulties will see the market price of its bonds fall, and thus will not be able to raise new funding without an increase in the interest rate it offers. It will thus be at a significant competitive disadvantage. However, it will not face a run, and will have time to repair its balance sheet, whereupon it will be able to again attract funds at competitive interest rates: this provides stability to the bank’s risk profile, mitigating Flannery’s underlying proposition.

3. Finally, in any case bondholders could be protected from capital losses if the bank sold them put options over the bonds (which it could hedge by buying put options), or if interest rates were variable.

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7 Flannery assumes that bank creditors can estimate a bank’s riskiness at any point in time.
The bond bank also obviates the need for deposit insurance, and thus delegates back to the market, rather than the regulator, oversight of the bank's activities. The far reduced risks would result in much lower capital requirements.

More broadly, the interest rate in a bond-banking system is self-adjusting to the prevailing economic conditions: if investment opportunities abound, so that the demand for loanable funds increases, then the interest rate will also increase, tending to reduce the value of bonds and cull consumer demand. Conversely, if the investment outlook is pessimistic, the demand for loanable funds will fall, thus lowering the interest rate, raising the value of bonds and stimulating consumer demand. In this way, the bond banking system acts as a form of automatic stabilizer.

Readers would note that the short term interest rate is always zero. This begs the question of the role of the central bank. Since short-term interest rates are predetermined as 0%, its role would be limited to printing money, at a rate that allows for optimal economic growth.

In practice, it is likely that retail customers of the bank may never see much difference in their banking operations, other than slight changes in their balance as interest rates vary (if they do not buy put options). The bank would still settle intrabank transfers between its own customers unilaterally, as happens now. For interbank transactions, it would act as an accumulator of transactions, and manage the wholesale net interchange of funds between banks, as also happens now. However, rather than that interchange occurring through a clearinghouse arrangement, it would occur through the exchange. (See Figure 8.) And rather than transferring its own cash, it would be merely acting as a wholesale broker on behalf of its customers, buying or selling bonds in response to customer instructions, in much the same way as foreign exchange transactions are managed today. Hence, unlike FRB, bond-bank customers are not dependent on one particular bank to sell their financial assets, an alternative broker can be used if need be.

Section 5: Conclusion

The key advantages of fractional reserve banking are usually cited as: its ability to harness the quasi-stable nature of short term deposits for long-term investments; depositors' ability to liquefy their deposit at parity at any time; and that it pays interest on even short term deposits. Its inherent fragility is usually managed by deposit insurance and layers of regulatory oversight. This paper shows that these positive features can be replicated by what I have termed a “bond-bank” system of banking, which could operate without FRB's inherent fragility. The essence of the difference is to recognize that the FRB deposit is a put option in a bilateral relationship that is utterly dependent on the issuing bank to honour, but an identical arrangement can be structured in a multilateral exchange environment that breaks this dependency. The bond-banking system would: obviate the need for deposit insurance with its attendant moral hazards; delegate the setting of interest rates and monitoring of banks back to the market rather than government; and, by acting to stabilize both the banking industry and the economy, significantly reduce the need for bank capital.

References


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Appendix

The literature on the nature of banks also includes at least two strands that do not entail fractional reserves. The first of these postulates the existence of banks based on their greater ability, compared to bond markets, to efficiently produce or elicit information. Key papers include Leland and Pyle (1977) and Boyd and Prescott (1986). The essence of this strand is that it is expensive for investors to collect information about investment opportunities, so there are economies of scale advantages for individual investors to coalesce into a coalition, to avoid duplication of effort in collecting information. In Boyd and Prescott, agents are entrepreneurs who may be endowed with good or bad projects, but who do not reveal this information; the coalition induces both types of agents to join it. The coalition pays out to all (albeit differing amounts), so that even bad project entrepreneurs receive some benefit: hence they are motivated to join the coalition, rather than beguiling others to invest in their dud. However, none of these papers address the fragility of banks’ capital structure. A bond-bank coalition could perform this role as efficiently as a FR bank coalition (indeed the Boyd Prescott coalition mode is a bond-bank).

The second of these strands, attributable to Diamond (1984), likens banks to monitors of borrowers, and compares the efficiency of a banking system with a bond-market system. It is more efficient for a bank to monitor a portfolio of borrowers than it is for individual lenders to monitor all the individual borrowers in their bond portfolios: in the first case, the bank will monitor all the borrowers, and lenders (who deposit in the bank) need only monitor the bank. (See Figure 9.) Moreover, as the bank grows and its portfolio of loans becomes more diverse, its earnings become more stable, there is less probability it will be unable to meet its commitment to depositors, so the cost of monitoring decreases. Note that this role is also independent of the bank’s funding structure.
FR Bank Balance Sheet

Figure 1a. A typical FR bank balance sheet. Note the level of cash supporting the amount of deposits. Typically, a bank might have been required to hold 10% of its deposits in cash reserves to meet depositor withdrawals: hence the term “fractional reserve banking.”

FR Bank Assets and Liability Maturity Structure

Figure 1b. Note, however, the differing maturity structure of assets and liabilities. Cash is available now, but deposit liabilities can become payable in a very short time frame. However, loan assets typically do not mature for several years. This is called a “negative maturity mismatch”.

$ Assets

Liabilities

Short term Deposits
(usually rolled over or returned to bank)

0 200 400 600 800 1000 1200
Loans Deposits
Cash Equity

Assets Liabilities and Equity

FR Bank Assets and Liability Maturity Structure
The Cycle of Cash

Banks meet to net out payments and settle net claims.

Figure 2. Bank A provides cash to a depositor, but it will be ultimately returned, either if the vendor deposits it directly, or if it is lent by another bank, or lent by the central bank. The ratio of cash to transactions is declining.
Figure 3.
Figure 4: The economic impact of financial crises stemming from banking systemic weaknesses in east Asian countries in 1997

Source: IMF IFS database
Figure 5a. A FR bank has deposit-liabilities with a generally shorter maturity than its loan-assets. This is known as a negative maturity mismatch.

Figure 5b. The narrow banking proposal limits banks to storing cash, and precludes them from making loans (the credit-creation process). Non-bank investment trusts undertaken this function, but may still maintain a negative maturity mismatch, and hence be fragile.

Figure 5c. A bond bank is not precluded from making loans, but does not maintain a negative maturity mismatch – its assets are funded by liabilities of equal or longer duration. Long term bonds can be listed and traded.
Figure 6a. US Treasury yield curve for 3 and 5 year constant maturity rates since 1970.

Figure 6b. Sample 3-year gradual yield curves, a histogram of resulting bond prices, and the value of a bond-bank’s portfolio. In the middle graph, bond prices are skewed to the right, indicating they are usually valued above their face value. Bond-banks could therefore profitably sell put-options, to achieve a deposit-like stable price.

Figure 6c. Sample 3-year steep yield curves, a histogram of resulting bond prices, and the value of a bond-bank’s portfolio. In the middle graph, bond prices are still skewed to the right, albeit not as strongly.

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<td>Median of bond prices</td>
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<td>Percentage of values below $1</td>
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### Individual 5 year bond prices - Summary data

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<td>Percentage of values below $1</td>
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Figure 6d. 5-year gradual yield curves. The histogram of resulting bond prices is more broadly spread, but still skewed to the right. Likewise, the value of the bank’s bond portfolio is more variable, but generally over parity.

Figure 6e. 5-year steep yield curves. The histogram is still skewed to the right, albeit less than above. Likewise the value of the bank’s bond portfolio is generally over parity, but less than above.
Figure 7. Under conditions of total stability, with an invariant yield curve, the value of bonds would never fall below parity. The chart below gives values of a 5 year 5% coupon bond over the course of its life, assuming a) a gradual and b) a steep, invariant yield curve.
Comparison between FR and bond-banking

The FR bank deposit is a bilateral contract – if the bank fails the deposit is worthless

The bond bank is a bond-broker – the bond always has a market value
Comparison between the bond market and banking

**The bond market**

With $m$ investors and $n$ borrowers, in a bond market there are $m \times n$ surveillance relationships.

**Banking**

When a bank acts as a monitor of borrowers, only $m+n$ surveillance relationships are needed.

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*Figure 9.*