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Deposit Insurance, Bank Regulation, and Financial System Risks

by

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Abstract

Recent theoretical and empirical research has identified a role for banks in hedging risks from liquidity shocks. This paper presents empirical evidence that banks act in this capacity in modern times but did not do so prior to the creation of the Federal Deposit Insurance Corporation (FDIC). Because government deposit insurance appears critical for banks' ability to hedge liquidity risks, the paper considers potential problems associated with this guarantee. It discusses new evidence of moral hazard incentives created by the government's inherent limitations in assessing bank risks. The situation appears to have worsened since the Gramm-Leach-Bliley Act of 1999 expanded access to deposit insurance.

The paper also presents a model of banking when risk-based deposit insurance premiums are set according to reforms proposed by the FDIC and when risk-based capital standards are implemented according to Basel II. The model predicts that these risk-based regulations create incentives for banks to invest in loans and off-balance sheet activities, such as loan commitments, having high systematic risk. Motivated by empirical evidence that money market mutual funds also can hedge liquidity shocks, I consider an alternative government insurance system built on these funds. It is shown that this alternative structure can mitigate the distortions to risk-taking created by government insurance.

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Deposit Insurance, Bank Regulation, and Financial System Risks

I. Introduction

Many financial contracts have the primary purpose of transferring risk between different economic agents. In recent decades, innovations by private financial institutions and markets in the form of derivatives and other securities have expanded the opportunities for allocating risks. However, for many years the federal government has offered insurance contracts that shift risk from private entities to taxpayers. Its role as an insurer of private risks continues to be large despite the private financial innovations that might be expected to supplant it.

This paper considers how the largest federal insurance program, deposit insurance, influences financial system risks. I focus on how the presence of this insurance can change the investment decisions of individuals, banks, and firms. While a government deposit guarantee may produce risk-sharing benefits, I argue that the current methods for pricing this guarantee and for regulating banks are leading to new forms of moral hazard that are killing off efficient private financial innovations. Moral hazard is also created because insurance mis-pricing and capital regulations have the effect of subsidizing systematic risks. I then explore the possibility that there are alternative ways that a government might offer deposit insurance that produce less inefficiencies.

As a starting point, I present empirical evidence on how deposit insurance has influenced the role of banks as providers of liquidity. In particular, I re-examine the question of why banks appear to have an advantage in offering the off-balance sheet services of loan commitments and lines of credit. My evidence relates to recent research by Kashyap, Rajan, and Stein (2002) (hereafter referred to as KRS) who present a model that explains why it is efficient for banks to simultaneously provide liquidity to borrowing firms in the form of loan commitments and to depositors in the form of demandable deposits. They show that under particular conditions, the coexistence of commitments to future lending and commitments to allow future withdrawals of

deposits creates an economy of scale that conserves on the amount of costly liquid assets that are needed to support these commitments. Using recent banking and financial market data, Gatev and Strahan (2005) (hereafter, referred to as GS) present empirical evidence that supports KRS's prediction of synergies in loan commitments and deposit taking.

I add to this research by showing that prior to the establishment of the Federal Deposit Insurance Corporation (FDIC), banks did not appear to embody the synergy proposed by KRS. I do this by replicating some of the tests carried out by GS but using pre-FDIC data. My results cast doubt on the notion that banks efficiently provide liquidity due to their inherent financial structure. Rather, their ability to specialize in liquidity provision appears to be linked to the federal safety net provided by deposit insurance. Furthermore, I show that even in modern times, there may be financial institutions other than banks that can serve as conduits of liquidity to borrowers.

If the FDIC is critical for banks' role in hedging liquidity risks, a natural question is whether the current system of deposit insurance and bank regulation is the best arrangement for providing liquidity or whether an alternative institutional structure would be better. To answer this, I begin by noting that it is difficult for a government to properly evaluate financial risks, particularly default risks that vary systematically over the business cycle. This makes it hard for a government to set insurance premiums without distorting banks' cost of financing. There is a natural tendency for governments to subsidize deposit insurance and require too little bank capital, even under risk-based capital standards such as Basel II. The inefficiencies from this subsidization have been magnified due to recent U.S. legislation that expanded financial services firms' access to bank deposit financing. Moral hazard has been exacerbated and risk-reducing private financial innovations have been stifled.

Given that a government insurer is unlikely to properly price risks, but that there is a social benefit to the liquidity provided by a government guaranteed, default-free transaction account, I explore whether alternative institutional structures might improve upon the current

system. I present a model that suggests that moral hazard from government mis-pricing can be mitigated by an alternative financial architecture.

The plan of the paper is as follows. The next section presents empirical evidence on the behavior of banks during 1988-2004 as well as during the pre-FDIC period of 1920-1933. The results suggest that banks were able to hedge against liquidity shocks during recent times but not when they lacked deposit insurance. This section also examines whether another financial institution, a money market mutual fund, has the potential to hedge liquidity shocks. Because deposit insurance appears critical for banks' ability to hedge liquidity risks, Section III studies potential problems with government insurance. It presents evidence of recent moral hazard incentives created by the government's inherent limitations in assessing bank risks. The situation appears to have worsened since the Gramm-Leach-Bliley Act of 1999 expanded access to deposit insurance.

Section IV presents a model of banking when risk-based deposit insurance premiums are set according to reforms proposed by the FDIC and when risk-based capital standards are implemented according to Basel II. It predicts that such risk-based regulations provide incentives for banks to invest in loans and off-balance sheet activities, such as loan commitments, with high systematic risk. These incentives have the potential to increase the pro-cyclicality of the economy. Section V then considers an alternative government insurance system that can potentially mitigate these distortions to risk-taking. Concluding comments follow in Section VI.

II. Empirical Evidence Regarding the Effects of Liquidity Shocks on Financial Institutions

The KRS (2002) theory of banks as efficient liquidity providers is built on the notion that demand deposits and loan commitments (or lines of credit) are similar cash-management services. By providing them together, a bank diversifies cash inflows and outflows thereby conserving the liquid assets needed to support both types of transactions. An assumption of this theory is that outflows from loan commitment drawdowns and outflows from deposit withdraws have

sufficiently low correlation. The synergistic benefits of combining loan commitments with deposits are greatest (lowest) if this correlation is negative (positive). In other words, banks will have a significant advantage in hedging liquidity if loan commitment drawdowns tend to coincide with deposit inflows, not withdrawals.

GS (2005) provide evidence in support of this theory by analyzing bank behavior during times of changing financial market illiquidity, where the change in illiquidity, referred to as a “liquidity shock” is measured by the change in the commercial paper – Treasury bill spread.¹ Using bank balance sheet and market interest rate data from 1988 to 2002, GS (2005) provide a number of convincing tests in support of the condition that both loans and deposits tend to respond positively to a liquidity shock.²

II.A Bank Behavior, 1988 – 2004

In this section, I first re-examine the evidence of bank’s ability to absorb liquidity shocks over the period 1988 to 2004, using data and a methodology that is similar, but not identical, to that employed by GS. The nature of this analysis is to estimate vector autoregressions to test the effect of a liquidity shock on banks’ loans, securities, and deposits. To proxy for a liquidity shock, I follow GS in using the spread between the three-month AA-rated non-financial commercial paper rate and the three-month Treasury bill rate as reported in the Federal Reserve’s H.15 Release.

Bank balance sheet data come from the Federal Reserve H.8 Release, and include the bank loans, securities, and deposits of the approximately 50 largest weekly-reporting U.S. commercial banks. The tests are restricted to these large banks because only they report balance sheet data at a greater than quarterly frequency. The first panel of Figure 1 shows the 1988 to

¹ Covitz and Downing (2002) provide evidence that a firm’s commercial paper spread primarily reflects the firm’s liquidity risk while its longer-maturity bond spread reflects its credit risk.

² GS also show that yields on banks’ wholesale Certificates of Deposit tend to fall when the commercial paper spread widens, consistent with an increase in the demand for these deposits. Further, using quarterly Call Report data they find that banks with greater pre-existing loan commitments have greater loan and deposit growth following a liquidity shock.

2004 path of total loans for this group of banks as well as the commercial paper spread. The vector autoregressions that I estimate use seasonally adjusted data for either a weekly or monthly frequency. This contrasts with GS who use weekly data that is not seasonally adjusted.

The choice of the seasonally adjusted weekly times series is due to my finding of a strong two-week cycle in the weekly growth rates of each of the non-seasonally adjusted balance sheet data.³ In other words, the weekly growth rates in total assets, loans, securities, and deposits of weekly reporting banks tend to have high negative serial correlation at a weekly frequency. While this two-week cycle is diminished with seasonally-adjusted weekly series, it is not entirely eliminated. Hence, to avoid the likelihood that this seasonal is biasing the results, I also perform vector autoregressions using monthly data.

Each vector autoregression is a three-equation system with the first equation's dependent variable being the growth rate (log difference) of a particular type of bank asset or deposit. The second equation's dependent variable is the commercial paper spread while that of the third equation is the change in the Treasury bill rate. This specification is the same as GS except that I measure an asset or deposit's growth as a simple (continuously-compounded) rate of change while they measure growth as the quantity change normalized by prior period total assets.⁴ I also include a constant and time trend as right-hand-side variables.

Table 1 reports the results of this estimation using weekly data over the period January 1988 to February 2004.⁵ The right-hand-side variables in each autoregression include four weekly lags of the three dependent variables.⁶ The coefficient estimates of the four lagged commercial paper spreads for each equation having an asset/deposit growth rate as its dependent

³ A periodogram of weekly growth rates of loans, securities, or deposits shows that the largest seasonal is at a two-week frequency. This seasonal is highly statistically significant. Results are available upon request.

⁴ Specifically, if b_t is a balance sheet item measured at date t , I calculate its growth as $\ln(b_t/b_{t-1})$ rather than $(b_t - b_{t-1})/a_{t-1}$ where a_{t-1} is total assets at date $t-1$. The former calculation may be more natural and is that used, for example, in Crabbe and Post (1994) to measure the quantity response of commercial paper to a rating downgrade.

⁵ This weekly data sample ended in February 2004 because following this month the Federal Reserve reports several weeks of missing data for the yield on commercial paper.

⁶ A lag length equal to four was generally supported by Akaike, Hannan-Quinn, and Schwarz criteria. It is also the lag length used by GS.

variable are given in the first four columns. The fifth column in the table reports the χ^2 statistic and p-value of a test that these four lagged coefficients are equal to zero. This joint test of significance is a Granger causality test of the hypothesis that an innovation to the commercial paper spread leads to a change in the asset/deposit's growth rate. The last four columns of the table report the impulse response of the asset/deposit's percentage growth over four weeks to a one standard deviation (approximately 8 basis point) innovation to the commercial paper spread.

The results are broadly consistent with those of GS, though the significance levels of my Granger causality tests are lower in some cases. Of the asset variables, I find that both total loans and commercial and industrial (C&I) loans react significantly to a liquidity shock. However, as with GS, bank loans show a small positive response after one week that is reversed the following week. This appears to be a very transitory increase in loans following a decline in liquidity.

On the liability side, total deposits, and in particular, non-transactions deposits and large time deposits react positively to a commercial paper spread shock. Unlike loans, large time deposit growth shows some persistence. An explanation might be that a rise in the commercial paper spread reflects investors' substitution out of commercial paper and into large Certificates of Deposit (CDs).

Let us now repeat this vector autoregression analysis but using data at a monthly, rather than weekly, frequency. Recall that one rationale for preferring monthly data is to avoid the possible spurious effects due to a two-week cycle present in the weekly bank balance sheet data. A second reason is that shocks to the commercial paper spread display persistence that is sufficiently long to show up at a monthly frequency. Evidence of this is based on my running a bivariate vector autoregression similar to those in Table 1 but using only the weekly data on the commercial paper spread and the change in the Treasury bill rate. The impulse response of the commercial paper spread to its own innovation displays a half-life of 10 weeks.⁷ In other words,

⁷ A half-life of approximately 10 weeks for the commercial paper spread was also found for each of the three-equation vector autoregressions reported in Table 1.

a commercial paper spread shock tends to take over two months to revert one-half way back to its steady state. A third reason to use monthly data from the 1988 to 2004 period is that the results will provide a better comparison to those of my subsequent analysis that uses pre-FDIC 1920 to 1933 data. That data is available only at a monthly frequency.

Table 2 reports results of this vector autoregression analysis using 1988 – 2004 monthly data and two monthly lags of the right-hand-side variables.⁸ Similar to Table 1, the first two columns give coefficient estimates of the two lagged commercial spreads for each equation having an asset/deposit growth rate as its dependent variable. The third column reports the χ^2 statistic and p-value of a joint significance test of these two lagged spreads, and the last four columns of the table report the impulse response of the asset/deposit's percentage growth over four months to a one standard deviation (approximately 11 basis point) innovation to the commercial paper spread.

Of the asset side variables, total loans have a significant positive response to a commercial paper spread shock, and the impulse response shows that this positive reaction is prolonged over a number of months. Regarding deposits, there is mild evidence that a liquidity shock leads to a rise in non-transactions deposits but a decline in transactions deposits. The deposit category that shows the strongest reaction to a liquidity shock is large time deposits. A one-standard deviation shock to the commercial paper spread, which is about 11 basis points, leads to an approximately two-tenths of a percent rise in time deposits over the next four months.

Overall, this evidence is broadly consistent with the previous analysis based on weekly data. A commercial paper shock tends to raise the growth rate of loans as well as time deposits. This suggests that a liquidity shock in the commercial paper market leads investors to re-direct their funds toward bank CDs. The increase in loans is consistent with banks using these funds to lend to borrowers under lines of credit or term loan commitments.

⁸ A lag length equal to two was generally supported by Akaike, Hannan-Quinn, and Schwarz criteria.

II.B Bank Behavior, 1920 – 1933

Let us now analyze banks' reaction to a liquidity shock during the pre-FDIC insurance period of 1920 to 1933. All data used in this analysis comes from the National Bureau of Economic Research Macro-History Database. This data is at a monthly frequency. The commercial paper yields are those of prime borrowers and having a four- to six-month maturity. The Treasury yields are for securities of three to six months.

To correspond with the previous 1988 to 2004 analysis, I use seasonally-adjusted balance sheet data for weekly reporting Federal Reserve member banks. However, the data on various assets and deposits are more limited during the 1920 to 1933 period. The available asset variables are total loans and "investments other than U.S. government securities."⁹ There are two categories of deposits: net demand deposits and time deposits. The second panel of Figure 1 shows the time path of the commercial paper spread and total loans from the beginning of 1920 to the end of 1933.

Table 3 presents results of the same vector autoregressions as in Table 2 but for these four 1920 to 1933 asset/deposit categories. In contrast to the modern results, we see that a commercial paper shock led to a significant decline in banks' loans and investments. A one-standard deviation shock to the commercial paper spread, which is approximately 22 basis points, tended to decrease loans by about a quarter of a percent after two to three months. Furthermore, there is no evidence that a liquidity shock raised bank deposits. There is mild evidence that demand deposits declined after the first few months and no evidence that time deposits rose, in sharp contrast to the modern period.

Based on the vector autoregression estimates, Figure 2 compares the impulse responses of loans and time deposits to a one-standard deviation innovation of the commercial paper spread for the 1988 to 2004 period (first panel) versus the 1920 to 1933 period (second panel). It is clear that, in response to a liquidity shock, time deposits grew sharply during the recent period, while

⁹ Total loans are constructed from summing "loans on securities" and "all other loans."

during the pre-FDIC period, time deposit growth was mostly negative. Loan growth had a moderately positive reaction to a liquidity shock in recent times, while pre-FDIC loans declined substantially in response to a widening commercial paper spread.

In summary, it appears that prior to federal deposit insurance, banks lacked the ability to hedge against liquidity shocks. They did not experience deposit inflows following a rise in the commercial paper spread, and they significantly reduced loans. This casts doubt on whether the KRS theory of banks as efficient liquidity providers was relevant prior to the FDIC. Indeed, the KRS model implicitly assumes that deposits are insured. This is because a financial intermediary's non-deposit debt is assumed to suffer an "adverse-selection" premium that rises with the amount of debt issued, so that an increasing penalty rate is paid if more debt is issued to meet loan takedowns. Importantly, the model assumes this adverse selection premium does not affect bank deposits. The justification for this asymmetric treatment of debt and deposits is that deposits are insured whereas debt is not.¹⁰

Consistent with the pre-FDIC empirical evidence, U.S. banks appear to have made little, if any, formal loan commitments prior to 1933. According to Summers (1975), longer-term loans, term loan commitments, and lines of credit first appeared in the 1930s. He states "Early usage of revolving credits was very limited, their number being estimated as only 5 percent of the number of term loans outstanding in 1941. There appears to have been resistance on the part of banks to enter revolving credit arrangements, presumably due to uncertainties involved with credit usage." This contrasts with modern times where over 70 percent of business lending comes in the form of loan commitment drawdowns.¹¹

¹⁰ The adverse selection premium is derived by Stein (1998) for the case of a bank's uninsured deposits. Hence, to avoid this penalty, deposits must be insured.

¹¹ For example, Call Report data indicate that the ratio of loan commitments to bank assets was 73.9 % in December of 2002.

II.C Money Market Mutual Fund Behavior, 1975 – 2004

A final aspect of this paper's empirical analysis of liquidity hedging investigates whether another non-bank financial institution may have the potential to hedge against liquidity shocks. In particular, this section examines whether money market mutual funds experience fund inflows in response to liquidity shocks. If so, they are potential suppliers of funds to borrowers seeking financing during periods of credit tightness. A reason for focusing on money market funds is that they will be relevant to the paper's later discussion of deposit insurance reform.

A priori, it is not clear whether investors would shift funds out of or into money funds when commercial paper spreads widen. Withdrawals might be generated because, unlike bank deposits, money fund liabilities are not FDIC insured and money fund assets often include large amounts of commercial paper.¹² Money fund investors might move their holdings elsewhere if they perceive an increase in the likelihood of commercial paper defaults.

On the other hand, investors may view money funds as a safe haven because of the generally high credit quality of the funds' assets and the fact that, historically, sponsors of money funds have provided implicit insurance by buying a fund's defaulted commercial paper at its par value. Currently, there is only one case of a money fund reducing its net asset value below its fixed \$1 share price ("breaking the buck"), and this instance involved an institutional money fund and was not the result of a commercial paper default.¹³

Gorton and Pennacchi (1993) discuss the operations of money market mutual funds and consider their exposure to investor "runs" or "panics." Using data on the growth of money market fund assets from 1986 to 1991, they examine whether money fund asset growth

¹² From 1980 to 2003, the proportion of taxable money market fund assets in the form of commercial paper ranged from a low of 24.4 % (in 1982) to a high of 49.9 % (in 1989). See Investment Company Institute (2004). Other types of assets held by money funds include bank CDs, government securities, and repurchase agreements.

¹³ In 1994 the U.S. Government Money Market Fund's net asset value declined to 96 cents. Small banks were the fund's main investors, and the fund held 27.5 % of its assets in structured notes whose value declined sharply when market interest rates spiked. Unlike other sponsors, this fund's sponsor, the Community Bankers Mutual Fund Inc., chose not to assist the fund. Subsequently, the fund was liquidated, and the SEC disallowed money funds from holding the type of structured security that led to the loss.

experienced statistically significant declines at the times of 11 different commercial paper defaults that occurred during this period. The results from this event study indicate that they did not. Money fund investors apparently were unconcerned by these defaults. However, in a separate event study using 1979 to 1991 Federal Reserve data on commercial paper and finance company spreads for AA-rated firms, Gorton and Pennacchi (1979) also found that these spreads did not widen following the announcements of 12 different commercial paper defaults.

While money fund investors appear to not withdraw funds following the commercial paper defaults of individual firms, there still is the possibility that investors might react to market-wide shocks that shows up as a widening of spreads on highly-rated firms' commercial paper. Hence, let us repeat the vector autoregressions of the previous two sections but use a three-equation system that includes the growth in money fund assets as a variable, in addition to the commercial paper spread and the change in the three-month Treasury bill yield. As with the previous tests, a lag length of two months is assumed. The data on money market mutual fund assets are monthly and seasonally-adjusted. They are obtained from the Federal Reserve's H.6 Release for the period 1975 to 2004.

Table 4 reports separate results using the growth rate of institutional money fund assets, the growth rate of retail money fund assets, and the growth rate of all (institutional and retail) money fund assets.¹⁴ For each of the three vector autoregressions, we see that an innovation to the commercial paper spread produces a change in money fund growth that is statistically significant at better than the 5 % significance level.

Figure 3 shows the impulse responses of money fund asset growth to a one standard deviation (approximately 21 basis point) innovation in the commercial paper spread. In general, asset growth shows a strong, positive response to a liquidity shock, especially for the case of institutional money funds. The only exception is a small first month decline in the assets of retail

¹⁴ At the end of February 2005, the assets of institutional money funds equaled \$1.062 trillion while the assets of retail money funds equaled \$708 billion.

funds, but this decline is offset by strong positive growth during months two and beyond. The assets of all money funds grow throughout the period, with peak growth of about 0.35 of a percent after three months. This positive reaction to a liquidity shock exceeds that of most bank deposits during the 1988 to 2004 period and is similar to that of large time deposits, the highest growing deposit category.

Thus, following a liquidity shock, money market funds' cash inflows grow at least as much as those of large banks. Of course, some of the inflows by money fund investors could result in bank inflows as money fund portfolio managers purchase the large time deposits of banks. Still, it is interesting that money funds can serve as a primary source of liquidity during times of credit tightness. Money fund portfolio managers, using their expertise in credit analysis in conjunction with information supplied by rating agencies, may channel funds directly to credit-worthy commercial paper issuers. They may also indirectly supply funds to non-financial firms by purchasing CDs or finance company paper and having the bank or finance company choose the ultimate borrower of the funds. Such an action would not be unlike the Federal Reserve's function as a supplier of liquidity to financial institutions (via the discount window) during periods of market stress.

III. Recent Developments That Have Expanded Access to Deposit Insurance

The prior section's empirical evidence suggests that FDIC insurance has been successful in enabling banks to attract funds and increase lending, often via loan commitments, during times of market illiquidity. The ability of banks to attract funds by issuing debt that is explicitly or implicitly insured against default is consistent with prior empirical evidence that when a bank's own risk of failure rises, it tends to replace uninsured liabilities with deposits.¹⁵ While FDIC

¹⁵ Billett, Garfinkel, and O'Neal (1998) document that financially distressed banks substitute uninsured liabilities with risk-insensitive insured deposits. Crabbe and Post (1994) find that when a bank holding company's credit rating is downgraded, its (uninsured) commercial paper declines but there is no significant change in the large CDs issued by its affiliated banks.

insurance appears produce a benefit by creating a channel for backstop liquidity, a natural question to ask whether deposit insurance also generates costs. This section examines current developments that have increased individuals' and financial service firms' access to deposit insurance. Much of this expansion of the bank safety net can be traced to the government's inability to set premium rates that reflect the market value of the insurance. This section serves as a prelude for the following section that considers the distortions that arise from this mis-pricing.

Compared to market investors, government regulators may face additional constraints that limit their ability to discriminate between banks having different risks of failure. Because of these limitations, it is unlikely that deposit insurance premiums and bank regulation will reflect the true cost of the government's guarantee. Stiglitz (1993) argues this point in the following quote:

“Government, however, faces a tremendous disadvantage in assessing risks and charging premiums based on risk differences. The reason for this, at least in part, is that risk assessments are basically subjective. Economic conditions are constantly changing, and no matter how rational the risk assessor may be, there is always a subjective element in choosing the relevant base for making such judgments....Is it plausible to believe that the government could charge banks in Texas a higher premium for insurance than banks in Idaho, or firms in Houston more than those in Dallas? Any such differentiation might be quickly labeled unfair.

The market makes such differentiations all the time, converting the subjective judgments of many participants into an objective standard. If some bank in Houston complains about the risk premium it is being charged by the market (in the form of a higher rate it must pay to attract uninsured depositors), there is a simple reply: Provide evidence that the risk has been overestimated, and the market will render a verdict. If the information is credible, the risk premium will be reduced.

In short, government inevitably has to employ relatively simple rules in assessing risk - rules that almost certainly do not capture all of the relevant information, since political considerations will not allow government to differentiate on bases that the market would almost surely employ.

The difficulties government has in assessing risk, and that citizens face in evaluating the government's performance on this score, provide an opportunity for granting huge hidden subsidies.”

The current pricing of FDIC insurance almost certainly incorporates a large subsidy.

Since 1996, the vast majority of U.S. banks have paid nothing for deposit insurance. The reason

for this originates with the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) that required the FDIC to set deposit insurance premiums that would gradually achieve a target ratio of the FDIC's Bank Insurance Fund (BIF) reserves to total insured deposits of 1.25 percent.¹⁶ The Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) and the Deposit Insurance Funds Act of 1996 further specified that if reserves exceed the Designated Reserve Ratio (DRR) of 1.25 %, all but the riskiest banks would pay zero premiums for deposit insurance. Because the DRR has been above 1.25 % since 1996, deposit insurance has essentially been free.

It is not surprising that a zero price has increased the attractiveness of deposit insurance. While the banking industry has thus far been unsuccessful in obtaining legislation that would raise the deposit insurance ceiling of \$100,000 per depositor per bank, financial innovations have allowed banks to skirt this restriction. If, as is increasingly the case, a bank is a member of a multi-bank holding company, it may allocate large deposits in below \$100,000 segments between other member banks to achieve full insurance. A similar service for independent banks was established in 2003 by Promontory Interfinancial Network.¹⁷ Their Certificate of Deposit Account Registry Service (CDARS) allows a bank that joins this network to swap chunks of below \$100,000 deposits with other banks in the network. Currently over 700 banks have joined the CDARS program, and Promontory advertises that it allows a bank to achieve FDIC insurance on deposits of up to \$10 million.

Access to free deposit insurance was made easier by the "Gramm-Leach-Bliley" (GLB) Financial Modernization Act of 1999 which allowed banks, securities firms, and insurance

¹⁶ BIF reserves are the accumulated value of premiums previously paid by commercial banks less the value of FDIC losses from past bank failures. The FDIC also maintains a separate reserve fund for thrift institutions, known as the Savings Association Insurance Fund (SAIF). See Pennacchi (1999) for an analysis of setting insurance premiums to target FDIC reserves.

¹⁷ Promontory is a bank consulting firm led by former Comptroller of the Currency Eugene Ludwig and former vice chairman of the Federal Reserve Board of Governors Alan Blinder.

companies to affiliate under a financial holding company.¹⁸ An important example of this is the recent trend by securities brokers to shift their customers' "sweep" account balances from money market mutual funds into FDIC-insured bank deposits.¹⁹ In many cases, sweep accounts, which hold customer cash from securities transactions and dividend payments, have been converted to Money Market Deposit Accounts (MMDAs) at newly-affiliated banks that became possible by GLB. Crane and Krasner (2004) estimate that \$350 billion is now in FDIC-insured deposits that would have been in retail money funds. They forecast that this shift could reduce retail money funds by a further \$50 to \$100 billion per year in 2005 and 2006 and lead to continued strong growth in MMDAs. During the five years from the end of 1999 to the end of 2004, balances in MMDAs grew at a 16.4 % annual rate while assets of retail money funds *declined* at a 3.0 % annual rate, a phenomenon that Crane and Krasner (2004) refer to as "re-intermediation."²⁰

The source of securities firms' profitability from making this conversion is that FDIC-insurance often allows them to pay lower interest rates on deposit sweep balances than they would be required to pay on money market mutual fund balances. The deposit balances can also be invested in loans that pay the affiliated banks a much higher average return than money market

¹⁸ Even prior to GLB, non-banking firms could gain access to insured deposits by forming a unitary thrift holding company. GLB disallowed new formations of this type, but ones formed prior to May 1999 were grandfathered. Another important method that gives non-bank financial firms and commercial firms access to deposit insurance is by forming an "industrial loan company" chartered in one of the seven states (e.g., Utah) that permit such a depository institution. Undoubtedly, one of the motivations for the recent formation of depository institutions such as Volkswagen Bank, Toyota Financial Services, GMAC Bank, BMW Bank, and Nordstrom Federal Savings Bank was the ability to issue low cost deposits with free FDIC insurance. See "Now Open: The Bank of VW: Auto Makers, Retailers Offer Checking Accounts and CDs; A \$1,600 Rebate on Next Car," *The Wall Street Journal*, November 3, 2004.

¹⁹ Merrill Lynch was the first to change the default sweep of its Cash Management Account (CMA) from Merrill's CMA Money Fund into MMDA accounts at Merrill Lynch Bank USA or Merrill Lynch Bank & Trust. These two depository institutions allow total FDIC-insurance of up to \$200,000. Customers of Citigroup's Smith Barney and Cititrade can now place sweep account balances in up to 10 Citigroup-affiliated banks, for total deposit insurance coverage of \$1 million. Almost all major brokerages, including American Express, Charles Schwab, E*Trade, Morgan Stanley, TD Waterhouse, UBS, and Wachovia have participated in establishing FDIC-insured sweep accounts.

²⁰ This is in contrast to the process of "disintermediation" that occurred during the 1980s and 90s. From 1999 to 2004, domestic deposits of U.S. depository institutions increased at an 8.0 % annual rate and estimated insured deposits rose at a 5.0 % annual rate. Assets of institutional money funds increased by 10.1 %, making the growth of all money fund assets equal to 3.8 % per year.

securities.²¹ Furthermore, as discussed in Gorton and Pennacchi (1993), a provider of cash accounts will prefer deposits over money fund shares because the former gives it more freedom to pay differing returns based on the size of a customer's balance. This allows the provider to engage in price discrimination that can extract more consumer surplus from its customers.

In summary, there are clear signs that free deposit insurance and easier access to insured deposits have unnecessarily expanded the government's safety net for banks. Market discipline has been eroded as loopholes allow large depositors to avoid the \$100,000 insurance ceiling. Furthermore, money fund account balances that were previously invested in highly credit worthy securities have now been converted to deposit account balances that are invested in risky loans, with the FDIC liable for the increased risk. This moral hazard is related to the model of the next section which considers why deposit insurance may continue to produce moral hazard even if deposit insurance and capital standards are made risk-based along the lines or reforms proposed by the FDIC and the new Basel II Capital Accord.

IV. A Model of Deposit Insurance and Its Effect on Banks Choice of Risk

This section delves further into problems created by a government's limitations on evaluating bank risk. It presents a simple model that analyzes a bank's choice of investments when deposit insurance and capital standards are risk-based in the way proposed by the FDIC and Basel II. It shows even under such risk-based bank regulation, a particular type of moral hazard continues to exist. As a benchmark, let us first consider the situation a lending institution whose debt is uninsured, such that it pays a default-risk premium determined by market investors.

IV.A A Bank with Uninsured Debt

Consider a simple one period model of a lending institution that finances loans by issuing shareholders' equity and short-maturity debt. This financial intermediary could be a commercial

²¹ Crane and Krasner (2004) estimate that the switch to FDIC insured deposits can result in a financial holding company earning a net interest margin of from 200 to 400 basis points on secured loans. In contrast, the earnings from investment management fees from operating a money fund ranges from 50 to 100 basis points.

bank or thrift institution, in which case its debt can take the form of a demand deposit or a short-maturity time deposit, an example being a CD. Alternatively, this financial intermediary could be a finance company, in which case its debt may be commercial paper. I shall refer to this generic lending institution as a “bank,” though we may later interpret it to include all financial intermediaries whose assets consist primarily of loans.

Let us normalize this bank’s initial deposits (debt) to equal 1 and denote its initial equity capital as a proportion of these deposits as k . Therefore, the bank has $1+k$ available at the start of the period to invest in loans. Loans are subject to default risk, but loan interest rates are assumed to be set in a competitive lending market. For simplicity, assume that a given bank’s portfolio of loans has a binomial probability distribution. With probability p , the loans pay their promised return per amount lent of R_L , and with probability $1-p$ the loan portfolio experiences default. The recovery value per amount lent on the defaulted loans is assumed to equal d . Also assume that there is a default-free investment, such as a U.S. Treasury bill, that pays the one-period return of R_F and that $d < R_F < R_L$.

In summary, the bank’s beginning-of-period asset value equals $1+k$ and its end-of-period asset value equals $(1+k)R_L$ with probability p or $(1+k)d$ with probability $1-p$, where $1-p$ is the physical (actual) probability of the loans’ default.²² While the two-point distribution for the bank’s loan portfolio is clearly a simplification, this modeling is meant to capture the idea that lending is a risky activity, and a particular bank’s loan portfolio might reflect industry or geographic specialization that limits its ability to fully diversify loan risk.

Given these assumptions, one can derive the promised payment on uninsured deposits that investors would require in a competitive money market, which is denoted as R_D . To make the model relevant to a world where bank failure is possible, I assume that the bank’s equity

²² This model could be generalized to give banks an economic role in screening a loan applicant’s credit or monitoring the borrower’s loan in order to circumvent adverse selection or moral hazard. The bank’s cost of performing these services could be recovered in the form of a higher promised interest rate on the loan. Hence, in the model, the loan interest rate, R_L , can be interpreted as the competitive promised interest net of a spread necessary to compensate the bank for credit screening and monitoring services.

capital is not sufficient to fully absorb losses should the bank's loan portfolio default.

Specifically, it is assumed that

$$d(1+k) < R_F < R_L(1+k) \quad (1)$$

It will be shown that this implies $R_F < R_D < R_L$. To solve for R_D , note that the actual payment made by the bank may be less than its promised payment and is given by

$$\begin{array}{ll} R_D & \text{if the loan portfolio does not default} \\ d(1+k) & \text{if the loan portfolio defaults} \end{array} \quad (2)$$

R_D must be set such that the present value of the end-of-period payoff in (2) is equal to unity, the beginning-of-period value of the deposits contributed by investors. Following the logic in Cox, Ross, and Rubinstein (1979), the initial value of these default-risky deposits can be determined by noting that their payoff can be replicated by an investment in the default-free asset and the default-risky loans.²³ In the absence of arbitrage, the initial value of the deposits must be

$$\frac{R_D - d(1+k)}{(R_L - d)} + \frac{R_L d(1+k) - dR_D}{(R_L - d)R_F} \quad (3)$$

Setting (3) equal to unity (the initial amount contributed by depositors) and solving for R_D , one obtains

$$R_D = R_L \left(1 - \frac{dk}{R_F - d} \right) + R_F \frac{dk}{R_F - d} \quad (4)$$

Equation (4) shows that the deposits' promised return reflects the bank's default risk because it is a weighted average of the promised return on the default-risky loans, R_L , and the return on the default-free asset, R_F . The lower is the bank's capital, k , the more the promised deposit rate reflects the loans' risk. As capital approaches zero, equation (4) confirms that $R_D = R_L$. At the

²³ An investment composed of an amount of the default-free asset equal to $[R_L d(1+k) - dR_D]/[(R_L - d)R_F]$ and $[R_D - d(1+k)]/(R_L - d)$ units of the loans replicates the return of the default-risky deposits given in (2). When the loans do not default, this investment equals $[R_L d(1+k) - dR_D]/[(R_L - d)R_F] + R_L [R_D - d(1+k)]/(R_L - d) = R_D$. When the loans default, this investment equals $[R_L d(1+k) - dR_D]/[(R_L - d)R_F] + d[R_D - d(1+k)]/(R_L - d) = d(1+k)$.

other extreme, if capital increases to the level sufficient to absorb all loan losses, that is, $d(1+k) = R_F$, then $R_D = R_F$.

IV.B Deposit Insurance

This result also determines a premium that a deposit insurer would need to charge the bank to cover the market value of a guarantee against the deposits' default. Maintaining the assumption that deposits are competitively priced, note that the bank's promised return on insured deposits is now $R_D = R_F$ rather than the promised return on uninsured deposits given in equation (4). Let us assume that the deposit insurer charges a premium, P_M , that is payable by the bank at the end of the period. When the bank does not default, the insurer receives the premium of P_M , but when the bank does default, the insurer pays the claim of $R_F - d(1+k)$, which is the difference between the promised payment to depositors and the bank's asset value.

Given this set-up, it is clear that the insurer's premium necessary to cover the market value of its guarantee equals the default risk premium that uninsured depositors received for being exposed to their risk of deposit losses. Subtracting R_F from equation (4), one sees that the premium equals

$$\begin{aligned}
 P_M &= (R_L - R_F) \left(1 - \frac{dk}{R_F - d} \right) \\
 &= \frac{R_L - R_F}{R_F - d} [R_F - d(1+k)]
 \end{aligned} \tag{5}$$

which is proportional to the loan portfolio's default risk premium, $R_L - R_F$, and is decreasing in the amount of capital held by the bank. Furthermore, if one considers a system in which a deposit insurer charges the same premium per deposit for all banks but sets a risk-based capital standard that makes the present value of its claims equal to the fixed premium, P_M , then the k that satisfies equation (5) would be the bank's risk-based capital per deposit ratio. Thus, equation (5) gives the relationship between a risk-based deposit insurance premium and capital ratio that would be required by a private guarantor.

Importantly, a government insurer of deposits is unlikely to set premiums or capital standards on the same basis as would a private insurer. Similar to the argument by Stiglitz (1993) that a government faces limitations in assessing risk, Bazelon and Smetters (1999) contend that the U.S. government fails to incorporate a premium for systematic risk in its evaluations. Their view holds true for regulators' assessment of bank risk which is based on setting "actuarially fair" insurance premiums or capital standards derived from a Value at Risk (VaR) calculation. This approach differs, in general, from the market value premium/capital standard given in (5). An actuarially fair premium allows the insurer to "break-even" on average and is the definition of a risk-based premium that the FDIC has proposed to implement.²⁴ In terms of the model, an actuarially fair premium, P_A , satisfies

$$pP_A - (1-p)[R_F - d(1+k)] = 0 \quad (6)$$

or

$$P_A = \frac{1-p}{p} [R_F - d(1+k)] \quad (7)$$

A risk-based capital ratio, k , satisfying (7) is also consistent with a VaR approach to setting a minimum capital requirement. In this simple model, there is a $(1-p)$ probability that losses to the insurer equal $R_F - d(1+k)$, implying that the insurer's VaR of $R_F - d(1+k)$ can be reduced by raising capital. As shown by Gordy (2003), Basel II's Internal Ratings Based (IRB) approach formulates capital requirements that result in a large, well-diversified bank having a 99.9% probability of suffering a loss equal to its capital over a one-year horizon.

To gain insight regarding how market-based premium and capital requirements differ from their actuarially fair counterparts, define $p^* \equiv (R_F - d)/(R_L - d)$ as the *risk-neutral* probability of no-default and note that equation (5) can be re-written as

$$P_M = \frac{1-p^*}{p^*} [R_F - d(1+k)] \quad (8)$$

²⁴ See Federal Deposit Insurance Corporation (2000, 2001).

so that P_A would equal P_M if the physical (or actual) probability p equaled the risk-neutral probability p^* . If p equals p^* , this implies that the expected return on the loan portfolio would equal the risk-free return since $R_L p^* + d(1-p^*) = R_F$.

However, empirical evidence points to the expected return on bank assets, $R_L p + d(1-p)$, exceeding the risk free return, R_F , which implies $p > p^*$. Historically, banks' returns on assets, measured using either accounting data or derived from bank stock returns, have on average exceeded Treasury bill returns by almost 100 basis points.²⁵ In other words, empirical evidence implies that the return on banks' loans incorporates a risk-premium. Such a risk-premium on loans would be predicted by asset pricing theory. Loan defaults rise in a recession and fall in an economic expansion, implying a systematic risk component to loan returns.²⁶

Now let us compare the value of a bank's shareholders equity when regulators set deposit insurance premiums or capital standards on an actuarially fair basis versus a market value basis.

Note that the end-of-period payoff to bank shareholders equals

$$\begin{array}{ll} R_L(1+k) - (P_i + R_F) & \text{if the loan portfolio does not default} \\ 0 & \text{if the loan portfolio defaults} \end{array} \quad (9)$$

where P_i , $i = M, A$, is the deposit insurance premium paid by the bank. As in the case of default-risky deposits or deposit insurance, this call-option-like payoff can be valued using the Cox, Ross, and Rubinstein (1979) logic to obtain a beginning-of-period market value of bank equity, E_B , equal to

$$\begin{aligned} E_B &= \frac{p^*}{R_F} [R_L(1+k) - (P_i + R_F)] \\ &= \frac{R_F - d}{(R_L - d)R_F} [R_L(1+k) - (P_i + R_F)] \end{aligned} \quad (10)$$

²⁵ Over the seventy-year period 1926 to 1996, the annual returns from a value-weighted index of bank stocks averaged 14.56 % while Treasury bills returned 3.67%. De-leveraging this stock return premium of 10.89 % implies that bank assets earned an average premium over Treasury bills of approximately 0.985 %. This premium is consistent with banks' returns on assets using accounting data. See Pennacchi (1999).

²⁶ Also see Duffie et al. (2003) on this point. They conclude that bank default has a significant systematic risk premium based on the credit spreads of default swaps written on uninsured bank debt.

As we know should be the case, if P_i in equation (10) is set to the market value based deposit insurance premium P_M given in equation (5), then one obtains $E_B = k$. Thus, market value pricing of deposit insurance implies no subsidy to the bank and the initial value of equity equals the amount of funds contributed by shareholders.

This is not the case when insurance premiums or capital standards are set on an actuarially fair basis. Since, as argued earlier, $p > p^*$, comparing equations (7) and (8) shows that $P_A < P_M$. When $P_i = P_A$, the initial value of equity becomes

$$E_B = k + \frac{R_F - d(1+k)}{R_F} \left(1 - \frac{p^*}{p} \right) \quad (11)$$

which exceeds k when $p > p^*$. To the extent that a bank has some control over the type of loan portfolio that it selects, equation (11) indicates that the bank has an incentive to select loans having a low p^* relative to p . A bank would do this by selecting loans that have a high systematic risk component.

To see this, consider the following simple modeling of a systematic risk premium in loan returns. Suppose that at the end of the period, there are two possible macroeconomic states: an economic expansion (e) and an economic contraction (c). The physical probability of the expansion state is \mathbf{a} while that of the contraction state is $(1-\mathbf{a})$. Conditional on the expansion state, the probability that a bank's loan portfolio does not default is p_e , and conditional on the contraction state, the probability that a bank's loan portfolio does not default is p_c where it is reasonable to expect that for most loans $p_c < p_e$. Because the unconditional probability of no default equals p , it must be that

$$p = \mathbf{a}p_e + (1-\mathbf{a})p_c \quad (12)$$

A systematic risk premium is modeled by assuming that the risk-neutral probability of the expansion state equals \mathbf{a}^* so that

$$p^* = \mathbf{a}^*p_e + (1-\mathbf{a}^*)p_c \quad (13)$$

Consistent with asset pricing theory, I assume that the risk-neutral probability of the contraction state exceeds its physical probability, that is, $(1-\mathbf{a}^*) > (1-\mathbf{a})$ or $\mathbf{a}^* < \mathbf{a}$.²⁷ Together with the assumption that the loan default probability is greater in the contraction state, $(1-p_c) > (1-p_e)$, this implies that $p^* < p$.

Now consider the situation of a bank paying an actuarially fair deposit insurance premium and regulated to meet a Basel II, VaR-type capital standard where it a probability of p of incurring a loss less than $R_F - d(1+k)$. One can think of the bank choosing loans that have different probabilities of default in expansion and contraction states. To maintain p constant, this implies that the bank would vary the probabilities p_e and p_c such that $\partial p_e / \partial p_c = -(1-\mathbf{a})/\mathbf{a} < 0$. The effect on the risk-neutral probability of such a choice is

$$\frac{dp^*}{dp_c} = \mathbf{a}^* \frac{\partial p_e}{\partial p_c} + (1-\mathbf{a}^*) = 1 - \frac{\mathbf{a}^*}{\mathbf{a}} > 0 \quad (14)$$

and, therefore, from equation (11) the effect on bank shareholders' equity is

$$\frac{dE_B}{dp_c} = -\frac{R_F - d(1+k)}{R_F p} \left(1 - \frac{\mathbf{a}^*}{\mathbf{a}} \right) < 0 \quad (15)$$

Hence, by reducing p_c and raising p_e at the proportional rate $(1-\mathbf{a})/\mathbf{a}$, the bank is able to increase the value of its shareholders' equity above its non-subsidized value of k . Hence, the bank has an incentive to select loans having the highest probability of default in the contraction state (and least probability of default in the expansion state). In other words, the bank would prefer to fund businesses that, for a given probability of default, would be excessively pro-cyclical. Since $p^* \equiv (R_F - d)/(R_L - d)$, operationally the bank would select these pro-cyclical loans by choosing those with the highest promised payment, R_L , for a given probability of solvency, p . Intuitively, if a loan's credit rating is based on its actuarial default probability, the bank could locate the loans

²⁷ In a consumption-based asset pricing model, it can be shown that the risk-neutral probability of state $s \in \{e,c\}$ equals the physical probability of state s multiplied by the ratio of the marginal utility of consumption in state s to the average marginal utility of consumption across all states. Given that utility is concave (equivalent to risk-aversion), the marginal utility of consumption will be relatively high in low consumption states.

having the highest systematic risk by choosing those having the highest spread within a given credit rating category.

This regulatory-induced incentive is distinct from others identified in previous research. Penati and Protopapadakis (1988) argue that FDIC policy gives banks an incentive to increase systemic (as opposed to systematic) risk. Their model assumes that the FDIC provides de facto deposit insurance to de jure uninsured depositors whenever a large proportion of banks fail. The reason for bailing-out uninsured depositors is to protect the financial system against a system-wide shock. Because this policy is recognized by uninsured depositors, they charge a lower default-risk premium to banks whose loan portfolios are heavily weighted toward loans that are also held by other banks. As a result, a bank can lower its cost of funding by over-lending to borrowers that other banks have access to, such as developing-country borrowers, relative to borrowers in the bank's local market.²⁸ As a result, banks rationally "herd" by making loans that, should they default, result in uninsured depositors being protected.

The insight from the current paper's model may also explain a bank's choice of off-balance sheet activities. As with loans, if regulators require capital for off-balance sheet activities based on payoffs that do not distinguish between whether the payoff occurs in a business cycle upturn or downturn, then banks will choose those activities that tend to have high systematic risk. For the case of credit derivatives, the model predicts that a bank would choose to sell (buy) credit protection for loans or bonds of firms with a high (low) systematic risk of default.²⁹ Furthermore, the model may reinforce why deposit insurance gives banks an incentive to provide loan commitments. Loan commitments will be most (least) profitable when firms' credit quality turns out to be high (low), ex-post, which is likely to occur during an economic upturn (downturn).

²⁸ Penati and Protopapadakis (1988) apply their model to explain banks' high concentrations in Latin American debt during the late 1970s and early 1980s.

²⁹ This may explain why commercial banks are often both buyers and sellers of credit protection.

Hence it is likely that the business of providing loan commitment contains significant systematic risk.³⁰

Is the incentive to take excessive systematic risk inevitable? The next section considers a different structure for government insurance that has the potential to mitigate this moral hazard.

V. An Alternative Insurance Plan

Motivated by Section III's empirical evidence that money funds experience inflows following a liquidity shock, consider modeling a money fund whose assets are in the form of uninsured, money market debt such as the commercial paper of non-financial firms, asset-backed commercial paper, finance company paper, and uninsured bank CDs. This intermediary is assumed to hold a diversified portfolio of n different debt issues each of which has the promised yield to maturity of R_D satisfying equation (4). Let us normalize this intermediary's liabilities to equal 1, so that if it holds n different debt securities, a proportion $1/n$ is invested in each uninsured debt instrument.

Consistent with the previous modeling, assume that each debt instrument has a systematic risk component where the probability of default is greater during a contraction state than an expansion state. Further, for simplicity assume that, conditional on the macroeconomic state, the debt instruments' likelihoods of default are identically and independently distributed. Note that while defaults are independent conditional on the state, their unconditional probabilities of default are positively correlated because more (less) defaults occur when the state turns out to be a contraction (an expansion).

Now the value of the money fund's end-of-period asset return can be written as

³⁰ Under Basel I, banks' incentives to provide loan commitments are even greater than what the model (based on Basel II) predicts. This is because banks need not hold any additional capital on 364-day commitments or lines of credit. Wood (2005) states that "364-day lines are massively popular: Banks use them as loss leaders to attract large corporate customers..." As this quote implies, some of the subsidy in providing loan commitments and lines of credit may be passed on to the banks' customers. In addition, as many investment banks have claimed, the offer to provide subsidized credit lines may give commercial banks an unfair advantage in competing for a corporation's underwriting business.

$$R_D - \frac{m}{n} [R_D - d(1+k)] \quad (16)$$

where m is the number of debt instruments held by the fund that default at the end of the period.

The physical probability of m defaults given n total debt instruments, denoted $\mathbf{p}(m,n)$, equals

$$\mathbf{p}(m,n) = \frac{n!}{(n-m)!m!} \left[\mathbf{a} p_e^{n-m} (1-p_e)^m + (1-\mathbf{a}) p_c^{n-m} (1-p_c)^m \right] \quad (17)$$

The corresponding risk-neutral probability of m defaults given n total debt instruments, denoted $\mathbf{p}^*(m,n)$, is the same as in (17) but with \mathbf{a} replaced by \mathbf{a}^* . If the money fund's liabilities are pure equity shares, the fair market pricing of its asset portfolio of money market (debt) instruments implies that the market value of its beginning-of-period equity equals unity, the amount contributed by investors.

However, if, as in Gorton and Pennacchi (1990) and Qi (1996), there is a social benefit to having a perfectly default-free transactions account, then insurance of money market liabilities may be justified. Historically, private credit enhancement to money market funds has been provided implicitly by the money funds' parent companies. Except for one instance, sponsors of the money funds have protected investors by purchasing at par the securities held by the fund that have defaulted. Some money funds have purchased private insurance.

Rather than a government directly insuring bank deposits, let us consider government insurance of money funds liabilities, where the money fund may, or may not, be affiliated with a bank.³¹ An insurance plan could work as follows. The government insurer guarantees to the fund the end-of-period Treasury bill return of R_F . In return for this guarantee, the fund pays the insurer a promised end-of-period premium of P_i . Thus, the end-of-period net payoff to the insurer is

$$\min \left[P_i, R_D - R_F - \frac{m}{n} [R_D - d(1+k)] \right] \quad (18)$$

³¹ iMoneyNet reports that as of March 2004, approximately 50 banking organizations sponsored 489 taxable money funds having assets of \$650.5 billion, equal to 33.1 % of total money fund assets.

where, as before, m is the number of defaults and $i = M, A$ would be a market-based or actuarially fair premium.

It is easy to see that the fair market-based premium equals $P_M = R_D - R_F$, the spread of the securities yield over the Treasury bill rate.³² In this case, (18) can be re-written simply as

$$R_D - R_F - \frac{m}{n} [R_D - d(1+k)] \quad (19)$$

which is the difference between the end-of-period return on the securities and the default free return. This difference has a present value of zero since they both represent the fair return on a beginning-of-period unit investment. Hence, a market-based promised premium of $P_M = R_D - R_F$ provides no subsidy or distortion to the fund's choice of risk. Quite simply, this type of insurance could be implemented by having the government insurance premium take all of the fund's return in excess of the one-period Treasury bill return.

Note that this insured money fund could be perceived as issuing insured deposits but with the deposits collateralized by money market instruments. If deposits were competitively priced, their return would equal R_F . However, if regulators permit the fund's sponsor to set deposit rates below R_F , the sponsor could extract consumer surplus, as is currently the case for managers of insured banks. Since the government insurer receives the promised premium of $P_M = R_D - R_F$, the sponsor could earn the spread between R_F and what is paid to the fund's investors.³³ On the other hand, policymakers may decide that the fund should operate like today's money market funds, in which case the spread earned by the sponsor would be restricted to covering reasonable management expenses. The point is that the general insured fund structure outlined here could permit flexibility in how the sponsor sets rates on investor balances. What is less flexible, compared to current banks, is the fund's choice of assets.

³² Note that if the money fund held only Treasury bills ($m = 0$ with probability 1 and $R_D = R_F$), the premium would be zero, as would the insurer's default guarantee.

³³ As is currently the case with bank deposits, the sponsor may even price discriminate by paying interest rates that increase with the investor's balance.

As with our previous analysis of an insured bank, now suppose the government insurer charges money funds an actuarially fair premium, rather than a market-based one. I now illustrate that the subsidy to the fund's sponsor from this insurance mis-pricing is less than the subsidy to a bank that is charged an actuarially fair premium. First, note that the insured fund's actuarially fair premium equals

$$P_A = -\frac{\sum_{m=\hat{m}+1}^n (R_D - R_F - \frac{m}{n}[R_D - d(1+k)])\mathbf{p}(m,n)}{\sum_{m=0}^{\hat{m}} \mathbf{p}(m,n)} \quad (20)$$

where \hat{m} is the integer floor of $(R_D - R_F - P_A)n/[R_D - d(1+k)]$ and represents the maximum number of defaults that the fund can experience and continue to earn an asset return of at least $R_F + P_A$, the fund's promised payment to the insurer and (competitive) investors. When defaults exceed \hat{m} , the insurer's payoff equals the difference between the fund's assets and the insured return of R_F , which in most cases represents a loss.

Given a premium payment, the subsidy provided by the insurer to the fund, denoted S_F , can be calculated as the present value of the fund's return in excess of the insured return of R_F and its payment to the insurer, P_i , whenever this excess is positive. Using risk-neutral valuation, it equals

$$S_F = \frac{1}{R_F} \sum_{m=0}^{\hat{m}} (R_D - R_F - P_i - \frac{m}{n}[R_D - d(1+k)])\mathbf{p}^*(m,n) \quad (21)$$

Note that when $n = 1$ and $P_i = P_A$, then $\hat{m} = 0$ and P_A in (20) equals that in equation (7). Also $S_F = (1/R_F)[R_F - d(1+k)](1 - p^*/p)$ which, from inspection of equation (11) is the same amount of subsidy provided to an insured bank.³⁴ This is because with the money fund's assets composed of a single bank's uninsured deposits (debt), government insurance for the money fund is equivalent to government insurance of the single bank deposit. The money fund receives a subsidy equal to that of the insured bank modeled in the previous section.

³⁴ Note that $\mathbf{p}(0,1)=p$, $\mathbf{p}(1,1)=1-p$, $\mathbf{p}^*(0,1)=p^*$, and $R_D = [R_F - (1-p^*)d(1+k)]/p^*$.

This equivalence is no longer the case when $n > 1$. As the money fund holds a more diversified portfolio composed of multiple banks' and/or firms' debt, its total risk and systematic risk decline.³⁵ As n increases, this lowering of systematic risk reduces the subsidy that the insurer's mis-pricing conveys to the money fund. While the proof of this result is lengthy and tedious, Figure 4 illustrates the effect of this diversification for the not too unrealistic parameter values of $R_F = 1.05$, $R_L = 1.10$, $d = 0.70$, $k = 0.10$, $\mathbf{a} = 0.80$, $p_e = 0.95$, and $p_c = 0.85$. These assumed parameter values then determine $p = 0.93$, $p^* = 0.875$, $\mathbf{a}^* = 0.25$, and $R_D = 1.09$, so that $P_M = R_D - R_F = 0.04$.

The solid line in Figure 4 gives the actuarially fair promised premium, P_A in equation (20), as a function of the number of debt issues held by the money fund, n . P_A declines from a value of about 2.1 cents per dollar of fund liability when $n = 1$ to around a tenth of this value, 0.21 cents, when $n = 150$. Although the promised premium P_A declines with n because the total variance of default risk is decreasing, the dashed line in Figure 4 shows that the subsidy when this actuarially fair premium is charged, S_F in equation (21), also declines. Because diversification also reduces the variance of systematic risk, S_F decreases from 1.6 cents per dollar of liabilities when $n = 1$ to less than 0.6 cents when $n = 150$.³⁶

The dotted line in Figure 4 shows the value of S_F in equation (21) for the case of $P_i = 0$, that is, the subsidy when the insurer charges a zero premium, as is currently the case for the FDIC. While, of course, the subsidy is always higher compared to the case of an actuarially fair premium, it is similar in that it declines monotonically with n , from 3.3 cents per dollar liability when $n = 1$ to 0.64 cents when $n = 150$. Thus, a highly diversified money fund can mitigate distortions from relatively severe insurance mis-pricing.

³⁵ The variance of defaults conditional on the contraction state, as well as the variance of defaults conditional on the expansion state, declines.

³⁶ Note that subsidy for the case of $n = 1$ equals the subsidy granted to an insured bank per dollar of deposit. Hence if this bank held 10 % capital, the market value of equity would be 16 % greater than its book value.

Compared to the current system of direct insurance of bank deposits, this alternative system reduces the subsidy and, in turn, the moral hazard incentives associated with government insurance mis-pricing. Also, government regulation of a money fund-based insurance system would be less complex, taking the form of restrictions on the diversification, credit quality, and duration of the money fund's portfolio.³⁷ As is currently the case, some money funds could be affiliated with banks, so that potential economies of scope in providing checking and lending services could be preserved.³⁸ However, the money fund would be a separate legal entity, so that the FDIC would not become involved with the bank's (or any other financial institution's) failure. This could reduce the likelihood of the government bailing out a "too-big-to-fail" bank due to the FDIC's difficulty in liquidating bank assets and in sorting out bank creditors' claims.³⁹

The proposed system would differ from the current one in that all lending institutions' liabilities would be subject to market discipline and pricing. Uninsured CDs and commercial paper would need to undergo scrutiny of credit rating agencies and market investors before being held by money funds and other investors.⁴⁰ Money funds, whose shares would be held by both retail and institutional investors, would be the primary conduit of liquidity. Insured money funds would almost surely experience even greater cash inflows during liquidity shocks than do the

³⁷ For example, currently the SEC restricts taxable money market mutual funds from investing more than 5 % of their assets in a single issuer, with the exception of the U.S. government. Hence, this requirement can be interpreted as $n \geq 20$. Also, the SEC requires that no more than 5 % of money fund assets have credit ratings of the middle-grade of A2/P2. The remaining assets must carry the highest rating of A1/P1. In addition, to limit interest rate risk, the SEC restricts the average maturity of assets to be less than 90 days.

³⁸ For example, as in Mester, Nakamura, and Renault (2003), observation of a borrower's checking account activity may provide information to a bank that aids its monitoring of the borrower. Also, while U.S. money funds currently are not permitted access to the Fedwire payments system, there is precedent for allowing such access. The Canadian Payments Act of 2001 opened membership in Canada's payment system to money market mutual funds, life insurance companies, and securities dealers. Previously, only depository institutions could be members in this payments system, the Canada Payments Association.

³⁹ See Stern (2004) for a discussion of the moral hazard problems related to "too-big-to-fail." In contrast, FDIC resolution of a money fund's failure would be a snap. The fund's assets are of short maturities and their market values are easily estimated. The direct cost of liquidating the fund or transferring it to another sponsor would be minimal.

⁴⁰ As is currently the case for small finance companies, smaller banks that lack access to wholesale CD markets could finance their loans from inter-bank loans and lines of credit provided by larger banks. To achieve economies of scale, smaller banks may form cooperatives in operating money funds, or affiliate with a money fund sponsored by a third party investment advisor.

uninsured money funds of today. These inflows would be allocated to credit-worthy commercial paper and CD issuers, creating a larger and more liquid money market that may, in equilibrium, reduce the severity of the initial liquidity shock. In turn, lending institutions receiving financing from money funds could provide lines of credit to small businesses and individuals.

From an historical perspective, the system proposed here is not radical. Prior to the creation of the FDIC, commercial banks held significant amounts of reserve securities to meet deposit withdrawals. Similar to the money market funds of today, prior to the 1930s it was commercial banks that held the vast majority of commercial paper and bankers acceptances.⁴¹ Commercial paper was attractive due to its high credit quality and short maturity. Greef (1938) estimates that losses from commercial paper defaults during the 1920s and the first half of the 1930s were much lower than for loans and other corporate securities.⁴²

Deposit insurance appears to have fundamentally changed bank portfolios. Banks now hold almost no commercial paper.⁴³ They appear to take on more systematic risk by their possibly excessive provision of loan commitments. Furthermore, systematic risk is likely to have increased because bank loans tend to have longer maturities than what was common prior to the FDIC.⁴⁴

VI. Conclusion

Risks that are large and systematic tend to be difficult for private institutions to insure. Pooling such risks reduces only their idiosyncratic component, leaving systematic risk that could

⁴¹ As discussed in Foulke (1931) and Baxter (1966), commercial paper became an especially popular secondary reserve after the panic of 1907 when banks were able to meet deposit withdrawals with funds from maturing commercial paper. Banks' demand for commercial paper also increased following the 1914 Federal Reserve Act which made prime commercial paper eligible collateral for Discount Window lending.

⁴² Commercial paper losses as a proportion of the total amount outstanding averaged 1/20 of 1 %, while similar loss ratios for "loans and discounts" was 1.27 % and for "bonds and securities" was 1.19 %.

⁴³ Federal Reserve Fourth Quarter 2004 *Flow of Funds* data on ownership of "open market paper" (which includes commercial paper) indicate that commercial banks and savings institutions each held less than \$1 billion, credit unions held \$1.9 billion, and money market mutual funds held \$395.3 billion.

⁴⁴ As discussed in Foulke (1931) and Baxter (1966), prior to the 1930s bank loans tended to be "self-liquidating," having short maturities and often financing a firm's working capital and trading needs. Even firms' longer-term capital investments tended to be financed by short-term bank loans where a bank did not formally guarantee a loan's renewal.

bankrupt a private insurer. Hence, whereas private insurers may be efficient at managing independent risks such as life, property, and casualty losses, a government might be called upon to insure systematic risks, such as losses from bank failures.

Government deposit insurance substantially changes investor attitudes toward bank deposits. Investors now consider deposits a safe haven during “flights to quality,” but this was not the case prior to the FDIC. While government insurance appears to be successful in creating liquidity during times of financial stress, the distortions arising from actuarially fair insurance premiums and capital regulations could lead to longer run economic instability.

Actuarially fair premiums are correct assessments for insuring independent risks, but, as this paper has emphasized, create moral hazard when assessed to insure systematic risks. Banks that are charged actuarially fair premiums for deposit insurance and faced with risk-based capital standards of the type required by Basel II can increase their insurance subsidy by concentrating their lending and off-balance sheet activities in highly systematic risks. Providing loan commitments may be an example of such systematic risks, as banks are most likely to face losses on these contracts during business cycle downturns.

The U.S. government has insured bank deposits for over 70 years. Instituting fundamental reforms for this long-established program may be politically difficult. However, the program’s large and growing subsidies are cause for concern, as the moral hazard that they generate could lead to another banking crisis. Because recent advances in information technology have broadened the set of feasible financial contracts, a more efficient and stable structure of government insurance needs to be explored.

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Table 1
Vector Auto-Regressions
Weekly Data January 1988 to February 2004

Growth Equation	Coefficients on Commercial Paper Spread (t-statistic in parentheses)				Joint Significance	Impulse Response in % Growth to a 1 Std. Dev. Shock to the Commercial Paper Spread			
	Lag 1	Lag 2	Lag 3	Lag 4	χ^2 (p-value)	Week 1	Week 2	Week 3	Week 4
Assets	0.0100 (2.33)	-0.0101 (-1.70)	0.0034 (0.57)	-0.0021 (-0.49)	5.77 (0.217)	0.064	-0.053	0.014	-0.017
Loans	0.0049 (2.21)	-0.0036 (-1.17)	0.0034 (1.09)	-0.0019 (-0.86)	16.84 (0.002)	0.017	-0.005	0.020	-0.005
C&I Loans	0.0025 (1.17)	-0.0021 (-0.70)	0.0034 (1.16)	-0.0007 (-0.33)	18.77 (0.001)	0.006	-0.007	0.032	0.007
Liquid Assets	0.0182 (1.99)	-0.0180 (-1.42)	0.0012 (0.10)	-0.0049 (-0.53)	6.02 (0.198)	0.199	-0.142	-0.003	-0.029
Deposits	0.0072 (1.51)	0.0008 (0.13)	0.0020 (0.31)	-0.0082 (-1.72)	8.23 (0.084)	0.062	0.0008	-0.008	-0.018
Transactions Deposits	0.0168 (1.02)	-0.0056 (-0.25)	0.0046 (0.20)	-0.0253 (-1.53)	6.59 (0.160)	0.191	-0.066	-0.082	-0.169
NonTransactions Deposits	0.0033 (0.95)	0.0001 (0.02)	0.0055 (1.14)	-0.0040 (-1.15)	19.82 (0.001)	0.032	0.021	0.009	0.004
Large Time Deposits	0.0113 (1.83)	-0.0023 (-0.27)	0.0049 (0.57)	-0.0024 (-0.39)	29.73 (0.000)	0.052	0.051	0.057	0.032

Each vector autoregression uses 840 weekly observations. The right hand side variables for each regression equation include four lags of asset/deposit growth, four lags of the commercial paper spread, four lags of the change in the Treasury bill rate, a constant, and a time trend. The reported impulse responses are those of the percentage growth in the asset/deposit variable to a one standard deviation innovation of the commercial paper spread.

Table 2
Vector Auto-Regressions
Monthly Data January 1988 to December 2004

Growth Equation	Coefficients on Commercial Paper Spread (t-statistic in parentheses)		Joint Significance	Impulse Response in % Growth to a 1 Std. Dev. Shock to the Commercial Paper Spread			
	Lag 1	Lag 2	χ^2 (p-value)	Month 1	Month 2	Month 3	Month 4
Assets	-0.0041 (-0.79)	0.0071 (1.38)	2.52 (0.284)	-0.063	0.018	0.030	0.028
Loans	0.0052 (1.34)	0.0006 (0.15)	7.28 (0.026)	0.029	0.053	0.055	0.054
C&I Loans	0.0035 (0.85)	-0.0029 (0.07)	1.98 (0.371)	0.024	0.006	0.021	0.023
Liquid Assets	-0.0142 (-1.37)	0.0077 (0.76)	2.58 (0.276)	-0.149	-0.063	-0.025	-0.025
Deposits	0.0063 (1.22)	-0.0035 (-0.69)	1.95 (0.377)	0.112	-0.022	0.012	0.009
Transactions Deposits	-0.0125 (-0.83)	-0.0054 (-0.36)	5.02 (0.081)	-0.177	-0.071	-0.093	-0.075
NonTransactions Deposits	0.0079 (1.74)	-0.0038 (-0.85)	4.30 (0.117)	0.061	0.041	0.043	0.036
Large Time Deposits	0.0262 (2.31)	-0.0051 (-0.45)	11.84 (0.003)	0.218	0.184	0.202	0.185

Each vector autoregression uses 201 monthly observations. The right hand side variables for each regression equation include two lags of asset/deposit growth, two lags of the commercial paper spread, two lags of the change in the Treasury bill rate, a constant, and a time trend. The reported impulse responses are those of the percentage growth in the asset/deposit variable to a one standard deviation innovation of the commercial paper spread.

Table 3
Vector Auto-Regressions
Monthly Data January 1920 to December 1933

Growth Equation	Coefficients on Commercial Paper Spread (t-statistic in parentheses)		Joint Significance	Impulse Response in % Growth to a 1 Std. Dev. Shock to the Commercial Paper Spread			
	Lag 1	Lag 2	χ^2 (p-value)	Month 1	Month 2	Month 3	Month 4
Loans	0.0039 (0.61)	-0.0123 (-2.00)	10.90 (0.004)	-0.007	-0.238	-0.257	-0.218
Investments	-0.0130 (-1.94)	-0.0739 (-0.90)	4.76 (0.092)	-0.105	-0.016	-0.004	-0.001
Demand Deposits	0.0061 (0.64)	-0.0124 (-1.38)	4.34 (0.114)	0.013	0.054	-0.131	-0.156
Time Deposits	-0.0048 (-0.55)	-0.0001 (-0.02)	2.09 (0.351)	-0.089	0.068	-0.041	-0.074

Each vector autoregression uses 167 monthly observations. The right hand side variables for each regression equation include two lags of asset/deposit growth, two lags of the commercial paper spread, two lags of the change in the Treasury bill rate, a constant, and a time trend. The reported impulse responses are those of the percentage growth in the asset/deposit variable to a one standard deviation innovation of the commercial paper spread.

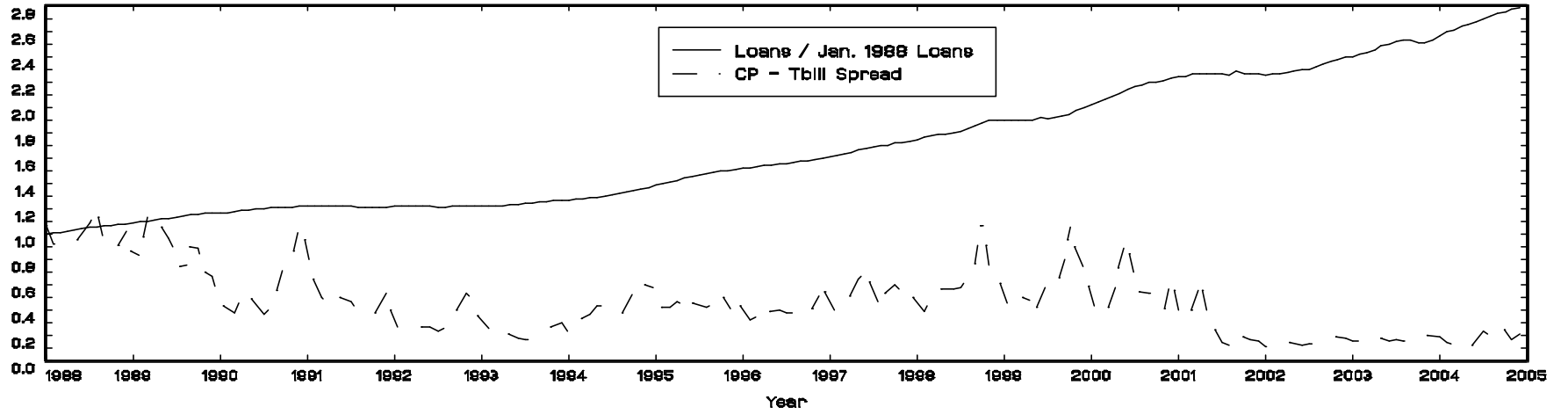
Table 4
Vector Auto-Regressions
Monthly Data January 1975 to December 2004

Growth Equation	Coefficients on Commercial Paper Spread (t-statistic in parentheses)		Joint Significance χ^2 (p-value)	Impulse Response in % Growth to a 1 Std. Dev. Shock to the Commercial Paper Spread			
	Lag 1	Lag 2		Month 1	Month 2	Month 3	Month 4
Institutional Money Funds	0.0166 (2.39)	-0.0044 (-0.62)	11.85 (0.003)	0.300	0.524	0.507	0.408
Retail Money Funds	-0.0029 (-0.73)	0.0084 (2.11)	6.95 (0.031)	-0.111	0.130	0.259	0.259
Total of Money Funds	0.0039 (1.07)	0.0027 (0.72)	8.35 (0.015)	0.038	0.255	0.345	0.323

Each vector autoregression uses 360 monthly observations. The right hand side variables for each regression equation include two lags of money fund growth, two lags of the commercial paper spread, two lags of the change in the Treasury bill rate, a constant, and a time trend. The reported impulse responses are those of the percentage growth in the money fund growth variable to a one standard deviation (approximately 21 basis point) innovation of the commercial paper spread.

Figure 1

Commerical Paper Spread and Bank Loans of
Weekly Reporting Banks, 1988 - 2004



Commerical Paper Spread and Bank Loans of
Weekly Reporting Banks, 1920 - 1933

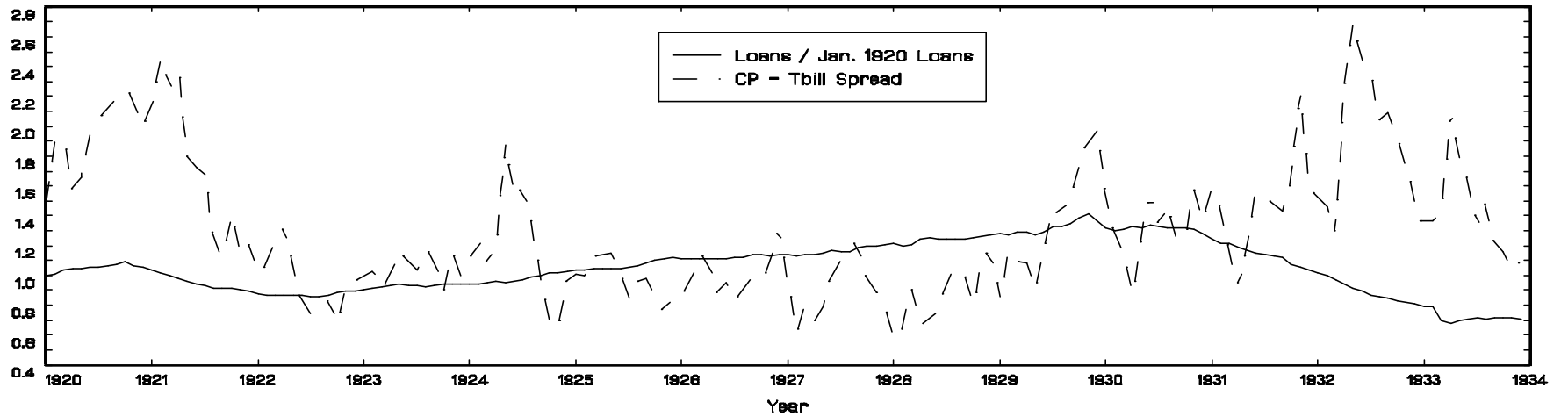
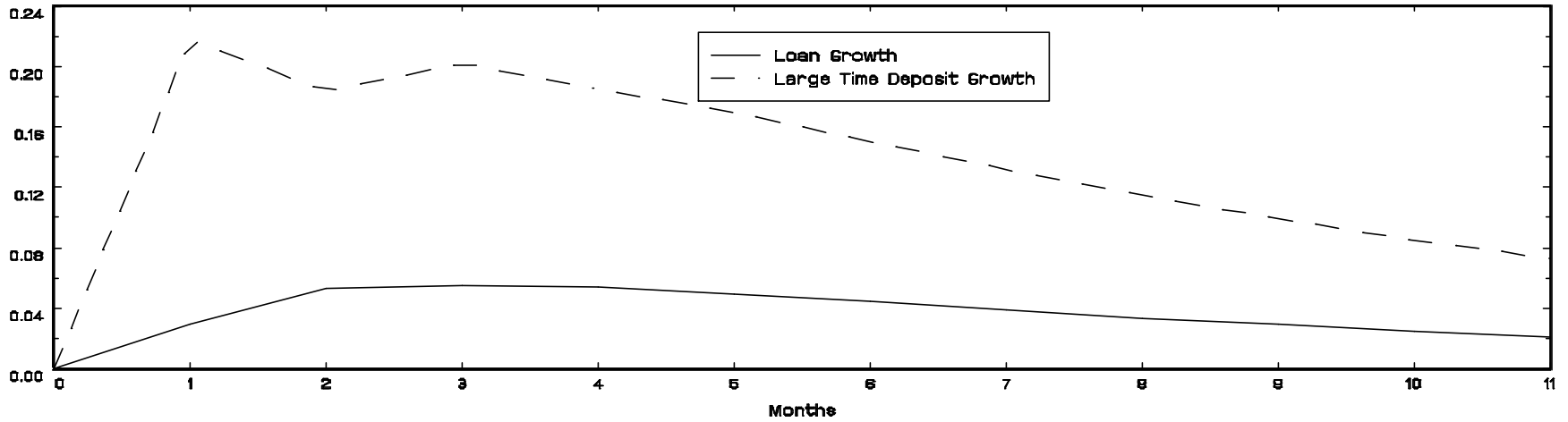


Figure 2

Impulse Response of Loan Growth and Large Time Deposit Growth to a Commercial Paper Spread Innovation, 1988 - 2004



Impulse Response of Loan Growth and Time Deposit Growth to a Commercial Paper Spread Innovation, 1920 - 1933

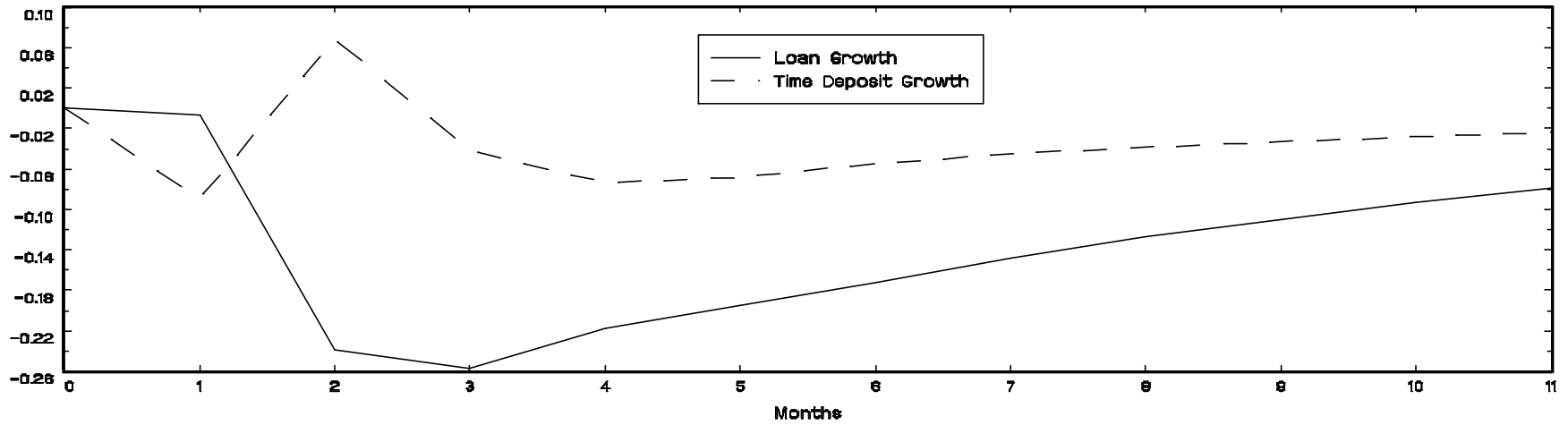


Figure 3

Impulse Response of Money Market Fund Asset Growth
to a Commercial Paper Spread Innovation, 1975 - 2004

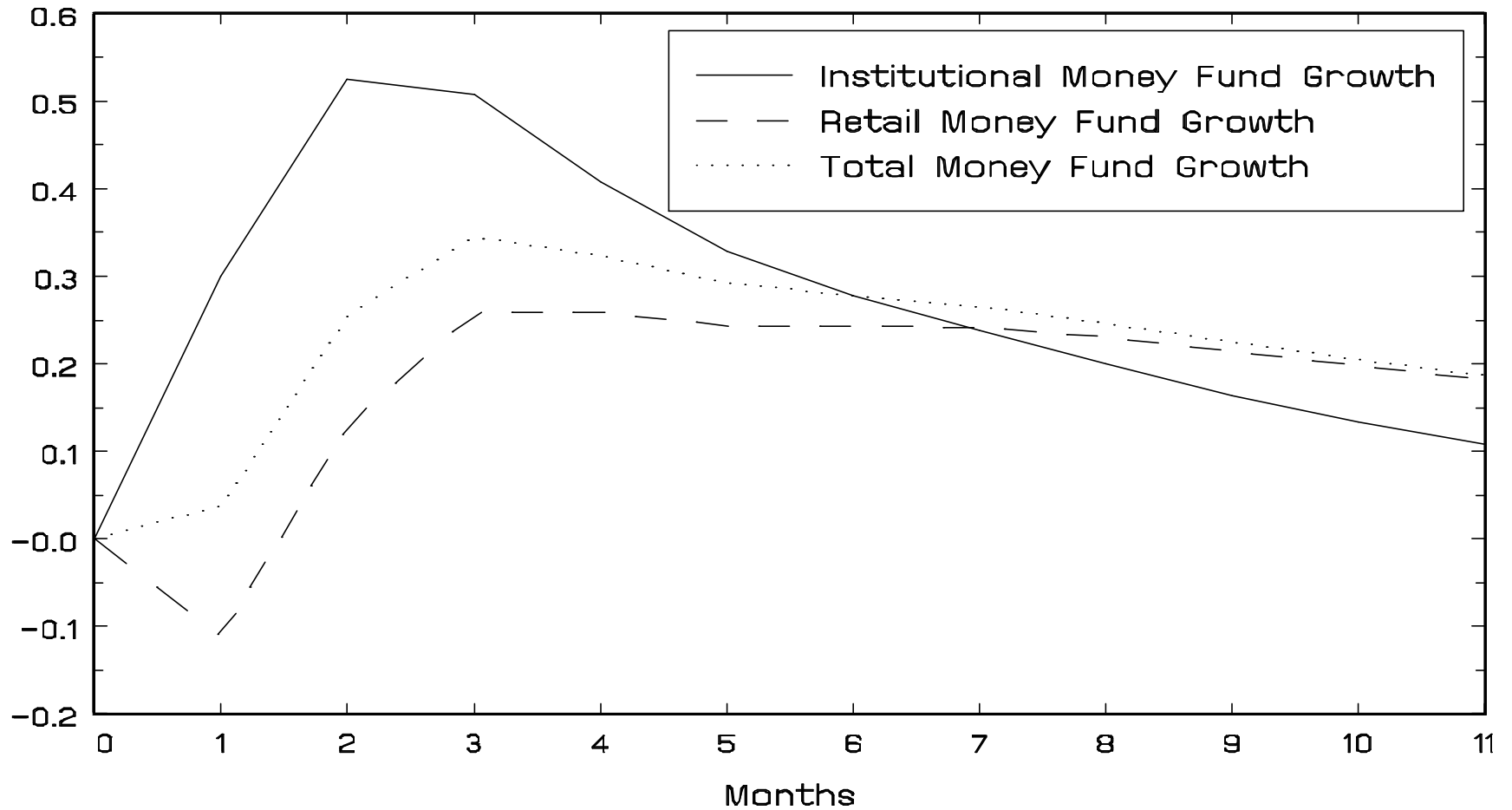


Figure 4

Actuarially Fair Premium and Value of Subsidy

