Financial Innovations and Banking Reform: Implications for banking without deposit insurance

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Abstract

Although bank loans themselves are somewhat illiquid because of private information, most of their cashflows are not. Recent financial innovations allow commercial loans to be liquefied via credit derivatives and actual and synthetic securitizations. The loan originating bank holds the remaining illiquid tranche containing the concentrated credit risk, private information rent and the "excess spread" that incentivize the bank to continue to monitor and service the loans. Empirically, we find that the average size of the residual tranche is about 3%, which reflects the size of the "market determined capital" necessary to support the liquefaction. The liquefaction of bank loans makes possible a banking system that restricts the guaranteed accounts to be backed by 100% reserves and the non-guaranteed deposits to be backed by liquid securitized loan tranches, while retaining the deposit-lending synergy. Such a system is perfectly safe without deposit insurance and it renders banks bankruptcy-remote without sacrificing a bank's traditional role as a financial intermediary.

Introduction

The fractional reserve banking system prevalent in most countries certainly has not been a conspicuous success. Over the past twenty years, we have witnessed numerous banking crises in industrialized countries as well as developing countries, from Northern Europe to Latin American to Southeast Asia.[1] None of these, however, were as spectacular as those in the world's largest two economies __ the US and Japan. The banking crises of the 1980s and early 1990s in the US ultimately cost about $200 billion to clean up. The ongoing Japanese banking crises could easily cost over one trillion dollars to clean up. These are just direct costs. The indirect cost of dragging the Japanese economy down for more than a decade is likely to be many times that.

At the root of many of the current banking system problems is the common practice for banks to take "riskless" liquid deposits and turn around and invest the money in some risky illiquid loans. Bank loans are illiquid in part because banks are thought to have private information about the borrower that the market does not have. Banks play an important role in providing private (versus public) sources of funding to borrowers who cannot credibly convey or are not willing to divulge inside information to the public.[2] This, unfortunately, induces a fundamental mismatch of risk and liquidity in banks if riskless liquid bank deposits are backed by risky illiquid bank loans.

Banking authorities have been trying to solve this problem with a convoluted system of deposit insurance, regulations, monitoring, surveillance and capital requirements. Despite the heavy intrusions of government into the private investment process in regulating banks, banking crises continue to erupt. The moral hazards posed by deposit insurance and anticipated government bailouts, combined with the high leverage ratios in banking, make such a banking system highly fragile and disaster-prone. Perhaps, it is time to take a fresh look at this old problem!

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[1] See, e.g., Kaminsky and Reinhart [1999] for a list of countries that experienced banking crises in recent years.

[2] Banks play a special role as a financial intermediary. See, e.g., Kane and Malkiel [1965], Diamond and Dybvig [1983], Diamond [1984], Santomero [1984], Fama [1985], James [1987], Calomiris and Khan [1991], Freixas and Riochet [1997], Boot [2000], James and Smith [2000], Diamond and Rajan [2001], Kashyap, Rajan and Stein [2002], Dahiya, Puri and Saunders [2003] and the review paper by Ongena and Smith [2000].

During the banking crisis years in 1930s, there was a proposal by Irving Fisher and others to separate a bank's deposit liabilities into two distinct components: the transaction accounts would be backed by 100% reserves and the non-guaranteed savings would be backed by risky loans. In such a system, there is no need for deposit insurance (except for fraud) and there is no need for the government to intrude into the private loan and investment process. While this proposal was favored by some bankers to deal with the banking crises then, many other bankers preferred a system of deposit insurance with government regulations and bailouts (Calomiris [2000]). Fisher's proposal was ultimately defeated in the US Congress as Amendments to H.R. 5357 (see Fisher [1936]).

Critics of Fisher's proposal would argue that the illiquid bank loans that support the non-guaranteed deposits would also make the deposits illiquid. If few depositors were willing to hold illiquid deposits, banks would lose their role as a private source of financing. Such a equilibrium could well be less economically efficient than the fractional reserves system (with deposit insurance and government interventions) that preserves the liquidity of most deposits and preserves the traditional role of banks as financial intermediaries.

The main purpose of this paper is to show that recent financial innovations provide a simple solution to this dilemma. The phenomenal growth of the credit default swap market over the past few years allows highly efficient transfer of credit risks between financial institutions, institutional investors and intermediate market instruments. Furthermore, when credit risks are packaged via actual and synthetic securitizations, the vast majority of the value of a bank loan can be financed with liquid market instruments, and the loan originating and monitoring bank would hold the remaining illiquid residual tranche. Thus, recent financial engineering can slice out the illiquid portion containing private information of a bank loan for the bank to hold, and securitize the liquid portion of a bank loan for the institutional investors and non-guaranteed depositors.

Empirically, we find that the illiquid portion in representative loan pools is small and the existing capital in the banking system is sufficient to support this illiquid portion. The recent market innovation of using "excess spread" as a dynamic incentive mechanism further helps align the interests of the bankers with the institutional investors and non-guaranteed depositors. Consequently, banks can retain its traditional role in providing private sources of financing and fund them with liquid non-guaranteed deposits, all without government

interventions and free of deposit insurance. At the general equilibrium level, if it is our national policy for the government to intervene in the relative supply of riskfree to risky investments in the economy to smooth out credit shocks, this can be accomplished with less distortion under a system with 100% reserves than under a system with fractional reserves and deposit insurance.

In section 1, we briefly review the recent banking crises and the history of the 100% reserve idea. Section 2 examines the feasibility of a variant of the 100% reserve idea taking into account of the latest innovations in market technology and credit derivatives. We illustrate how securitization can successively slice out the liquid portion of a loan's cashflows and transform them into liquid market securities, and keep the size of the illiquid economic core retained by the bank to a minimum. In section 3, we use the data bases provided to us by Moody's and Standard and Poor's to estimate how large is this illiquid portion of representative bank loan pools that has to be supported by bank capital. Section 4 considers the sufficiency of the market in linking liquid bank loan tranches to non-guaranteed deposits and the supply of government securities for the guaranteed deposits. Section 5 discusses the desirability of the resultant banking system over the prevalent fractional reserves banking system. Section 6 concludes the paper.

1. The recent banking crises and the 100% reserve plan

Perhaps the best way to appreciate the problems inherent in the current banking system is through the lessons we learn from the recent banking crises in the largest two economies in the world: US and Japan __ both of them run a fractional reserve system supported by deposit insurance laden with moral hazard. The early 1980s marked the beginning of a new banking era for banks in the world. Financial innovations, deregulations and international competitions pushed many US banks away from their once sheltered market (including deposit interest rate ceilings) into risky portfolios. Large banks assumed greater risk to boost profits, but many of them failed. At the same time, the S&Ls were hit hard because the mismatch in interest rates. The banking crisis period in the US did not end until the mid 1990s when the US economy was several years into the longest expansion period.

The S&L debacle ultimately cost about $160 billion, of which an estimated $132 billion was borne by the taxpayers. The cost of FDIC failed-bank resolutions in 1980-94 was $36.3 billion (the mutual savings bank crisis, Continental Illinois, Texas bank crisis, Northeast bank crisis and others).[3] At the outbreak of the LDC (less-developed-country) loans crisis in 1983, the problem for the big money center banks posed even greater systematic risks for the survival of the US banking system, as "seven or eight of the largest ten banks in the US might have been deemed insolvent (FDIC)" if their loans had to be marked to market without regulatory forbearance. The FDIC review (footnote 3) pointed out that "the seven-year period (1983-89)…was devoted to…protect the solvency of the US financial system." Fortunately, unlike the S&Ls, the money center banks were able to take advantage of the healthy world economic growth from 1982-90 to slowly build up their reserves until the late 1980s to take the hit (see "The banks' great escape" in *The Economist* [February 1989]), but not without the additional helps from the World Bank, the government of Japan, IMF (taxpayers of the member countries) under the Brady plan and the economic recoveries of the LDC countries.

Just as the banking crisis started to fade in the US in the 90s, the economy in Japan entered into a period of slow growth and the banking crisis in Japan began. Moral hazard in banking was clearly a major factor in the real estate bubble in Japan in the 80s when most banks speculated directly and indirectly (via subsidiaries and other "related" companies) in fueling the real estate price boom. When it burst, the banks were saddled with a bad loan problem so huge that it would impair their ability to finance even normal operations of viable firms. Forbearance is also being practiced in Japan in dealing with its ongoing banking crisis with a current estimate of the bad loans in the range of 41.4 trillion yen ($338 billion) to

[3] The historical facts for this section are collected mainly from a book published by FDIC called "The banking crises of the 1980s and early 1990s," Japan's Financial Supervisory Authority, and financial presses like *Wall Street Journal* and the *Economists*. There were 2978 bank and S&L failures between 1978 and 1999 in the US (source: FDIC). Figure 1A shows the number of bank failures (*excludin*g S&Ls) from 1934 (after the inauguration of deposit insurance) to 1995. In 1983, it was estimated that it would take FSLIC $25 billion to close those insolvent S&Ls but FSLIC had only $6.3 billion. Thus, FSLIC granted forbearance and encouraged those that were insolvent to continue operations and hoped that they would grow out of insolvency. The huge moral hazard problem (with already insolvent institutions) coupled with less than spectacular business environment for the S&Ls doomed such forbearance and cost taxpayers $132 billions, an average of about $500 per man, woman and child in America.

150.9 trillion yen ($1.23 trillion) (*WSJ*, source: Japan's Financial Supervisory Authority). These are the remaining ones after the help of the Japanese Resolution Trust[4] since 1992. Right now, more than a decade after the real estate bubble, Japan is still praying for the same miracle as with the US money center banks to grow out of its banking system's bad loans.

Perhaps all these crises could have been avoided if "riskless" deposits were backed by 100% reserves and separated from risky loans. Fisher (1936) ascribed the original 100% reserve idea (to reform the fractional banking system) to the "Chicago Plan of Banking Reform" that first appeared in a University of Chicago memorandum by Henry Simmons, Aaron Directors, Frank Knight, Lloyd Mints, Henry Schultz and others (see, e.g., Hart [1935], Fisher [1936], Simmons [1948] and Mints [1950]).[5] Over the past half century, it has been revised and redefined to address the periodic crises ranging from the banking disasters in the US and Japan to the recent international financial turmoil that started in the summer of 1997 (see, e.g., Friedman [1960], Tobin [1986], Litan [1987], Miller [1995, 1998a], Chen [2001]). The following is a brief outline of the main ideas on the 100% reserves system.

For a typical 100% reserve bank, its balance sheet would look like the one in Figure 1. In a nutshell, the plan calls for all (insured) transaction accounts to be backed by deposits with the monetary authority (at interest rates reflecting the cost of access to the payment system).[6] In that sense, banks are required to have 100% reserves. This itself will guarantee the safety of the payment system and there is no need for any deposit insurance except perhaps for fraud.[7]

Banks will raise funds to support their loan portfolios by issuing *non-guaranteed securities* at rates reflecting each bank's risk characteristics. A bank would typically initiate the loan process using its working capital. After the loan is structured, the bank can keep all

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[4] Kyodo Saiken Kaitori Kiko, or Cooperative Credit Purchasing Company, Ltd., established Aug. 28, 1992.

[5] The idea behind the 100% reserve banking has a long history and it is discussed in detail in a book by Fisher (1936). A similar idea went way back to Ricardo and The Bank Act of 1844 requiring 100% reserves for all Bank of England notes, putting an end to the era commonly known as the wild cat banking in England. Since then, fractional reserve backing of bank notes was replaced by fractional backing of bank deposits, which aggravated the economic depression and precipitated the general banking failure in the 1930s. In the words of Fisher who had to live through it, the fractional reserve banking system almost wrecked the capitalistic civilization.

[6] See, e.g., Friedman (1960) and Litan (1987) for different variations of the same general concept.

[7] Thus, there is no need for regulations beyond what is normal for other types of financial institutions. Banks may still want to have additional reserves or cash equivalent for their working capital to initiate loans and for the purposes of clearing and carrying out normal banking transactions. See also Shy and Stenbacka (2000).

or part of it on its book and repackage the reminder for the non-guaranteed depositors. Thus the items on the balance sheet below the transaction accounts resemble that of a typical investment trust or brokerage firm and they can be structured in accordance with the current market demand.

A concern about this system is that the illiquid nature of many private loans would also make the non-guaranteed deposits illiquid. If depositors prefer liquid deposits, would such a system destroy the banking system as we now know? Could our current convoluted banking system, despite its periodic catastrophic collapses, be welfare improving (over a 100% reserve banking system) because it can transform illiquid loans into liquid deposits under the protection of deposit insurance and government bailouts? It is not possible to have a conclusive answer to this question without a large-scale social experiment. Fortunately, with the recent advances in financial engineering, there is a simple but elegant solution that gives us the best of both worlds. The answer lies in the recent innovations in the market that allow banks to liquefy consumer, commercial and industrial loans alike into liquid securities.

Figure 2 illustrates the typical structure of a 100% reserve bank after its loans are liquefied. Transaction accounts with access to the payment system are 100% backed by interest bearing deposits with the monetary authority, where the lower interest rates reflect the cost of access to the payment system. Riskfree savings deposits are 100% backed by short term T-bills or their close equivalent. A government guarantee, whose cost is borne by account holders, may still be desirable as insurance against fraud. Risky private loans are liquefied into tranches of different risk and liquidity classes and an illiquid residual. These liquid tranches support the non-guaranteed deposits with the risk-reward-liquidity characteristics as determined by the market supply-demand. *The illiquid residual is held by the bank against its capital.* With such a suitably revised 100% reserve banking system, a bank can provide perfectly safe transaction accounts with access to the payment system, guaranteed riskfree deposits backed by government papers, private sources of financing and liquid non-guaranteed deposits, all without deposit insurance (except for fraud) and government intrusions into the private loan and investment process. The reality of such a banking system depends on the ability of the market to liquefy bank loans __ the main subject of our study.

2. Feasibility of a 100% reserve banking scheme with liquid non-guaranteed deposits

There are three key financial innovations in recent years that combine to make most bank loans liquid. The first one is the growth of the bank loan market. The second one is the growth of credit derivatives, in particular credit default swaps (CDS). The third one is the growth of collateralized debt obligations (CDO), which include both collateralized bond obligations (CBO) and collateralized loan obligations (CLO). It is well reported that these financial innovations have made our banking system more "flexible, efficient and resilient" through effective risk-sharing during the recent stressful years (e.g., the defaults of Argentina, Enron, Worldcom, etc.).[8] In this section, we will examine in detail how these innovations collectively can liquefy almost the entire loan portfolio of a bank.[9]

Table 1 shows a breakdown of the aggregate loan portfolio of all the FDIC insured banks in the US at the end of 2003. Of the approximate US$4.4 trillion in loans, the largest three categories are real estate (51%), commercial and industrial loans (20%) and loans to individuals (17%). Real estate loans and consumer loans (credit card, auto loans and leases, home equity lines, student loans, etc.) have been securitized and resold in the secondary market since the early 1980s. They are easy to liquefy because their loan process usually follows a standardized procedure with credit risk measures such as FICO scores and almost *no private information*. A diversified portfolio of these loans has essentially only systematic credit risk that is a function of the average credit rating, geographic characteristics, business conditions and interest rates. Thus, the tranches are liquid and easy to price. For large and small banks alike, after they originate these loans, they can *choose* to sell them off easily.

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[8] In Federal Reserves chairman Alan Greenspan's monetary report to the Congress (February 27, 2002) and again before the Council on Foreign Relations (November 19, 2002), he stated that "New financial products—including derivatives, asset-backed securities, collateralized loan obligations, and collateralized mortgage obligations, among others—have enabled risk to be dispersed more effectively to those willing to, and presumably capable of, bearing it. Shocks to the overall economic system are accordingly less likely to create cascading credit failure…the wide-ranging development of market in securitized bank loans…has been a major contributor to the dispersion of risk…in decades past, such a sequence [of defaults] would have been a recipe for creating severe distress in the wider financial system...more generally, such instruments appear to have effectively spread losses…from banks…to insurance companies, pension funds, or others with diffuse long-term liabilities or no liabilities [mutual funds] …but because of significant capital, they were able to avoid the widespread defaults of earlier periods of stress." This is also echoed in *Financial Times* (February 18, 2003) and in the June 2003 *Annual Report of the Bank for International Settlements*.

[9] We are indebted to many bankers, asset managers and rating agency analysts of structured products for information and insightful comments, in particular Diane Lam (S&P), Marie Lam (Moody's), Powell Thurston (PIMCO), Irene Tsao (Societe Generale), Ram Willner (Banc of America) and Patrick Wright (Deutsche Bank).

In this study, we focus on the *commercial and industrial loans* that are considered to be less liquid because they tend to be more chunky with some private information. These corporate loans are also the focus of many theoretical models and empirical research on banking (see review article by Ongena and Smith [2000]). Recent financial innovations, however, allow the market to slice out the most illiquid portion of the loans to be retained by the loan originating agent bank and liquefy the rest. The contract design leaves sufficient incentives for the agent bank to continue to service and monitor the loans on behalf of the investors. In many aspects, this theory is also well understood in practice[10] and it is similar to the standard corporate finance paradigm of a manager acting on behalf of the shareholders (see, e.g., Gorton and Pennacchi [1995], DeMarzo and Duffie [1999]). The interesting empirical question is *what the market actually requires as incentive mechanisms that would allow bank loans to be liquefied in practice*.

Figure 3 provides a road map of how large and small loans from big and small banks get liquefied in the market. Large loans are often traded in the institutional loan market. Smaller loans can be bundled together for securitization. Big money center banks can off-load their credit risks via many conduits. Smaller banks can do it through big banks or arbitrage CDO. We will discuss each of these in turn and then consider them collectively.

A. Growth of the Institutional Loan Market

Starting in the 1980s, bank loans, which were once thought to be nonmarketable, became marketable (see, e.g., Gorton and Pennacchi [1995]). By the end of 2003, the institutional loan market was about $1.07 trillion dollars (source: CSFB, Loan Pricing Corporation; in comparison, the total outstanding corporate bonds in 2003 were about $4 trillion dollars and 0.6 trillion Euros), which was bigger than the total commercial and industrial loans of $0.879 trillion remaining on the books of all the FDIC insured banks combined (source: FDIC 4Q2003). This is in part due to the fact that most large commercial banks adopting a portfolio-management approach to credit products since financial liberalizations in the late 1970s. "In the old days…loans sat on the book of banks and stayed

[10] It is commonly recognized in the industry that "structural mitigants, balanced equity return profiles and managerial interest-aligning incentives [are] the powerful drivers of CDO performance." See, e.g., S&P: "Balancing Debtholder and Equityholder Interests in CDOs, November 2002"

there. But now … banks put a premium on the ability to package loans and sell them… (S&P: A Guide to the Loan Market, October 2002) "

The average size of these syndicated bank loans is not small, with a typical size of $200 million to $1 billion. The liquidity of the loan market has significantly increased recently due to innovations in information technologies that allow efficient sharing of information from comprehensive database (e.g., Moody's, S&P Leveraged Commentary & Data). By the end of 2003, over 90% of these loans (in the outstanding value) are rated by rating agencies. *These standardized measures of risk contribute to the liquidity of the loan market.* With information so widely available on those loans and their obligors, the institutional investors (based on their own analyses) do not feel that they suffer any informational disadvantages relative to the loan originating financial institutions. They trade these institutional loans in the same way they trade corporate bonds.[11] This is probably the most significant reason why the institutional loan market is liquid.

Therefore, the large money center banks can easily off-load most of their large syndicated loans in the institutional loan market if they choose to. How about regional banks and smaller loans? The next two sections show that there are now conduits for banks to transfer the credit risks of their smaller loans to the eventual investors.

B. Credit Default Swaps (CDS)

According to the British Banker Associations, the outstanding global credit derivatives are expected to reach $4.8 trillion in 2004. A majority (69%) of these credit derivatives are in the form of a credit default swap (CDS). A CDS is simply an agreement between two parties to exchange credit risk on a reference asset (e.g., a bank loan or a corporate bond) or a basket of them. The main idea behind a CDS is that it will allow a bank to sell the credit risk of a loan without actually selling the loan.

[11] We thank PIMCO, one of the world's largest fixed income management companies and bank loan buyers, for providing us with details on the stylized facts of the institutional loan market. Interested readers can also consult "A guide to the loan market (S&P)." When Tyco International Ltd. turned to its banks for a $1.5 billion loan in 2003, "Morgan Stanley, Bank of America, J.P. Morgan, Citigroup, Goldman Sachs Group and the Credit Suisse First Boston unit of Credit Suisse Group -- each agreed to back $250 million of the $1.5 billion credit line. The banks likely won't retain all of their $250 million pieces; they are in the process of parceling out pieces to other banks and institutional investors (WSJ 1/13/2003)."

For example, a bank wants to transfer the credit risk of a loan on its book to an institutional investor, say, a mutual fund. In this case, the bank buys credit protection from the mutual fund and the mutual fund sells credit protection to the bank. The bank will make periodic swap counterparty payments to the mutual fund (like interest payments). In the event of a credit event related to the reference loan (failure to pay, bankruptcy, restructuring, repudiation/moratorium and obligation acceleration: based on International Swap Dealers Association Inc. [ISDA] 1999 credit swap master agreement), with the event independently verified by third parties or public information, the mutual fund will make a credit protection payment to the bank. The credit protection payment is equal to the difference of the notional amount of the defaulted reference obligations and the loan recovery value determined by a "calculation agent" (usually a bank or a group of banks, verified by third parties) at certain time, say 180 days, after the credit event.

In this example, the transaction is similar to the mutual fund "buying" the loan from the bank. The mutual fund will be receiving periodic "interest payments" in the form of swap counterparty payments, but will have to bear the risk of default. The bank transfers the credit risk of the loan to the mutual fund investors and typically receives the "excess spread" (the spread between the interests it receives on the actual loan and the "interests" it pays to the mutual fund) as incentives for monitoring and servicing the loan. In a typical CDS involving a basket of loans (see also synthetic CLO below), there is usually a first loss piece kept by the bank, making the bank the residual claimant, and a reserve account (see Figure 4) funded by the bank to align the bank's interests with the swap counterparty.[12] *The reserve account is periodically replenished from the excess spread cash flows to keep the bank's interests continue to be aligned throughout the life of the CDS even after some defaults.*

This type of setup has far-reaching applications in terms of conduits for transferring credit risks. As noted by Jones (2000), "…a money-center bank or a securities firm might sell credit protection to regional banks whereby the guarantor promises to cover all losses above a certain amount against a specified pool of loans." Thus, a CDS is a feasible way for *regional banks* who are not large enough to directly liquefy their loan portfolio into the market to unload their credit risks to *larger banks and securities firms*, who would then bundle many of these CDS into a deal large enough to be of interests to institutional investors

[12] See related incentive issues discussed by Pennacchi (1988) for bank loan sales.

in the market. Conversely, smaller banks may sell credit protection to larger banks on syndicated loans in order to get exposures to the risk and reward of those corporate clients of the larger banks (*Bank for International Settlements Annual Report,* June 2003). The very low structuring costs fuel the phenomenal growth of the CDS market and make the transfer of a loan's credit risk extremely liquid. With the prevalence of CDS, it is increasingly unclear how much of the credit risks of those commercial and industrial loans remaining on the bank book are still borne by the banks as "banks were net purchasers of credit protection while insurance companies and financial guaranty insurers were important net sellers."(BIS, 2003)

C. Collateralized Debt Obligations (CDO) and Collaterialized Loan Obligations (CLO)

Collateralized Loan Obligations (CLO) and Collateralized Bond Obligations (CBO) are just securitizations of cash flows from loans and bonds. They are collectively called Collateralized Debt Obligations (CDO). In the simplest case of a CLO, it takes a portfolio of commercial and industrial loans as assets and issues securities with claims against the cash flows. Figure 5 illustrates a typical structure (S&P: Global CBO/CLO Criteria). The seller/servicer chooses loans from different banks to form a diversified portfolio and transfer it to the issuer, usually a special-purpose vehicle (SPV), with an asset manager, a trustee and possibly swap agreements to hedge against interest rate and currency risks. The bankruptcy-remote SPV sells asset-backed securities (ABS) backed by most of the cash flows from the loans and usually retains an equity position with claims against the residual cash flows.

The main idea is similar to that of Mortgage Backed Securities (MBS) which became popular right after the financial market liberalization of the late 1970s. At that time, it was obvious it would be more profitable for banks to originate and service the mortgages rather than funding them because banks do not have any particular advantages in holding something so *standardized, homogeneous and devoid of private information* as residential mortgages. By early 2000s, the size of MBS alone was about the same as the US Treasury market (about $4 trillion). The CDO market took off around 1996 following the other asset-backed securities (ABS) market. The late start of the CDO was partly due to the uncertainty of how to structure the securitizations acceptable to the market, knowing that banks may have private

information __ the same reason why bank loans are considered illiquid in the first place. Over the past several years, the CDO market has endured market tests with exponential growth and the outstanding global volume was more than 1 trillion in 2003.

The main reason for the success of the CDO market is that *securitization transforms something heterogeneous and illiquid (loans with private information) into something homogeneous and standardized (e.g., an AAA tranche) so that it is liquid.* Since this is the critical link in liquefying banks' commercial and industrial loan portfolios, we will illustrate with several examples on how the CDO technologies have evolved over time to deal the incentive issues and provide empirical evidence on the feasibility.

Typical Bank CLO and incentive alignment mechanisms

A Simple Example. The NationsBank (now part of the Banc of America) Commercial Master Trust[13] provides an example of a simple CLO (Figure 6). In their series 1997-2, NationsBank had an initial loan pool of more than 1000 loans in 50 industries. The internal/external loan rating distribution was 2.07% *AAA*, 0.37% *AA*, 10.35% *A*, 45.21% *BBB* and 42.0% *BB*.[14] The securitization backed by these loans has four tranches due in 2002. Class A is a $2 billion floating-rate asset-backed certificate with an *AAA* rating, Class B (subordinated to Class A) is a $66 million certificate with a rating of *A*, and Class C (subordinated to Class B) is a $66 million certificate with a rating of *BBB*. Class D, with a par value of $66 million, is the residual "equity" tranche retained by the originating bank, NationsBank, which backs the securitization with an additional 1% reserve. The credit enhancement to bring Class A to an *AAA* rating with a loan pool with a weighted average rating of *BBB*- was made possible by

[13] We thank Greg Duffee for pointing to us this example.

[14] This is also roughly the distribution of ratings in many bank CLO and the distribution of the corporate borrowers at the point of their bank loan originations. Approximately, 80% of bank loans are to companies with ratings Baa/BBB or Ba/BB (including companies that are not publicly rated, but would have fallen into this category based on banks' internal ratings; interestingly, the loans to those publicly *unrated* corporate borrowers would have a risk-based capital requirement at the same level of publicly rated BBB corporate borrowers in Basel II [April 2003]). This distribution is consistent with the findings of Quantitative Impact Study 3 – Overview of Global Results for Basel II (May 2003) for the performing loan qualities in Group 1 banks (large international banks) and in Group 2 banks (smaller specialized banks). Corporate borrowers with higher ratings would find raising money directly in the financial markets cheaper. Companies with ratings lower than BB would find bank financing prohibitively expensive __ they are better off raising fund from junk bonds or private capital. We thank Banc of America, PIMCO and CreditSpctrum for providing us the relevant information.

the subordination of Class B, C and D (representing about 9% of the loans) and the 1% reserve. Since Class A, representing more than 90% of par value the loans, has a rating of *Aaa/AAA/AAA* (Moody's, S&P, Fitch ratings), there is a liquid market for it among the world's institutional investors. The credit rating of Class A note is actually higher than the *AA* rating of NationsBank because of the survivability of the security interest in the notes even if NationsBank becomes insolvent. Class B and C are also of investment grade and there is reasonable liquidity for them. The credit risk of the original loans is concentrated in Class D (to be kept by NationsBank) with a par value that is 3% of the original loan value (with additional support through a 1% reserve).

Through subordination, the CLO creates liquidity for more than 96% of the loan value of a portfolio dominated by *BBB* and *BB* loans that are presumably laden with private information. As finance theory would predict, when there is substantial asymmetric information between the sellers and buyers of bank loans, it is efficient for the bank that originated the loans to hold the risk-reward for the private information (the residual tranche). In this CLO, financial innovations combined with an independent rating agent, *who also serves as the monitoring agent*, mitigated the problems associated with private information to the extent that most of the loan value can be sold off to outside investors. This is the typical structure of a CLO: after securitization of the original diversified loan portfolio with an average rating of *BBB,* "97% of the issued securities could receive an investment-grade rating. The remaining 3% of the pool would be held as equity. (Fitch research report December 1997, "Bank Collateralized Loan Obligations: An Overview")"

<u>*Synthetic CLO: Offloading Credit Risk without Selling Loans*</u> The transfer of credit risks can be more easily done via credit default swap (CDS) because of the lower structuring costs, especially if the loans are from different legal jurisdictions (to gain more geographic diversification). In Figure 7, the Deutsche Bank's Globe-R 2000-1 is a synthetic CLO because Deutsche Bank will keep the loans on its book but use CDS to transfer the credit risks to the eventual investors. The super senior tranche of Euro 1.722 billion (86% of the deal) is an "unfunded CDS" in the sense that the super senior tranche is not sold as notes and thus there is no funding. The Deutsche Bank portfolio contains mostly spot loans and the interests on those loans can be thought of being decomposed into two components: one

supporting the funding and the other supporting the risk (swap counterparty payments on the CDS). In recent years when funding is widely available in the market, banks would prefer sell the credit risk without selling the funding.[15]

Credit Lines and Synthetic CLO with Unfunded CDS A synthetic CLO structure with an unfunded CDS is often used when the reference portfolio contains credit lines that are undrawn. This is an important financial innovation that takes into account of the recent phenomenon that a significant fraction of money center bank loans are in the form of credit lines (see Kashyap, Rajan and Stein. [2002]). For example, CitiStar (Citibank) 1999-2 is a $4 billion synthetic CLO that references 233 senior unsecured facilities in US and Canada in which around 80% was undrawn at offer and Verdi (IntesaBci) 2002 is a Euro 4 billion synthetic CLO in which 89.5% are undrawn revolving credit facilities. When the credit lines are drawn, the bank would fund them with its working capital or through the interbank market (others' working capital).[16] As the credit line is already securitized with a synthetic CLO, the structure evolves into a CLO structure where the bank would hold an obligor's spot loan (rather than credit line) whose credit risk has already been transferred through a CDS.

The underlying idea is best illustrated with the help of the CLO of IntesaBci corporate loan portfolio in Figure 8. The credit risk is transferred via a CDS to a counterparty (usually a financial institution with an OECD bank, such as Merrill Lynch, for regulatory capital reasons) who will in turn parcel out to other institutional investors. The commitment fees from the undrawn credit lines are used to cover the swap counterparty payments on the "unfunded" super senior CDS (Euro 3,640 million or 91% of the deal). When the credit lines are drawn on IntesaBci, the structure will gradually evolve into the case of Deutsche Bank with spot loans in Figure 7.

"Excess Spread" as a dynamic incentive alignment mechanism. In many CLO structures, the bank will use "excess spread" in addition to the "first loss" as an incentive alignment

[15] See, e.g., WSJ (December 17, 2003) article entitled "Banks itch to lend, but firms sit tight." If funding becomes tight later, banks can always sell the funding of the already securitized tranches.

[16] In our 100% reserve banking, working capital includes cash, deposits with monetary authority, T-bills or their close equivalents. The LIBOR market, the EURIBOR market and the interbank capacity is ultimately determined by the money supply controlled by the monetary authorities (see Fisher [1936] and Friedman [1960] for related issues on monetary policies corresponding to 100% reserve banking).

mechanism to convince investors that the bank will continue to diligently monitor and service the loans. An example would be the synthetic CLO of Amstel Corporate Loan Offering (ACLO 2000, the SPV) offered by ABN AMRO Bank. In the ACLO structure, AMRO bank will use the "excess spread," [i.e., the difference between the interests that it receives from the original loans and the interests (including swap counterparty payments) it pays to ACLO] to build up a reserve account (see figure 4) at an annual rate of 0.5% of the reference portfolio amount, which is available to ACLO when making credit protection payments. For each period (quarter), if the reserve account is exhausted because of credit events, the loss will be allocated to the tranches in reverse order of their priority: Class F first, and then, Class E, and so on until Class A and then the super senior. The excess spread is an important *dynamic incentive alignment mechanism* that makes sure that there is fresh money going into the reserve account, regardless of what was the past default experience, to keep the bank as the residual claimant throughout the life of the CLO.

It is worth emphasizing here the importance of such an incentive alignment mechanism in driving the performance of recent CLO (see footnote 10). Diamond and Rajan (2001) discuss the implications of the fragility of our banking system (demand deposits) in aligning the interests of the bankers with the depositors in creating liquidity. Here, the excess spread is another practical alternative devised by the market to solve the same problem without the fragility of the banking system. With this mechanism, even if all the lower tranches are in default, the excess spread still puts in fresh money periodically into the reserve to entice the banker to act in the interests of the investors of the surviving tranches.

Loans to Small and Medium-size Enterprises. As expected, a large diversified portfolio to small and medium-size enterprises (SME) is easy to securitize. Each securitization may contain thousands, or even tens of thousands, of loans. An example is Geldilux 99-1 offered by HypoVereinsbank. The total loan portfolio is slightly more than EUR 2 billion with 1818 small and medium size corporations and private borrowers. Almost no borrower has a rating from Moody's or S&P.[17] Of the 5 tranches: Class A (94%) is *Aaa/AAA*, Class B (2.6%) is *A/A*, Class C (1%) is *Baa/BBB*, Class D (1.5%) is *Ba/BB* and Class E (0.9%) is the residual

[17] In rating SME, Moody's would use a binomial simulation based on the bank's internal rating system while S&P would use an actuarial approach based on recent default rates. The ratings from the two agencies are usually consistent.

tranche without rating. The size of the residual tranche is small because SME loans are like consumer loans in many aspects. This fact is also recognized in the Basel II consultation paper (April 2003) in that SME loans may be separated from other corporate loans, and loans to small businesses can be qualified as retail risk exposure (like consumer loans) warranting a lower risk-based capital requirement. The SME loans originated from the smaller banks can be sold directly into "arbitrage CDO" in the same way smaller banks unload their consumer loans. Arbitrage CDO is another noteworthy innovation that allows successively slicing of the liquid cash flows from a bank loan portfolio until only the illiquid residual is left. The appendix contains a discussion of this role together with empirical data.

Representativeness of the Loan Portfolio. There are two competing motivations for banks in selecting which loans to include in the portfolio to be securitized. Banks would want to get rid of their worst loans, but, over time if the bank misrepresents the true risk of the underlying loan portfolio, this "lemon problem" would ruin its own reputation for future deals and cause its own securitization market to break down. On the other hand, banks would like to securitize their best loans to save on their capital requirements as the best loans require smaller residual to be kept, but this would get the regulators really upset because what remains on the bank book are loans of lower quality. Banks, regulators and investors are all aware of this selection bias problem. Thus, in many of the deals, there is voluntary disclosure on the representativeness of the loans. Indeed, in the offering prospectuses and rating agency reports, there are always comments on the loan quality with explicit statements attesting to being representative of the loans within certain category (e.g., performing loans originated from normal banking operations). To appease regulators and investors alike, some structures go as far as stating that the loans are selected randomly or all loans are included within that category. Furthermore, rating agencies, *being the outside monitors*, often insist in their reports that the ratings depend on the quality and consistence of the bank's internal credit rating and the bank's continuing effort in monitoring and servicing and extracting recovery values for defaulted loans. Any deterioration of these would lead to a rating downgrade that will impact the bank's ability for future securitization.

D. Summary

Financial engineering is capable of liquefying almost the entire loan portfolio of a bank. The securitization markets for residential and commercial mortgages and consumer loans have been around for a long time. Recent financial innovations allow the liquefaction of commercial and industrial loans also. Small and Medium Enterprise loans are easy to securitize as one can bundle them like consumer loans. Larger loans are traded in institutional loan markets, securitized in CLO and CDO and their risk can be transferred via CDS. Smaller banks can sell their loans (like their consumer loans) into arbitrage CDO. Through these conduits, most of banks loans can be turned into liquid securities. As we will see in the next section, the remaining illiquid portion that must be kept by the banks is small and can be well supported by the existing banks' capital.

3. Empirical Estimation of the Size of the Residual Tranche.

There are more than 20,000 structured finance deals in the data bank of Moody's and S&P dating back to early 1980s. Most of these are residential and commercial mortgages and consumer loans because securitizations of commercial loans are a more recent phenomenon. A sample of recent CLO of commercial loans from North America, Asia and Europe is given in Table 2. This sample is based on a data set of CDO reports from the S&P for the purposes of illustrating the typical structures of all the *recent* CLO. These are supplemented with Moody's and Lehman Brothers reports for missing data. Our final sample is based on all the CLO that have *complete* data with respect to structure details, the sponsoring bank, ratings and tranche sizes, especially the residual tranche (or first loss). If there are several offerings based on the same master trust, only the most recent one with complete data is included. There is a bias in favor of more observations from the European banks because European Banks are still the main source of financing for many corporations in Europe.[18]

All the CLO in table 2 are from major international banks. With a few exceptions, the size of each deal is at least $1 billion. The range is from about $150 million to about $12

[18] We were told also that American deals become so commonplace that usually only a one-page deal summary with the ratings is in the database.

billion (the exact size depends on the exchange rate as different tranches of the same deal may be offered in different currencies to different markets). Most of the deals are in the range of $1 billion to $2 billion, which appears to be the typical size of interest to the market. Although we do not have hundreds of independent deals, each data point itself is an extensive empirical and optimization study on its own (no data mining, just billions of dollars at stake). The patterns across data points are remarkably consistent. Perhaps the most telling figures from Table 2 are the average sizes of the investment grade, non-investment grade and the residual tranches (including reserves, if any). It shows that in our sample, about 96% of the cash flows from the loans can be sold off as investment grade. The most illiquid portion pertaining to the residual tranche is only about 3%.

The "3% residual" is a very revealing figure that reflects the size of the "*market determined capital"* required to support the securitizations that sell off the rest of the cash flows. An interpretation with respect to the loans in the sample is that an estimate of the average value of private information on a diversified bank loan portfolio is about 3%.

We should emphasize that the underlying loans in our sample in table 2 are all performing loans from large international banks including Citibank, Chase, Banc of America, FleetBoston (now part of Banc of America), HSBC, Sumitomo Bank, Deutsche Bank, ABN AMRO, BNP, IntesaBci, etc. The loans they securitize are loans from their normal banking operations. Most of these large banks have an *Aa/AA* rating, which is an indirect reflection of the average quality of their loan portfolios. The rating on the bank itself is based on its own unsecured senior debt, with liquid deposits above it in the capital structure. In other words, *the existing capital in these banks, taking into account of the quality of its entire loan portfolio and the liquid deposits above, can support an Aa/AA rating for its unsecured senior debt.*[19] For these banks, it is not surprising to find that the market-determined capital required for supporting the liquefaction of their performing commercial loan portfolios is about 3%.[20]

[19] The weighted average rating of Western European and US banks is between *AA*- and *A*+ in 2002 (*Financial Times,* May 21, 2002).

[20] The size of the residual depends on the quality of the underlying loan pool as well as the amount of private information. Most of the reported weighted average ratings (if available from the rating agency report) of the underlying loan pools are about Baa3/BBB-. Interestingly enough, if we split our sample into two subsets, one containing only loans to SME (which presumably private information plays a lesser role in a large diversified portfolio as the loan process follows rather standardized procedures) and the other containing loans to larger corporations, the average size of the residual is about the same. The higher average credit quality of the larger companies offsets the higher amount of private information presumably more important in the larger loans.

On the other hand, it would be interesting to look at cases where the bank is of marginal rating because of the quality of its loan portfolio. Here, the 3% residual may not be a good estimate of the market-determined capital to support its commercial loans.[21] The CLO of Shinsei Bank provides a meaningful example different from the banks in Table 2. Shinsei Bank (not one of those mega banks in Japan) used to be Long Term Credit Bank of Japan (LTCB). It was taken over by the government in 1998 and then re-privatized in 2000. Shinsei Bank's own rating is at the minimum investment grade *Baa3/BBB-* (Moody's/S&P) and it has a series of CLO based on a master trust on its loan book. To arrive at the ratings for the CLO tranches, the rating agencies had to consider the fact that many "performing" loans in Japan could be doubtful. Furthermore, the recovery value once the loan is defaulted is assumed to be zero (S&P), which is different from their assumptions about other OECD bank loans (S&P recovery assumption: 50-60% for senior secured, 25-50% for senior unsecured and 15-28% for subordinated loans; Moody's experience: 69.5% for senior secured and 52.1% for senior unsecured). Despite the doubtful nature of the performing loans and the extreme assumption of zero recovery value, Shinsei Funding One (03/06/2002; source: Lehman Brothers), has a Class A tranche (75%) rated *Aaa/AAA*, Class B tranche (10%) rated *Baa/BBB* and the rest (15%) non-investment grade and residual. This example suggests a rough bound of 15% on the capital necessary for a solvent but marginal bank to liquefy its commercial loan portfolio.

Overall, the empirical results in this section clearly show that the illiquid economic core of performing bank loans is small and can be adequately supported by the existing bank capital. To complete our discussion of a 100% reserve banking system, we now turn to the remaining questions of linking the liquefied tranches with the non-guaranteed deposits and the supply of riskfree investments for the guaranteed deposits.

[21] If the average loan quality is *BB-*, a rough estimate (source: PIMCO, Deutsche Bank) of the size for the required residual tranche is between 7 to 10 percent. The average corporate loan quality in banks (excluding SME) is between *BBB* and *BB* (footnote 14). The number of CLO based on defaulted loans, non-performing loans and doubtful performing loans is increasing, but the total number is still small. For example, Ark CLO 2000-1 is based on a portfolio of distressed and defaulted loans from Fleet Boston, Korea Asset Funding 2000-1 is a CLO based on restructured corporate loans and International Credit Recovery – Japan One Ltd is based on non-performing loans. In these cases, summary statistics are less appropriate when the underlying portfolios are so different.

4. Links to the guaranteed and non-guaranteed deposits

A. Bank loans financed by small depositors

The market that connects bank loans to non-guaranteed deposits has already existed and is rapidly expanding. Nowadays, when a small depositor comes to his favorite bank, he can invest in a bank-sponsored non-guaranteed, non-FDIC insured mutual fund specializing in bank loans or Treasury securities just as easily as he would deposit his money in a FDIC insured account. A casual browse through the offerings of major mutual funds reveals that traditional mutual funds are already playing such a financial intermediary role in bringing bank loans and depositors together in a significant way without deposit insurance. Bank-loan mutual funds used to be closed end funds with quarterly liquidity. The recent market innovations that bring increasing liquidity to bank loans also make bank-loan mutual funds more liquid. The newer funds are open-end funds with daily liquidity.[22] These funds have also attracted much attention in recent years from financial press. For example, in a *Wall Street Journal* article entitled "Bank-loan Mutual Funds May be Good Bet" (May 24, 2002), it compares the virtues of investing such mutual funds against other fixed income funds. It is also reported in a *Wall Street Journal* article (March 14, 2001) that "institutional investors such as mutual funds bought 49% of all (bank) loans to noninvestment-grade companies last year (2000)." Thus even a regional bank can both retain its information advantage in knowing its borrowers (relationship banking) and have access to the world market of non-guaranteed depositors.

Of course, there is nothing special about the abilities of mutual funds in securitizing bank loans for the non-guaranteed depositors. Banks can easily play the same role, and even have some natural advantages, in directly offering these types of non-guaranteed deposits. This is especially true in this age when the distinction between commercial banks, investment banks and brokerages is fast disappearing. For example, deposit type A (figure 3) can be

[22] For an example of an open-end fund, see Franklin Floating Rate Daily Access Fund or Fidelity Floating Rate High Income Fund. The contractual relation between banks and mutual funds are also quite interesting. See, for example, prospectus for Merrill Lynch Floating Rate Fund, Morgan Stanley Dean Witter Prime Income Trust, Kemper Floating Rate Fund, and others.

collateralized by a diversified portfolio of *Aaa/AAA* tranches.[23] For deposit type B, it can be a bank-sponsored mutual fund (already very popular nowadays). Mutual funds can provide the benefit of diversifying across many banks and across many investment types (as in a diversified stock fund) to reduce the risk for the non-guaranteed depositors, in addition to the role of monitoring the banks whose loans they invest in. Competition among the mutual funds will keep them vigilant in what they invest in. Deposit type C can be caveat emptor with limited liquidity backed by lower rated tranches, emerging market loans, exotic loans or even the equity tranche of a CLO. Such depositors would vote with their deposits and diversify across banks just like a typical investor in stock mutual funds. Indeed, there is no need to go into more details. As long as bank loans can be liquefied, financial engineering technologies can slice them into shapes and forms consistent with the market demand.

Community Banks The 7,000 plus small banks in the US do not pose much of a systematic risk. Federal regulators have been suggesting that only the largest ten to twenty banks need to conform to Basel II because their instabilities might induce systematic risk to the economy. But, it might still be politically expedient for the government to continue to support those community banks with guarantees,[24] even though conduits for the smaller banks to liquefy their loan portfolios already exist. There is also no need for the smaller banks to have their own deposit fund type as it is more efficient for them to offer a line of funds from the bigger players. In this age of banking consolidations, it may be simpler for the smaller banks to act more like the deposit taking affiliates of larger banks.

Therefore, in regard to linking bank loans with investors including large institutions and small depositors, the necessary markets have already developed and will continue to develop. Thus, the 100% reserve plan would not disrupt the main roles of banking beyond some minor repackaging that have already existed for decades and have been fast expanding in response to regulatory and technological changes. The government role is greatly reduced

[23] It could also include private insurance from monoline insurance company or pension funds (or other credit enhancement derivatives) for the principal and interests. The insurance company or the other institutional investors will have the incentive to negotiate the appropriate incentive contract with the bank and monitor the bank's practices carefully. There will also be a natural role for third party rating agencies to rate those non-guaranteed deposits the same way as CLO, ABS, ABCP, bonds and commercial papers are rated nowadays.

[24] In the same way as with Small Business Administration, Farm Service Agency, etc. even if they might be a potential burden to the taxpayers. See Appendix for arbitrage CDO and related discussions.

and the monitoring will be largely left to the markets of competing banks and funds. This is fundamentally different from the government's present role of constantly keeping a watchful eye on thousands of banks in their lending and investment processes with the attendant deposit insurance moral hazard.

B. Sufficient Government Debt for the 100% Reserve

In the 100% reserve plan, an important ingredient is to make the riskfree deposits backed by direct government obligations. This would require the government to sell enough obligations to satisfy the demand of the economy. At the end of 2003, the total transaction account (demand deposits, checkable deposits, etc.) in commercial banks is about $727 billion, the total US government securities held in commercial banks is about $910 billion (source: Federal Reserves), the total government debt outstanding is about $3.94 trillion and the contingent liabilities of Social Security is about $9 trillion. It is not clear if the Treasury needs to float more government debts to support the 100% plan. If indeed it is necessary, there is a question as to where the proceeds should go.

These concerns parallel the concerns in what to do if the government on-budget surpluses would pay off the national debt and the government may have to accumulate private assets. The original 100% reserve plan suggests that the proceeds from issuing government securities be used to finance deficits, reduce taxes, abolish federal taxes, or invest in quasi-government obligations, obligations of states and municipalities, obligations of international organizations and of foreign governments, acceptances and other commercial papers. It is also possible to "establish mandated individual retirement accounts outside the Social Security system, (which would also) mitigate the erosion in national savings."[25] Any reasonable combination of these would work. For example, we can privatize Social Security. Using the Chilean model of recognizing the contingent liabilities by issuing Recognition Bonds, the government would issue debt and put the proceeds in a professional managed pension fund (like the California Public Employee retirement Fund) to insulate federal investment decisions from political pressures.

[25] See Greenspan (March 2, 2001) testimony before Congress.

The fund may invest in a great variety of financial instruments, *even credit risks in bank loans or CDS*. If so, the government not only creates liquidity by issuing liquid debt and investing (like institutional investors) in bank loans, but also increases the relative supply of riskfree investment to risky investments in the economy and reduces the risk premium. This is just a less convoluted and distortionary version of what deposit insurance has been doing through the banking system.

Some General Equilibrium considerations when there is a systematic shock. This brings out an important but rather subtle implication that deposit insurance has had on our economic equilibrium. With deposit insurance, if there is a systematic shock to the economy and there is a flight to riskfree investments, investors may pull their money out of risky investments and deposit them into insured bank accounts (assuming for this argument that FDIC is considered to be riskfree). If banks speculate the proceeds in risky investments, the government is effectively standing ready to invest in the risky investments (without the upside) through deposit insurance with its attendant moral hazard.

In a 100% reserve banking system, if the government does not interfere with the natural market forces in response to a shock, there is no immediate change in the relative supply of risky versus riskfree investments and the economy's risk premium would rise until the market clears. This is the free market equilibrium.

On the other hand, *if it is our national policy* for the government to intervene in the market in response to a shock (e.g., LTCM) as in the current policy of managing interesting rates, it can commit to do so by standing ready to issue government securities and buy the liquid loan tranches from the funds at the *prevailing market prices,* or, almost equivalently, sell credit insurance via CDS *at market prices*. Here, the banks do not face any new moral hazard problems as the tranches are already owned by the depositors. The government is merely helping the depositors rebalance their portfolio from risky investments into riskfree investments by selling credit protection, which would incidentally change the relative supply of risky versus riskfree investments and smooth out the shocks in the credit market. Thus, *if it is our national policy* for the government to assume some temporary credit risks in order to

absorb unnecessary credit market volatility in a crisis,[26] this can be accomplished with less distortion and in a much less convoluted way than with deposit insurance.

5. The advantages of the 100% reserve plan

The original intention of the 100% reserve plan was to prevent monetary meltdown like those of 1930s. Interested readers should refer to Fisher (1936) and Friedman (1960) for their analyses on the advantages of the 100% reserve plan on the financial system stability, monetary policies, price level determination and interest rates. Here, we just want to compare the implications to banking between a 100% reserve system and the current system.

1. *Separation of riskfree and risky investments.* In a 100% reserve system, there is no illusion on what is riskfree and what is risky. The transaction accounts are back by deposits with the Fed and guaranteed riskfree investment accounts are backed by T-bills. The non-guaranteed deposits are backed by risky loans and their liquefied tranches. For the brave souls who deposit in tranches backed by risky loans, they take the hits and the rewards and vote with their money (just like investors in the stock market). The system is so simple that it does not create any unrealistic expectations for the depositors to run to the government for help if they lose money on their risky investments. The payment system is safe with the 100% reserves and it does not have any unintended externalities.

2. *Moral Hazard.* At the dawn of federal deposit insurance, Fisher felt that the accompanying moral hazard would be the root of future banking crises and it could not be solved by mere government regulations and monitoring. This is echoed seventy years later by Greenspan in his testimony opposing increases in the limit of

[26] Central banks and monetary authorities have also routinely added liquidity to the market by open market operations and direct deposits (usually via short notice auctions) into the banking system whenever the credit conditions in the market require. This can be much better accomplished with a 100% reserve system, as the central bank and monetary authority do not have to counteract the slack and the positive feedback effect in the fractional reserve system with capital requirements. The Hong Kong Monetary Authority operates a highly efficient Real Time Gross Settlement banking system, which currently has neither deposit insurance nor fractional reserve requirements.

deposit insurance.[27] The spectacular banking crises in the US and Japan in the last 20 years confirmed Fisher's conjecture. The FDIC review had a long discussion on why these problems cannot be easily solved by regulations and risk-based capital requirements and insurance premium.[28] Under the 100% reserve plan, there is no need for the deposit insurance that creates the moral hazard problems. The incentive problems of a 100% reserve bank are no more than those facing a typical corporation with an agent manager and different liability classes.

3. *Market Discipline.* The FDIC report also lamented the difficulty for regulators to persuade the banks to change their investment behavior (e.g., in the Less-Developed-Country loans case) at the time when the banks and their loan portfolios were doing well. The depositors were largely unconcerned as they were protected by federal insurance and there was little market disciple. In our version of the banking system, if the banks cannot justify their risk profiles, the depositors can vote with their money and pull the plug.

4. *Contagious Runs.* When a large bank fails (for example, First Pennsylvania Bank and Continental Illinois in the 80s and Bank of New England in the 90s), there is always a fear of contagious runs on otherwise viable banks. For example, in 1984, Continental Illinois suffered a high-speed electronic bank run and sustained enormous withdrawals of foreign deposits through electronic transfers. The first move of FDIC was to protect both insured and uninsured depositors[29] to contain the damage (at the

[27] Testimony before the Senate Banking committee, February 26, 2003. Furthermore, in his February 24, 2004 testimony before the same committee, Greenspan expressed concerns over the implicit government guarantees for Fannie Mae and Freddie Mac which enable those mortgage giants to accumulate the mortgages themselves (rather than selling them off), which pose serious risks to the US financial system (see Footnote 8).

[28] For example, they found several risk characteristics common to the majority of the failed banks, but such characteristics would "flag a much larger number of banks that did not fail." The latter group of banks could well have extracted more profits from the same assumed risks because of superior managerial skills. It is hard to imagine that standard government one-size-fits-all regulations on "risk" based penalties can solve the moral hazard problems when the measurement of risk itself is fraught with errors from the omissions of relevant but non-quantifiable characteristics such as managerial skills in risk management and relationship banking (see also Mingo [2000] and Jones [2000]). It is obvious that government regulations can never hope to match the market balancing of interests through optimal contracting and monitoring in our variant of the 100% reserve banking system.

[29] Federal Deposit Insurance Corporation Improvement Act of 1991 made it more difficult to protect uninsured depositors in resolving bank failures.

cost of aggravating the moral hazard problem even further). As in the Less-Developed-Country case, the US regulators chose stability over market discipline[30] to prevent the US financial system from a monetary meltdown like those in early 1930s. Such catastrophic externalities would never happen to a 100% reserve system.

5. *Capital Requirements and its Positive Feedback Effect.* Our current system of backing insured deposits with capital requirements produces an unfortunate positive feedback effect that occasionally freezes up credits.[31] This is especially true for the Japanese banks since the early 1990s. The loan overhang and its impact on the capital requirements in Japanese banks have been hampering the banks' traditional role in lubricating the economy and it has been a major contributing factor for the Japanese economic stagnation and its destabilizing effect on the East Asian economies that led to the 1997-98 financial crises (see Miller [1998a]). In the 100% reserve system, banks are spreading their risks through securitizations (see footnote 8) and their capitals are compartmentalized (as in a submarine) into thousands of units, each supporting the residual tranche of a separate securitization. The bank would not sink even if the capital supporting a particular CLO is driven to zero (in response to major credit events like Argentina, Enron or Worldcom). Thus, unless there is fraud, banks can continue to function and they are bankruptcy-remote.

The role of banks in a 100% reserve system

Recent banking literature focuses on the special role that banks play as a financial intermediary. Obviously, banks can play its traditional financial intermediary role by bringing together borrowers and investors with less restriction imposed under a 100% reserve system than a fractional reserve system with deposit insurance and government regulations.

[30] "US bank regulators, given the choice between creating panic in the banking system or going easy…had chosen the latter course. It would appear that the regulators made the right choice." L. William Seidman (former chairman of FDIC) in *Full Faith and Credit* (1993)

[31] The US "credit crunch" of late 1980s and early 1990s was well reported. Greenspan was very much concerned that America was suffering from an "unprecedented credit crunch" *(The Economist,* November 1991) and the Fed plan would include "newer ways to break the back of the credit crunch (*New York Times,* February 23, 1993). See, e.g., *The Economists* "Crunch by Credit," November 1990, *WSJ* November 4, 1992, and related academic papers, e.g., Berger and Udell (1994), Brinkmann and Horvitz (1995) and others.

If banks can capture their private information rent in their relationship banking under the existing system, they can likewise do so after their loans are liquefied into tranches to match any of a variety of market demands and incentive schemes. These are private arrangements arising from optimal contracting and not the incidental by-products of our clumsy banking system.

Thus, a bank within the 100% reserve banking system has four roles to play:

1. It provides a perfectly safe payment system including an electronic medium for exchange. The deposits in transaction accounts are matched against deposits with the monetary authority.
2. It accepts *guaranteed* riskfree deposits and invests them in treasury bills or their close equivalents. Such deposits will be guaranteed by government agencies like FDIC and there is no need to place any limit on the size of the accounts. *Banks are not allowed to take government guaranteed riskfree deposits and speculate the proceeds in risky private loans.*
3. It originates and structures private loans and repackages them for large and small non-guaranteed depositors and earns fees in servicing and monitoring them.
4. It holds concentrated risk positions, funded by the shareholders of the bank, to take risk that it cannot credibly sell off and capture the potential reward and the private information rent.

In this 100% reserve system, the cashflows from the bank loan portfolio are decomposed and structured to match the demands of those who have the natural economic rationale for the ownership. The homogeneous liquid senior tranches, in which the banks have no comparative advantages in funding them, are sold to those who ultimately want to own them. More speculative investors would take the junior tranches. Banks, as the claimants of the residual cashflows in the "excess spread" and the equity tranche, are incentivized and rewarded for their relationship banking, private information, monitoring and servicing. All these can be accomplished without the need of any more government guarantees and regulations than those that are normal for other types of financial institutions.

6. Conclusions

Centuries ago, banking started with a 100% reserve concept of depositing gold and other valuables for safekeeping with goldsmiths and transferred through paper evidence called "bank money." All these began to change when some goldsmiths decided to start a side business of issuing bank money (lending out gold) in exchange for loan repayment promises. It led to the collapse of the Bank of Amsterdam two centuries ago, the wild cat banking era in England more than a century ago, the financial meltdown in the 1930s and the crisis in 1980s and 1990s in the US, and the ongoing banking crisis in Japan. The mixing of risky loans and the safe storage of value gave depositors the unrealistic expectation that their money was safe with the banks, even though the banks turned around and speculated their money in risky loans.

It would seem that a simple cure for this phenomenon would be to separate these two functions of a bank into two different departments, while keeping them within the same bank to preserve the synergy. The depositor who does not want to risk his money can put his money in a transaction account backed by 100% reserves or a guaranteed riskfree savings account backed by T-bills. A depositor who wants to take some risk can ask the agent bank to invest on his behalf in risky loans. Instead, the US opted for a clumsy system of deposit insurance, regulations, surveillance, and capital requirements __ with unsuspecting taxpayers standing by as occasional unintended participants. Economists of future generations, looking back on the 20th century, will marvel at how we ever came up with such a convoluted system.

The evidence over the past 20 years in the US and Japan clearly shows that the current banking system is not much of a success. Some fundamental banking reform is necessary to make it more robust and stable. Recent financial innovations allow liquefaction of almost all of a bank's loan portfolio. These liquefied tranches can be funded by institutional investors and small non-guaranteed depositors. The bank holds the residual that contains a concentrated tranche of risk-reward for their private information and their monitoring effort. Consequently, our variant of the Fisher (1936) 100% reserve narrow banking scheme incentivizes banks to continue their traditional role in originating and servicing private loans while, at the same time, provides a simple and robust solution that eliminates most banking crises problems and makes banks bankruptcy-remote.

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Appendix

Arbitrage CDO and loans to SME

For various political reasons, most governments are obliged to be heavily involved in guaranteeing the more opaque smaller bank loans with incentive contracts where banks remain as the residual claimants, as in CLO (see websites of Small Business Administration (SBA), Small Business Investment Companies (SBIC) and Farm Service Agency (FSA)). The moral hazards of these direct government guarantees (insurance) on the loans themselves are well understood as there are just like typical insurance contracts, which are much less convoluted than deposit insurance. The guaranteed portion of the loans produces eligible assets that can be matched against the guaranteed deposits in the 100% reserve scheme, or sold directly into the market without the need for securitization.

In parallel, financial institutions observe the success of bank CLOs and decide to take advantages of the same opportunities, but they are enticed by arbitrage. They find that semi-liquid financial claims such as bank loans, less liquid tranches of structured finance products, portion of the residual tranches from earlier securitizations, bridge loans, loans for the liquidity between loan originations to loan securitizations, etc., have market prices that are at a discount from its "true" intrinsic value. These market frictions motivate financial innovations and many new financial intermediaries spring up. They buy and bundle these semi-liquid financial claims, securitize them with a priority structure to create investment grade tranches and sell them off at prices that yield them arbitrage profits. We call them collectively "arbitrage CDO."

The arbitrage CDO open up further the loan market to small and medium-size enterprises (SME) as in the case of MBS for mortgages. The securitizations can easily include SME loans from smaller banks (whose loan portfolios are not large enough to be of interest to the market) as well as non-bank financial companies (such as GE Capital Small Business Finance Corp., Allied Capital SBLC Corp., etc. which have been providing loans to SME without deposit insurance). Loans to small businesses such as auto repairs, convenience stores, car wash, pay phones, chain restaurants, etc. are routinely included. Therefore, arbitrage CDO are important complements to the bank CLO. They allow successive

liquefying of illiquid bank loans until all the liquid portion of a bank loan is sliced out of the loan. For smaller banks, they can also channel their credit risks directly into an arbitrage CDO. Thus, arbitrage is a powerful financial incentive that incidentally liquefies loans that were once thought to be illiquid.

Summary statistics (based on a data set provided to us by S&P) related to arbitrage CDO from recent years are reported in Table 3. Here, we include only arbitrage CDO whose underlying assets are predominantly bank loans and their derivatives. In addition to those arbitrage-minded financial intermediaries, Table 3 includes subsidiaries of well known banks, fixed income management companies, insurance companies, mutual funds and pension funds. There are several subtle but important differences between Table 2 and 3. For example, the Fleet CLO in Table 2 is based on loans from FleetBoston, but the FlagShip CLO (managed by a subsidiary of FleetBoston) in Table 3 may contain loans from many smaller banks and it is not restricted to bank loans from FleetBoston

One obvious difference between Table 2 and 3 is the larger equity tranche with the arbitrage CDO. In Table 2, the residual tranches of bank CLO are usually kept by the banks as incentive for them to take the risk and reward for their private information. Although banks may still sell part of it into a CDO or repackage their CLO equities into subordinated notes (see, e.g., Entasi S.r.l.), the potential moral hazard limits the marketability of those equities. On the other hand, although the manager of an arbitrage CDO in Table 3 is expected to hold some of the equity tranche to align the incentives, a significant chuck of it is expected to be sold. This is due in part to the fact that CDO equity tranche is fast becoming a separate asset class for investing in alternative investments (in addition to hedge funds and venture capital) because of its low return correlations with stocks, bonds and cash (Lehman Brothers "Quantitative Credit research"). As *all* the tranches of an arbitrage CDO are expected to be sold, the sizing of the different tranches is very much affected by market demand.[32]

[32] We are grateful to Powell Thurston of PIMCO, an active participant in the CDO market, for numerous discussions on related issues. The compensation for an arbitrage CDO manager comes in several tiers: arrangement fees, senior management fees paid before the tranches in every period, junior management fees paid (if any) in every period after the requirements for the tranches are satisfied (periodic cash flow and amortizations for all tranches, sometimes including a minimum return for the equity tranche), a share of income through their ownership in the notes and equity, and then a share of the residual (see footnote 10).

Table 1 U.S Commercial Bank (FDIC) Loan Portfolio

	End of 2002 (in millions)	End of 2003 (in millions)
Total	4,163,400	4,428,784
Real Estate Loan	2,067,999	2,272,296
Loans to depository institution	133,535	142,501
Commercial and industrial loans	912,022	870,627
Consumer loans	703,576	770,447
Leases	162,460	149,107
Others	183,808	223,806
Notional amount of derivatives	56,273,526	71,354,947
Credit derivatives	641,520	1,001,213

Table 2: Bank Collateralized Loan Obligations (CLO)

Issue	Tranches with Investment Grade %	Tranches with Non-investment Grade %	Residual %
ACLO 2001 1-2	99.75%	0.00%	0.25%
ALCO 1	95.50%	0.00%	4.50%
Aurora Funding	94.70%	4.30%	1.00%
Brooklands Euro	94.80%	2.20%	3.00%
C*Strategic 1999-1	97.70%	1.30%	1.00%
C*Strategic 1999-2	97.59%	1.41%	1.00%
Cast 1999-1	96.00%	1.00%	3.00%
Cast 2000-2	95.25%	1.55%	3.20%
CDO	95.20%	0.00%	4.80%
CDO 2	97.60%	0.00%	2.40%
CDO 3	97.85%	0.00%	2.15%
Chase	95.00%	0.00%	5.00%
Clover No 2-3	94.52%	1.31%	4.17%
Clover No.4	96.90%	0.00%	3.10%
Cordusio	94.80%	3.00%	2.20%
CORE 1998-1	96.10%	2.18%	1.72%
CORE 1999-1	96.63%	2.12%	1.25%
CORE 1999-2	96.56%	1.97%	1.47%
Credico Funding CBO	97.00%	0.00%	3.00%
CROWN CLO	95.10%	0.90%	4.00%
CYGNUS	97.40%	1.90%	0.70%
Cygnus 2001-1	96.73%	0.73%	2.53%
Eirles Two Ltd	93.50%	2.50%	4.00%
Fleet CLO	96.50%	0.00%	3.50%
Fondo BBVA-1	94.88%	2.44%	2.68%
Fondo BBVA-2 SME	94.67%	1.83%	3.50%
Fondo PYMECAT-1	98.20%	0.00%	1.80%
FTPYME TDA	95.70%	2.40%	1.90%
Geldilux 02-1	97.90%	1.30%	0.80%
Geldilux 99-1	97.64%	1.47%	0.89%
Geldilux 99-2	97.05%	1.75%	1.20%
Globe R 2000-1	94.01%	2.00%	4.00%
Imperial II CDO	94.50%	0.50%	5.00%
London Wall 2002 1-2	96.70%	0.70%	2.60%

Melrose 2001 1-2	92.15%	3.43%	4.42%
NationsBank CLO I & II	96.01%	0.00%	3.99%
Olan II	98.10%	0.00%	1.90%
Park Mountain Capital	95.60%	1.60%	2.80%
Promise A	94.80%	1.10%	4.10%
Promise I	95.75%	1.25%	3.00%
Promise K	94.51%	0.95%	4.53%
Promise Z	93.90%	1.60%	4.50%
Repon 16	98.10%	0.25%	1.65%
Riviera 1 S.A.	94.79%	0.00%	5.21%
Riviera 2 S.A.	95.79%	0.00%	4.21%
Rose No. 2	96.29%	0.00%	3.71%
Scala 3	97.60%	0.00%	2.40%
SMILE 2001	99.01%	0.00%	0.99%
Sundial	95.50%	3.00%	1.50%
Verdi	97.00%	1.00%	2.00%

Summary Statistics	**Percentage of Investment Grade**	**Percentage of Non-Investment Grade**	**Percentage of Residual**
Average	**96.02%**	**1.16%**	**2.82%**
Median	**96.00%**	**1.10%**	**2.80%**
Max	**99.01%**	**4.30%**	**5.21%**
Min	**92.15%**	**0.00%**	**0.70%**
Std. Dev.	**1.45%**	**1.09%**	**1.33%**
Total Issues	**50**		

Table 3: Arbitrage Collateralized Debt Obligations (CDO)

Issue	Tranches with Investment Grade %	Tranches with Non-investment Grade or Non-rated %	Residual %
ACLC	98.00%	0.00%	2.00%
Addison CDO	76.20%	18.50%	5.30%
Aimco 2001-A	89.00%	4.00%	7.00%
American 2000-1	70.62%	18.26%	11.12%
AMMC	73.50%	19.50%	7.00%
APEX	82.11%	13.27%	4.63%
Ares IV CLO	85.10%	9.23%	5.67%
Ares V CLO	88.00%	4.50%	7.50%
Arroyo CDO I	95.83%	0.00%	4.17%
Ben Nevis One	98.89%	0.00%	1.11%
Berkeley CDO	74.09%	15.16%	10.76%
Blue Chips Funding 2001-1	98.50%	0.00%	1.50%
Blue Eagle CDO	80.46%	8.05%	11.49%
Blue Heron	99.50%	0.00%	0.50%
Brant Point II CBO 2000-1	86.00%	7.00%	7.00%
Carlyle	88.00%	4.00%	8.00%
C-BASS CBO	81.48%	17.72%	0.79%
Centurion IV	76.00%	12.00%	12.00%
CIGNA	70.13%	23.87%	6.00%
Citadel	90.14%	2.94%	6.92%
Clare Island	82.34%	5.95%	11.71%
Clydesdale 2001-1	89.86%	3.57%	6.57%
Coast 2000-1	85.00%	6.00%	9.00%
Connecticut CDO I	92.00%	0.00%	8.00%
Copernicus	80.50%	10.00%	9.50%
Costantinus CDO V	91.45%	1.08%	7.47%
CREST 2001-1	76.00%	19.00%	5.00%
Crest 2002-1	90.00%	0.00%	10.00%
Crest G-Star 2001-2	89.55%	6.50%	3.95%
CSAM	84.87%	7.13%	8.00%
Denali	88.75%	3.25%	8.00%
Diversified Global	66.46%	22.01%	11.53%
Dryden 2001-1	87.73%	3.00%	9.27%
Duke Funding I	86.67%	10.67%	2.67%
Duke Funding II	95.48%	1.33%	3.19%
F.A.B. 2002-1	98.00%	0.00%	2.00%
First Source Loan	89.33%	0.00%	10.67%
Flagship CLO 2001-1	84.57%	8.42%	7.01%
Flagship CLO II	89.25%	2.50%	8.25%
Forte CDO	73.58%	16.17%	10.24%
Franklin CLO I	88.75%	4.00%	7.25%
Golden Tree	78.80%	5.20%	16.00%
Grayston CLO 2001-1	89.82%	2.47%	7.72%
Harbourview CDO II	77.65%	13.15%	9.20%

Harbourview III	82.99%	13.01%	4.00%
Harbourview IV	88.14%	3.86%	8.00%
Indosuez VI	72.27%	19.73%	8.00%
Invesco 2000-1	89.02%	3.90%	7.07%
Madison Avenue CDO I	70.00%	23.00%	7.00%
Madison Avenue CDO II	81.81%	13.01%	5.18%
Madison Avenue CDO III	73.32%	17.19%	9.49%
Madison Avenue Structered	83.06%	12.96%	3.99%
magnetite CBO II	68.56%	18.56%	12.87%
Magnetite III	78.60%	4.40%	17.00%
Melchior	83.66%	3.96%	12.38%
Mid Ocean 2001-1	96.92%	0.00%	3.08%
MKP CBO II	96.00%	0.00%	4.00%
Mountain CLO II	89.36%	1.93%	8.70%
MWAM	78.84%	16.97%	4.19%
Octagon	74.19%	18.81%	7.00%
Pacific Coast	95.68%	0.00%	4.32%
Panther I CDO	72.07%	20.87%	7.06%
Pinstripe	68.22%	24.55%	7.24%
Prudential	90.38%	2.45%	7.17%
Race Point CLO	87.48%	4.17%	8.35%
RMB CDO I	70.37%	14.81%	14.81%
Saybrook	84.00%	12.00%	4.00%
Seaboard CLO 2000	83.44%	8.44%	8.12%
Sequils-Centurion V	93.15%	0.00%	6.85%
Sequils-Magnum	92.86%	0.00%	7.14%
Signature 5 L.P.	71.00%	21.00%	8.00%
Simsbury CLO	75.15%	17.94%	6.91%
Solstice	74.85%	20.75%	4.40%
South Coast I	95.80%	0.00%	4.20%
St. George	76.51%	20.76%	2.73%
Strong CDO III	86.00%	10.00%	4.00%
Structured 2001-1	70.00%	25.00%	5.00%
Suffield CLO	59.60%	34.40%	6.00%
Swing 2001-1 CLO	93.88%	1.87%	4.25%
TIAA	83.50%	5.50%	11.00%
Triton CDO I	95.35%	0.00%	4.65%
Varick	86.63%	9.90%	3.47%
Whitney II	80.10%	10.92%	8.99%

Summary Statistics	**Percentage of Investment Grade**	**Percentage of Non-Investment Grade or Non-rated**	**Percentage of Residual**
Average	**83.74%**	**9.23%**	**7.03%**
Median	**84.87%**	**7.00%**	**7.01%**
Max	**99.50%**	**34.40%**	**17.00%**
Min	**59.60%**	**0.00%**	**0.50%**
Std. Dev.	**9.12%**	**8.23%**	**3.36%**
Total Issues	**83**		

Bank

<table>
<tr><th>A</th><th>L</th></tr>
<tr><td>Deposits with the Fed</td><td>Transaction Accounts
(access to payment system)</td></tr>
<tr><td>Loans</td><td>Non-guaranteed deposits</td></tr>
<tr><td>Working capital</td><td rowspan="3">Other debts and Equity</td></tr>
<tr><td>Other Loans</td></tr>
<tr><td>Other assets</td></tr>
</table>

Figure 1: Irving Fisher's Proposal

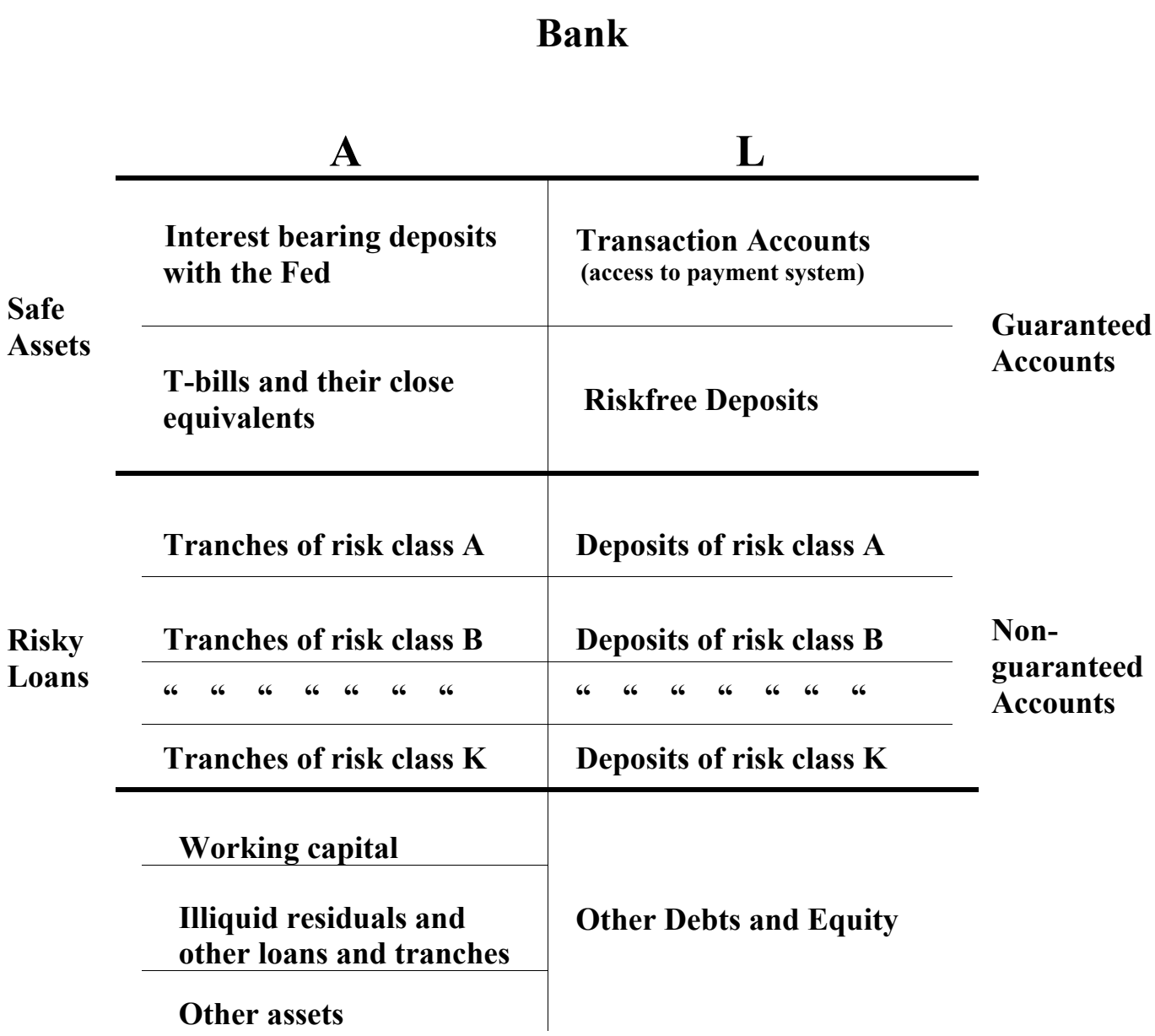


Figure 2: 100% Reserve Banking without Deposit Insurance

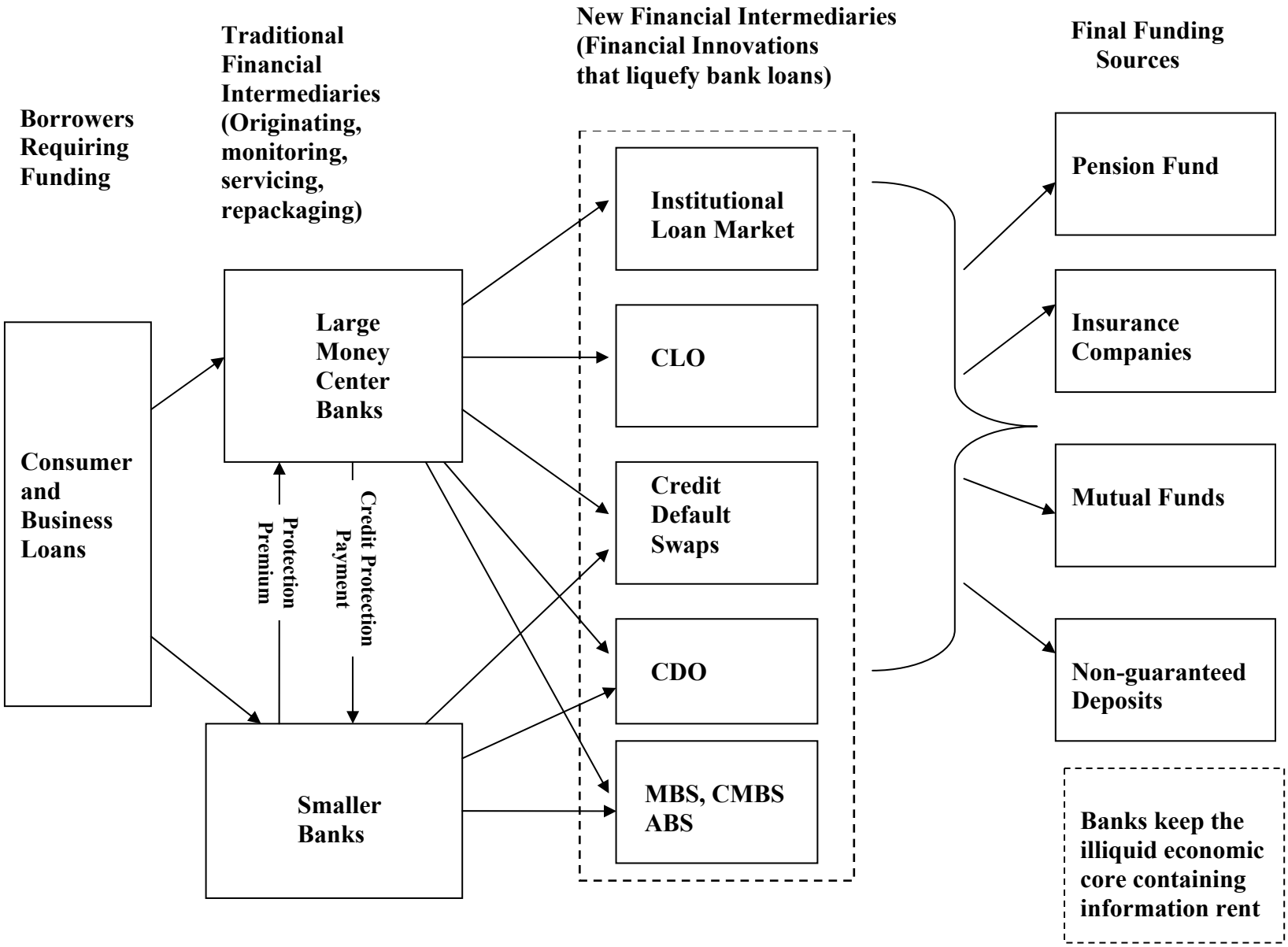


Figure 3: Liquefaction of Bank Loans and final Funding Sources

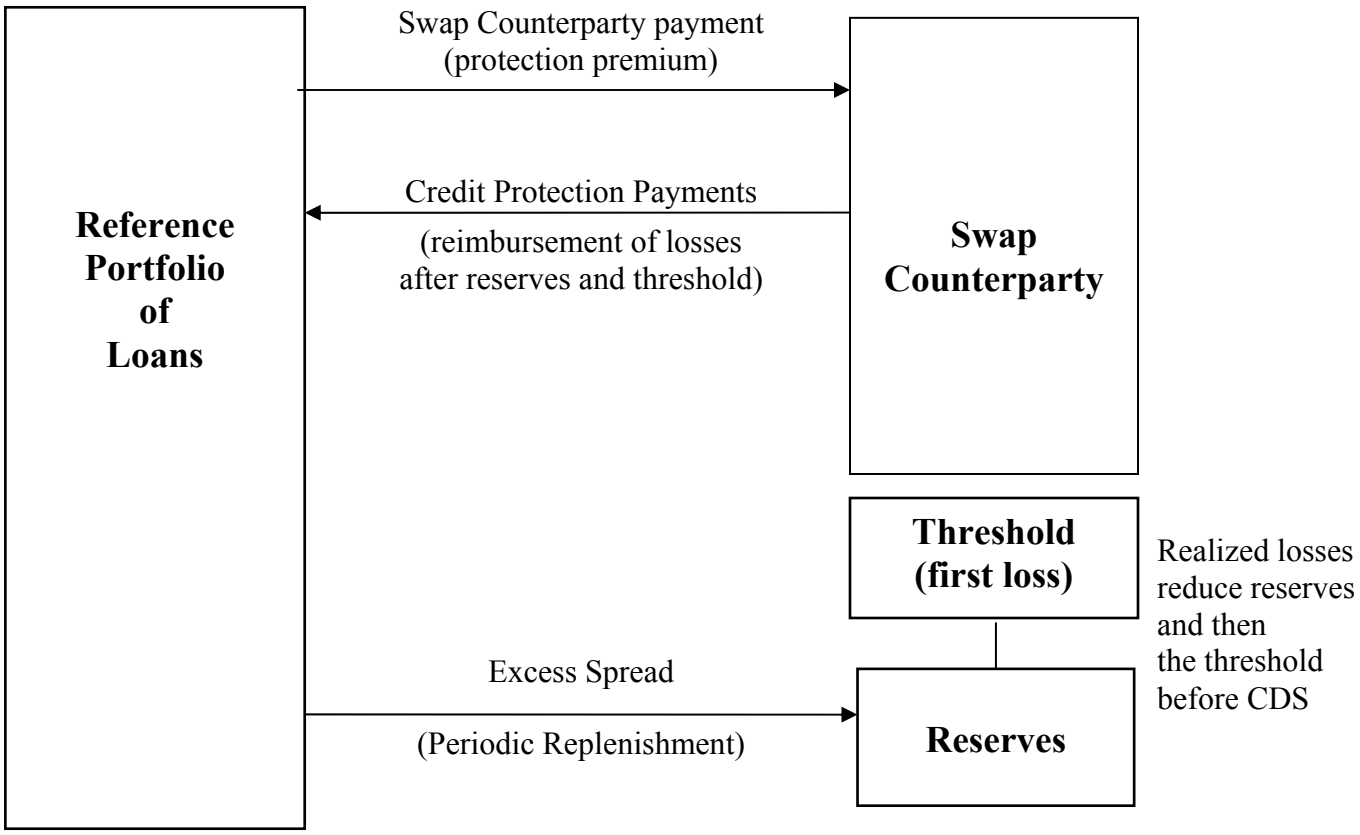
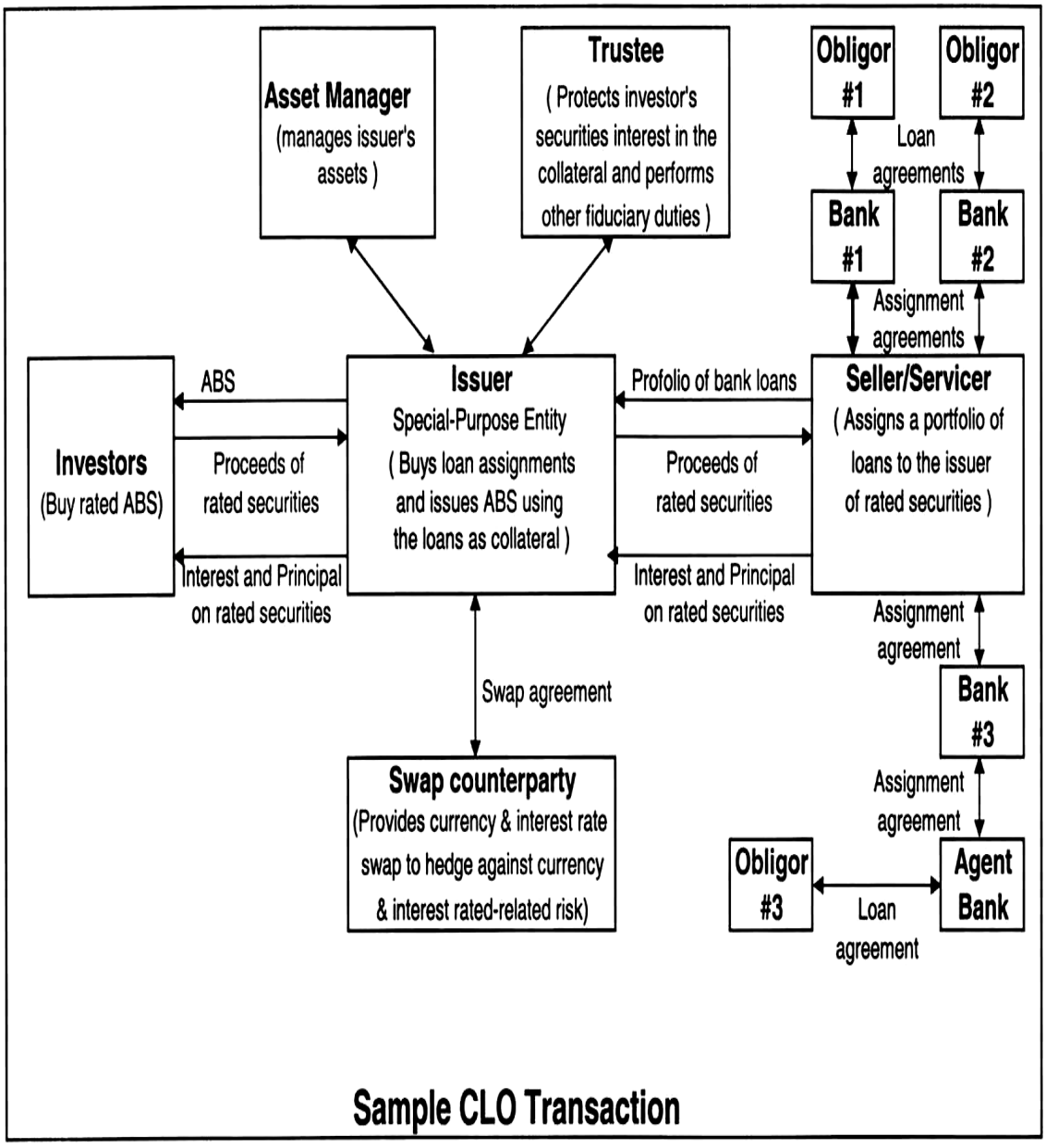
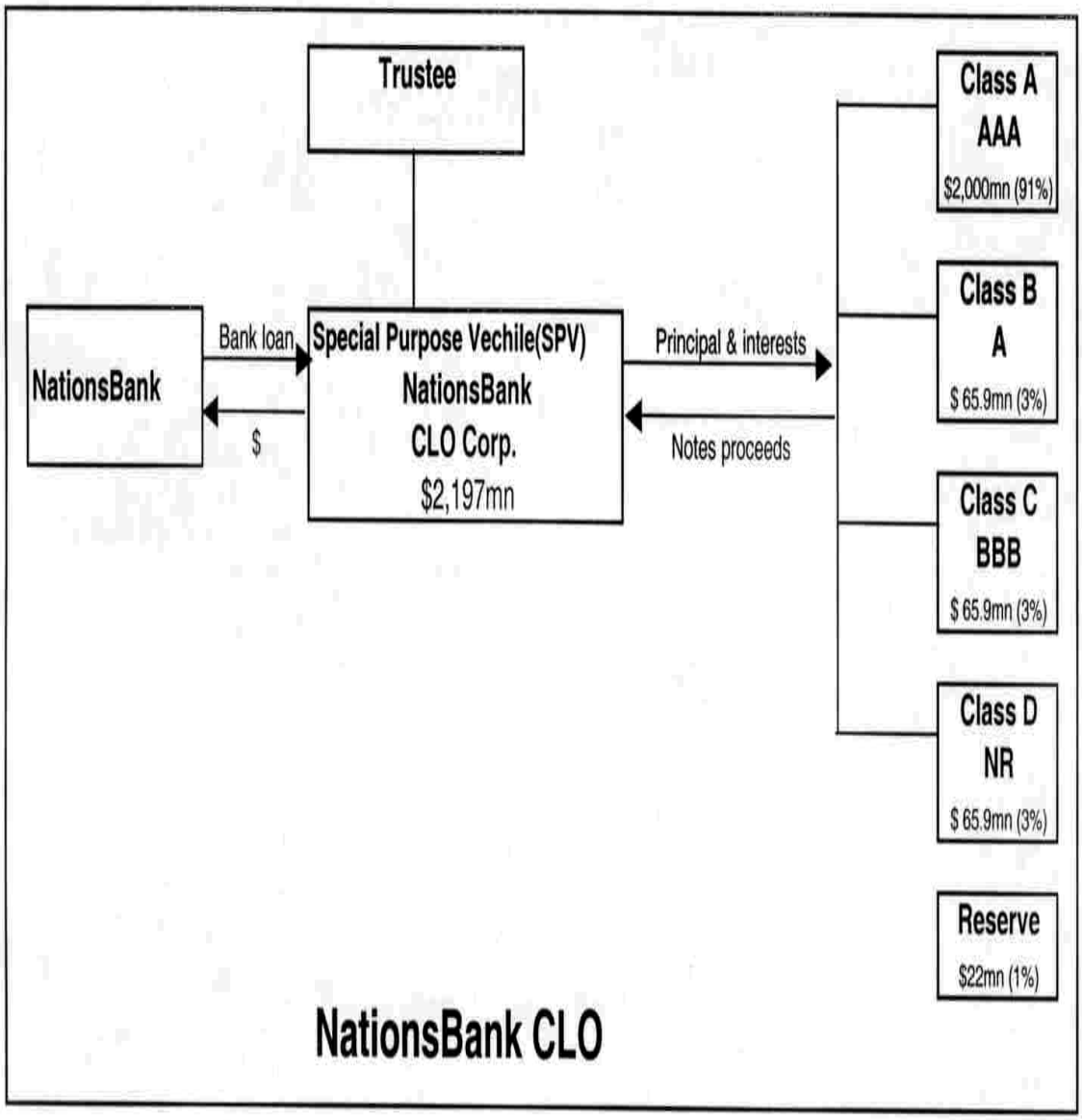


Figure 4: Credit Default Swap (CDS) on a Portfolio of loans



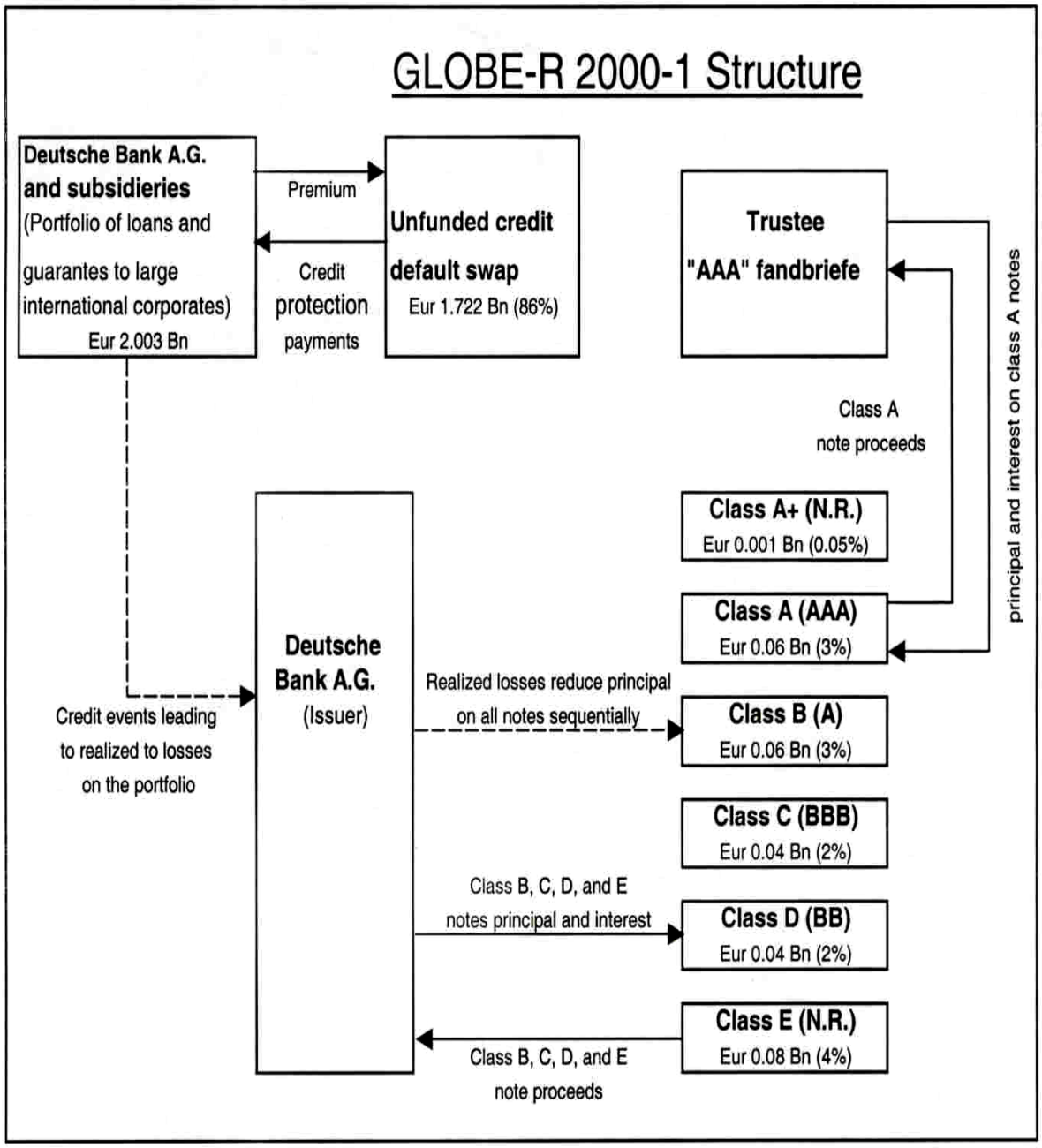
(Source: S&P)

Figure 5: A Typical Collateralized Loan Obligations



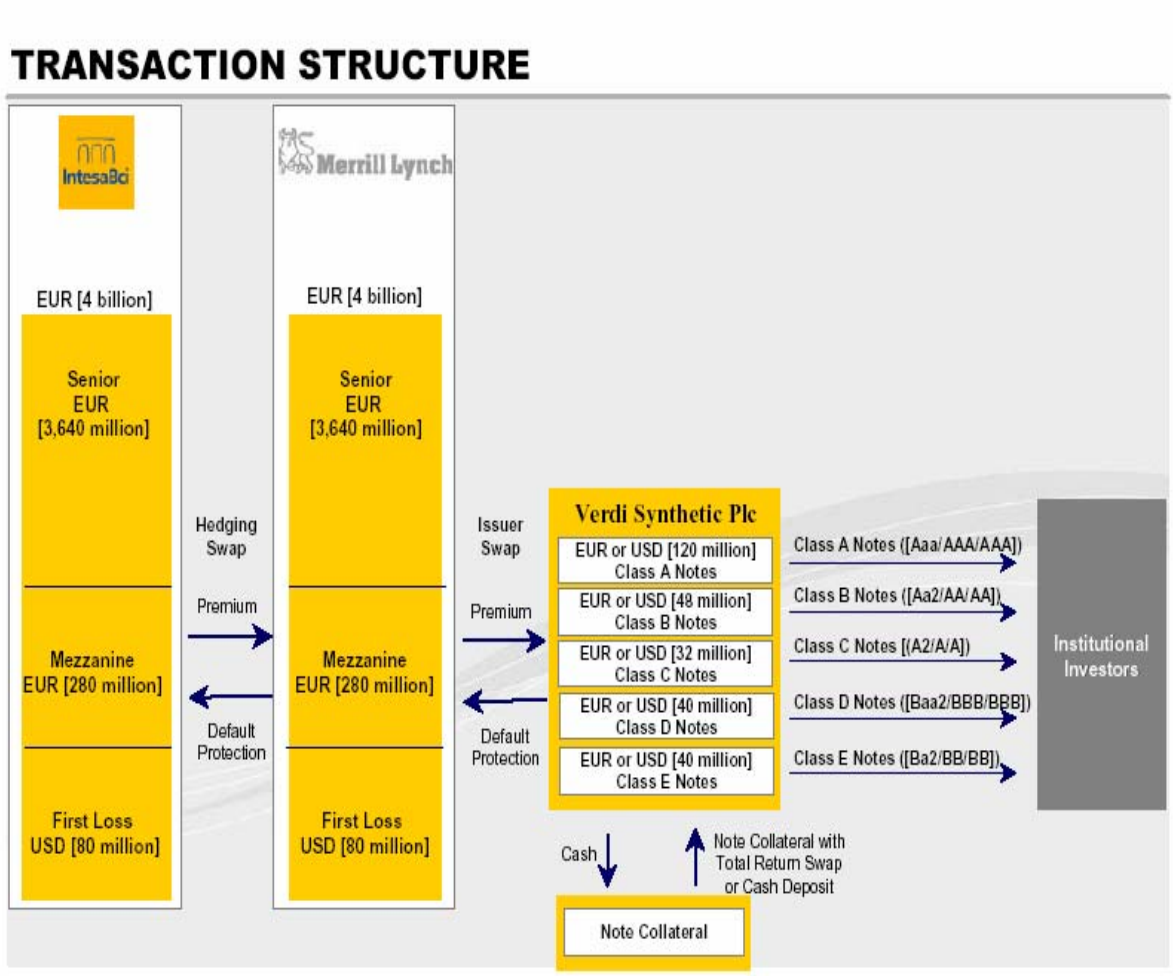
(Source: Moody's, S&P, Fitch)

Figure 6: Example of a Collateralized Loan Obligation (CLO)



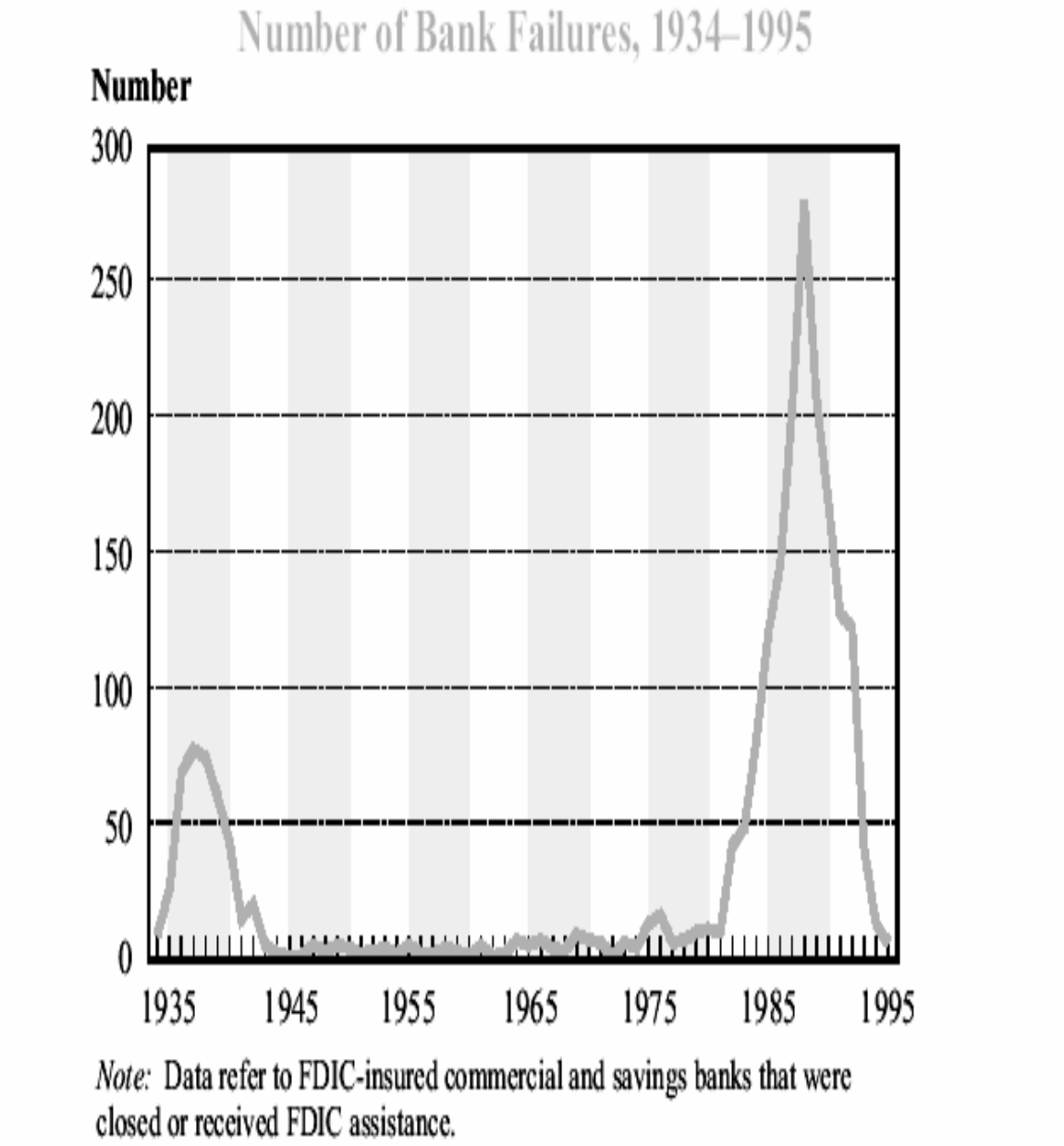
(Source: S&P)

Figure 7: A Synthetic CLO



(Source: Merrill Lynch)

Figure 8: Example of a CLO with Undrawn Credit Facilities



Source: FDIC Banking Review (1998)

Figure 1A: Bank Failures in the U.S.