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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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I. Introduction

The primary function of many financial contracts is to transfer risks from one set of individuals or institutions to another. Financial intermediaries and markets offer these contracts in the form of derivatives and other securities. In recent decades, information technology has driven financial innovations that greatly expand the opportunities for allocating risks. Along with the private sector, the federal government has been a long-time provider of insurance contracts that shift risk from private entities to taxpayers. The government's role as an insurer continues to be large despite the private financial developments 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 changes 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 kill off efficient private financial innovations. Moral hazard is created because insurance mis-pricing and capital regulations have the effect of subsidizing systematic risks. I then explore the possibility that an alternative form of government insurance would reduce this moral hazard.

As a starting point, I present empirical evidence on how deposit insurance has influenced banks' ability to hedge liquidity risks. 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 withdraws 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 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's backing 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 and price 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.[1] The inefficiencies from this subsidization have been magnified due to recent U.S. legislation that expanded financial services firms' access to insured 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 another insurance system would improve matters. I present a model

[1] See Basel Committee on Banking Supervision (2004).

that shows the 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 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 banks where risk-based deposit insurance premiums are set according to reforms proposed by the FDIC and where risk-based capital standards are implemented according to Basel II. Similar to Kupiec (2004) who analyzes the incentive effects of Basel II, I find that proposed risk-based deposit insurance premiums and capital regulations induce 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. One prediction of this theory, which KRS show is supported by empirical evidence, is that banks with relatively high proportions of

transactions deposits tend to have high proportions of loan commitments. Another implication of the KRS theory is that the synergistic benefit of combining loan commitments with deposits is greatest the lower is the correlation between deposit withdrawals and commitment drawdowns. 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 on this implication 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.[2] 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.[3] Similar evidence is reported by Gatev, Schuermann, and Strahan (2005) who specifically examine the 1998 crisis of liquidity following Russia's default. During this period when many firms drew down their loan commitments, banks with relatively high loan commitments and transactions deposits tended to experience the greatest deposit inflows.

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 of 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.

[2] 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.

[3] 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.

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 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.[4] 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.[5] I also include a constant and time trend as right-hand-side variables.[6]

[4] 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.

[5] 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 assumes an item's response is proportional to its prior period's value and may be a more natural and commonly-used empirical specification because it assumes depositors' or borrowers' responses tend to be in proportion to their prior period levels of activity with their banks. The latter calculation used by GS has the benefit of making comparisons of different items' responses more convenient because they are measured as proportional to

Table 1 reports the results of this estimation using weekly data over the period January 1988 to February 2004.[7] The right-hand-side variables in each autoregression include four weekly lags of the three dependent variables.[8] The coefficient estimates of the four lagged commercial paper spreads for each equation having an asset/deposit growth rate as its dependent 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).

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the same total balance sheet. While both methods have merits, my alternative to GS's method may provide insight on the robustness of their results.

[6] A time trend is included to account for the diffusion of financial innovations that competed with bank on-balance-sheet loans and deposits. For example, during 1988-2004 advances in information technology allowed more firms to issue publicly-traded debt and to have their loans securitized rather than to be financed by on-balance-sheet bank loans. Similarly, the growth of money market (and other) mutual funds provided alternatives to deposits as a vehicle for savings. However, the paper's vector-autoregression results are not sensitive to inclusion of this time trend.

[7] 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.

[8] 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.

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.[9] In other words, 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.[10] 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 report the impulse response of the asset/deposit's 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

[9] 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.
[10] A lag length equal to two was generally supported by Akaike, Hannan-Quinn, and Schwarz criteria.

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 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.

II.B Bank Behavior, 1920 – 1933

This section analyzes banks' reaction to a liquidity shock during the pre-FDIC insurance period of 1920 to 1933. The data come from the National Bureau of Economic Research Macro-History Database and are at a monthly frequency. As in the earlier analysis, a commercial paper – Treasury security spread is used to proxy for a liquidity shock. The commercial paper yields are those of prime borrowers and having a four- to six-month maturity.[11] 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 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."[12] 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 start of 1920 to the end of 1933.

[11] Greef (1938) reports that the average maturity of commercial paper during this period was five months, longer than the one and one-half month average maturity in recent times. The commercial paper market was reasonably developed during the 1920s. Statistics in Greef (1938) show that during the 1920s the average ratio of non-financial firms' commercial paper to total loans of weekly reporting Federal Reserve member banks was 5.4 %, with the peak year being 1920 at 8.3%. From 1988 to 2004, this same ratio averaged 10.3 %. Average ratios of non-financial commercial paper to GNP were 0.8 % in the 1920s versus 2.2 % in the recent period. Foulke (1931) estimates that during the 1920s, commercial paper outstanding averaged 5 to 12 % of total unsecured bank loans, and at the start of the decade the annual volume of commercial paper sales exceeded the annual underwritings of all other corporate securities.

[12] Total loans are constructed from summing "loans on securities" and "all other loans."

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 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 today's 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. It assumes that a financial intermediary's cost of non-deposit debt includes 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 drawdowns. 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.[13]

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.[14]

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

A final part of this paper's empirical analysis investigates whether another non-bank financial institution has the potential to hedge against liquidity shocks. In particular, this section examines whether money market mutual funds experience fund inflows in response to increased commercial paper spreads. 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 are relevant to the paper's later discussion of deposit insurance reform.

A priori, it is unclear 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.[15] Money fund investors might move their holdings elsewhere if they perceive an increase in the likelihood of commercial paper defaults.

[13] Stein (1998) derives the adverse selection premium for the case of a bank's uninsured deposits. Hence, to avoid this penalty cost of funding, deposits must be insured.
[14] For example, the ratio of loan commitments to bank assets was 73.9 % in December of 2002.
[15] 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

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.[16]

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 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. Moreover, in a another event study using 1979 to 1991 Federal Reserve data on commercial paper and finance company spreads for AA-rated firms, they 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

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(2004). Other types of assets held by money funds include bank CDs, government securities, and repurchase agreements.

[16] 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.

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.[17] 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 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 % after three months. This positive reaction to a liquidity shock exceeds that of most bank deposits during 1988 to 2004 and is similar to that of large time deposits, the highest growing 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 also may indirectly supply funds to non-financial firms by purchasing CDs or finance company paper and, in turn, having the bank or finance company choose the ultimate user of the funds. Such an action would be similar to the Federal Reserve's

[17] 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.

role as a supplier of liquidity to banks (via the discount window), who then lend it to non-banking firms 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 made it possible for banks to attract funds and increase lending, often via loan commitments, during times of market illiquidity. The ability of banks to obtain funds by issuing debt that is explicitly or implicitly insured is consistent with prior empirical evidence that when a bank's own risk of failure rises, it tends to replace uninsured liabilities with deposits.[18] While FDIC insurance appears to produce a benefit by creating a channel for backstop liquidity, a natural question is whether this insurance also generates costs. The current section examines recent developments that have increased individuals' and financial service firms' access to deposit insurance. I argue that this expansion of the bank safety net arises from the government's inability to set premiums equal to the market value of the insurance. This discussion serves as a prelude to the following section that considers the distortions that result from this mis-pricing.

Compared to market investors, government regulators face constraints that limit their ability to discriminate between banks having different risks of failure. Because of these limitations, deposit insurance premiums and bank regulation are unlikely to 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.

[18] 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.

> 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."

Current FDIC premiums undoubtedly create a large subsidy for deposit insurance. Since 1996, the vast majority of U.S. banks have paid nothing for deposit insurance. The reason originates with the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) that required the FDIC to set insurance premiums that gradually achieve a target ratio of the FDIC's Bank Insurance Fund (BIF) reserves to total insured deposits of 1.25 %.[19] 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 been essentially free.

As expected, highly subsidized deposit insurance is very attractive. 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. Because bank consolidation has created more multi-bank holding companies, a bank within the holding company can allocate large deposits in below $100,000 segments to other member banks to achieve full insurance. A similar loophole for independent

[19] 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.

banks was created in 2003 by Promontory Interfinancial Network, LLC. Their Certificate of Deposit Account Registry Service (CDARS) allows a bank that joins this network to swap $100,000 chunks of large deposits with other banks in the network. Currently over 700 banks have joined the CDARS program, and Promontory advertises that member banks can offer FDIC insurance on customer deposits of up to $20 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 companies to affiliate under a financial holding company.[20] 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.[21] 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

[20] 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.

[21] 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.

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."[22]

The source of securities firms' profitability from this conversion is that FDIC insurance can allow them to pay lower interest on deposit sweep balances compared to interest paid on money fund balances. Also, the deposit balances can be invested in loans that pay a much higher average return than less risky money market securities.[23] Furthermore, as discussed in Gorton and Pennacchi (1993), a financial institution that provides cash transactions accounts will prefer deposits over money fund shares because the former give it more freedom to pay rates of return that differ with the size of a customer's balance. Various deposit categories allow the provider to price discriminate and extract more consumer surplus from its customers.

In summary, there are clear signs that free deposit insurance and easier access to insured deposits have 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 distortions even if deposit insurance and capital standards are made risk-based along the lines of 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 arising from a government's failure to use

[22] 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.

[23] 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 200 to 400 basis points on secured loans. In contrast, earnings from investment management fees by operating a money fund range from 50 to 100 basis points.

market-based risk standards. It presents a simple model that examines a bank's choice of investments when deposit insurance and capital standards are risk-based in ways proposed by the FDIC and Basel II. The model is similar to that of Kupiec (2004) who presents a detailed analysis of Basel II's effects on bank incentives. The current paper's model differs in that it allows for explicit risk-based deposit insurance premiums and analyzes the incentives they create.[24]

The model's results show that even if insurance premiums are risk-based according to reforms proposed by the FDIC, a particular type of moral hazard identified by Kupiec (2004) continues to exist, namely, that banks have an incentive to choose loans and contracts with high systematic risk. In the following section V, the model will be used to analyze an alternative insurance plan that could mitigate this moral hazard.

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. This case provides a point of comparison that will help highlight the distortions of proposed risk-based regulations.

IV.A A Bank with Uninsured Debt

Consider a 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 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.

[24] The model in Kupiec (2004) assumes that a bank is charged no premium for insurance. It analyzes how different risk-based capital requirements affect the size of the bank's deposit insurance subsidy.

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 asset, 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.[25] 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 capital is not sufficient to fully absorb losses should the bank's loan portfolio default. Specifically, it is assumed that

$$d(1+k) < R_F < R_L(1+k) \tag{1}$$

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

[25] 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's promised repayment, R_L, can be interpreted as the competitive principal plus interest net of a spread necessary to compensate the bank for credit screening and monitoring services.

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

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.[26] In the absence of arbitrage, the initial value of the deposits must be

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

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

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

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 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

The result in equation (4) also determines the premium that a deposit insurer would charge the bank to cover the market value of a guarantee against default on the deposits. Maintaining the assumption that deposits are competitively priced, note that the bank's promised

[26] 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 $[R_L d(1+k) - dR_D]/(R_L - d) + R_L[R_D - d(1+k)]/(R_L - d) = R_D$. When the loans default, this investment equals $[R_L d(1+k) - dR_D]/(R_L - d) + d[R_D - d(1+k)]/(R_L - d) = d(1+k)$.

return on insured deposits would be $R_D = R_F$ 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

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

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.[27] In terms of the model, an actuarially fair premium, P_A, satisfies

$$pP_A - (1-p)\left[R_F - d(1+k)\right] = 0 \tag{6}$$

or

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

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. VaR is the foundation under Basel II's Internal Ratings Based (IRB) approach, where the intent is to set minimum capital standards so that a well-diversified bank would have a 99.9% probability of suffering a loss less than its capital over a one-year horizon.[28]

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

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

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 $R_L p^* + d(1-p^*) = R_F$.

[27] See Federal Deposit Insurance Corporation (2000, 2001).
[28] Gordy (2003) gives conditions for Basel II's IRB capital rules to be consistent with a VaR modeling approach. However, Kupiec's (2005) analysis of Basel II concludes that required capital under the IRB rules will fail to provide a one-year solvency probability of at least 99.9 %.

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.[29] 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.[30] Related evidence is provided by Elton et al. (2001). They find that expected default losses explain only a small part of the spreads of corporate bond yields over equivalent maturity Treasury yields. They attribute the largest component of corporate bond spreads to a systematic risk premium, implying that R_L is much greater than $[R_F - d(1-p)]/p$, that is, p significantly exceeds p^*.

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

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

where P_i, $i = M, A$, is the deposit insurance premium paid by the bank. As with 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

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

[29] 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).

[30] 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

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

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. As shown in Kupiec (2004), this incentive holds even when deposit insurance premiums are set at zero but (Basel II) capital standards are based on loans' physical, rather than risk-neutral, probabilities of default.

To illustrate the linkage between systematic risk and the business cycle, 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 α while that of the contraction state is (1-α). 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

$$p = \alpha p_e + (1-\alpha) p_c \tag{12}$$

A systematic risk premium is modeled by assuming that the risk-neutral probability of the expansion state equals α^* so that

$$p^* = \alpha^* p_e + \left(1-\alpha^*\right) p_c \tag{13}$$

Consistent with asset pricing theory, I assume that the risk-neutral probability of the contraction state exceeds its physical probability, that is, $(1-\alpha^*) > (1-\alpha)$ or $\alpha^* < \alpha$.[31] 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 has probability 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 $\partial p_e/\partial p_c = -(1-\alpha)/\alpha < 0$. The effect on the risk-neutral probability of such a choice is

$$\frac{dp^*}{dp_c} = \alpha^* \frac{\partial p_e}{\partial p_c} + \left(1-\alpha^*\right) = 1 - \frac{\alpha^*}{\alpha} > 0 \tag{14}$$

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

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

Thus, by reducing p_c and raising p_e at the proportional rate $(1-\alpha)/\alpha$, 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

[31] 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.

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 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 that of Penati and Protopapadakis (1988) who 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.[32] 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 also may explain a bank's choice of off-balance sheet activities. As with loans, if regulators require capital for off-balance contracts that fail to distinguish between whether the contract's payoff occurs in a business cycle upturn or downturn, then banks will choose those contracts with 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.[33] Furthermore, the model may reinforce why deposit insurance gives banks an incentive to provide loan commitments. Loan

[32] Penati and Protopapadakis (1988) apply their model to explain banks' high concentrations in Latin American debt during the late 1970s and early 1980s.
[33] This may explain why commercial banks are often both buyers and sellers of credit protection.

commitments are 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). Hence, the business of providing loan commitment contains significant systematic risk.[34]

Is this incentive to take excessive systematic risk inevitable? One remedy may be to reform bank regulation to account for systematic risk. If one interprets the model literally, deposit insurance premiums and/or capital standards could be linked to the spreads on banks' loans, rather than the loans' physical probabilities of default. Interestingly, Morgan and Ashcraft (2003) suggest that capital requirements and deposit insurance premiums be based on a bank's loan rate spread instead of (or in addition to) internal risk ratings and models. Their motivation for this policy is not to reduce systematic risk. Rather, their empirical work finds that a bank's average spread on new C&I loans predicts future loan losses and CAMEL rating downgrades. Nonetheless, such a regulatory reform has the potential to alleviate systematic risk incentives.

Implementing such a policy has both practical and political challenges. First, in addition to expected loan losses and a systematic risk premium, actual loan spreads incorporate a bank's loan market power, direct costs of screening and monitoring a borrower's financial condition, and pre-payment options related to interest rate risk. Second, once capital standards and/or insurance premiums are based on loan spreads, there is scope for banks to game the system by charging for credit risk in ways other through the loan's yield, such as loan origination fees or over-charging for other banking services provided to the borrower. Third, banks increasingly provide a wide-array of non-loan financial services, including off-balance sheet contracts, whose profitability may be sensitive to the business cycle, but whose systematic risk my not be linked to a spread. In these cases, it is not straightforward to derive a capital charge or insurance premium.

[34] 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.

However, suppose that these practical problems could be solved, so that fair capital standards and deposit insurance premiums could be set, either based on loan spreads or another method, such as an option pricing approach.[35] As illustrated in this paper's model and also in Pennacchi (1999), an outcome of setting fair rates is that the FDIC will make profits, on average. That is, premiums less insurance losses must be, on average, positive in order to compensate taxpayers for having to fund large net insurance losses during economic downturns. An implication of this is that the BIF and DRR are expected to grow without bound. This might strike policymakers and politicians with a poor understanding of financial economics as evidence of excessive, rather than fair, insurance premiums. Hence, as discussed earlier in the context of Bazelon and Smetters (1999), there is likely to be political resistance to setting fair deposit insurance premiums that would prevent subsidization and moral hazard.

If one takes seriously that a government is limited to setting, at best, actuarially fair insurance premiums, are there still ways of mitigating incentives for excessive systematic risks? Stiglitz (1993) suggests a number of possible reforms. One is to substantially raise minimum capital requirements for all banks, perhaps to 20% of deposits. Essentially, this reform attempts to make the physical and risk-neutral probabilities of bank default, as well as fair insurance premiums, all close to zero. His second possible reform is to not insure bank deposits at all, but rather insure money market mutual fund shares. The next section analyzes this possibility.

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

[35] See Duffie et al. (2003), Falkenheim and Pennacchi (2003), and Pennacchi (2005) for recent work on setting fair deposit insurance premiums using an option pricing approach.

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. Note that by assuming the money fund holds multiple uninsured debt securities, we are modeling the fact that its structure makes it inherently more diversified than the bank of the previous section: A bank's uninsured CD is a claim on a single portfolio of loans while the shares of a money fund that holds n different CDs is a claim on n CDs and, in turn, is ultimately a claim on n different portfolios of loans.

Consistent with the previous modeling, assume that each debt instrument held by the money fund 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 independently and identically 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

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

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 $\pi(m,n)$, equals

$$\pi\left(m,n\right) = \frac{n!}{\left(n-m\right)!m!}\left[\alpha p_e^{n-m}\left(1-p_e\right)^m + \left(1-\alpha\right)p_c^{n-m}\left(1-p_c\right)^m\right] \tag{17}$$

The corresponding risk-neutral probability of m defaults given n total debt instruments, denoted $\pi^*(m,n)$, is the same as in (17) but with α replaced by α^*. 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 of money market funds has been provided implicitly by the money funds' parent companies. Except for one instance, the sponsors of money funds have protected investors by purchasing at par the defaulted securities held by their funds. In addition, 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.[36] 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

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

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.[37] In this case, (18) can be re-written simply as

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

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 both payoffs represent fair returns 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

[36] iMoneyNet reports that as of March 2004, approximately 50 banking organizations sponsored 489 taxable money funds having assets of $650.5 billion, equal to 33.1 % of total money fund assets.
[37] Note that if the money fund held only Treasury bills ($m = 0$ with probability 1 and $R_D = R_F$), the premium would be zero, as would the insurer's default guarantee.

could be implemented by setting the government insurance premium equal to 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.[38] 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.

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

$$P_A = -\frac{\sum_{m=\hat{m}+1}^{n}\left(R_D - R_F - \frac{m}{n}\left[R_D - d\left(1+k\right)\right]\right)\pi\left(m,n\right)}{\sum_{m=0}^{\hat{m}}\pi\left(m,n\right)} \tag{20}$$

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 $\hat{m}$,

[38] 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.

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

$$S_F = \frac{1}{R_F}\sum_{m=0}^{\hat{m}}\left(R_D - R_F - P_i - \tfrac{m}{n}\left[R_D - d\left(1+k\right)\right]\right)\pi^*\left(m,n\right) \qquad (21)$$

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.[39] 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.

This equivalence is no longer the case when $n > 1$. As the money fund holds a more diversified portfolio composed of multiple banks' or firms' debt, its total risk and systematic risk decline.[40] 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 $R_F = 1.05$, $R_L = 1.10$ $d = 0.70$, $k = 0.10$, $\alpha = 0.80$, $p_e = 0.95$, and $p_c = 0.85$. These parameter values imply $p = 0.93$, $p^* = 0.875$, $\alpha^* = 0.25$, 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,

[39] Note that $\pi(0,1)=p$, $\pi(1,1)=1-p$, $\pi^*(0,1)=p^*$, and $R_D = [R_F - (1-p^*)d(1+k)]/p^*$.
[40] The variance of defaults conditional on the contraction state, as well as the variance of defaults conditional on the expansion state, declines.

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 $n = 150$.[41]

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.

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.[42] 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.[43] Affiliation with banks (or finance companies) also would allow money funds to share the lending division's information capital when choosing credit-worthy

[41] 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.
[42] 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.
[43] 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. In addition, affiliated money funds may benefit from being marketed through banks' existing branch networks. 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.

money market instruments. However, in this "segmented" financial institution, the money fund is a separate legal entity and the FDIC would have no involvement with the bank's failure. This would reduce the likelihood of a government bailout of a "too-big-to-fail" bank due to the FDIC's difficulty in liquidating bank assets and in sorting out bank creditors' claims.[44]

The proposed system differs from the current one in that all lending institutions' liabilities would be subject to market discipline and pricing. Uninsured CDs and commercial paper would be scrutinized by credit rating agencies, commercial paper and CD dealers, and investors.[45] 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 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 funding from money funds could provide lines of credit to businesses and individuals.[46]

From an historical perspective, the system proposed here is not radical. Prior to the creation of the FDIC, commercial banks, like the money funds of today, held significant amounts of reserve securities to meet deposit withdrawals. Foulke (1931) states that prior to the 1930s

[44] Some may believe that a government bailout of any large financial institution, with or without insured deposits, is inevitable. For an opposing view, see Stern and Feldman (2004). To reduce the likelihood of a bailout, they recommend that legal and regulatory adjustments clarify the treatment of creditors at failure. Explicit insurance solely for money funds would further this goal. FDIC resolution of a money fund failure would be quick and simple. The market values of the fund's short-maturity assets are easily estimated, so that the direct cost of liquidating the fund or transferring it to another sponsor would be minimal.

[45] 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.

[46] A liquidity shock or credit worsening may force some businesses to exit the commercial paper market and access lines of credit. However, if money funds and other investors are willing to buy the commercial paper or CDs of the financial firms providing credit lines, liquidity risk would be hedged. Recent evidence is consistent with this behavior. Federal Reserve data show that the commercial paper of non-financial firms and financial firms both peaked in November 2000 at $351 billion and $1,276 billion, respectively. Since then, non-financial commercial paper declined due to the recession, accounting scandals, and firms' shift to longer-term debt. It stands at $138 billion as of July 2005. However, commercial paper of financial firms has remained more stable and reached a record high of $1,406 billion in July 2005.

banks and trust companies held over 99 % of commercial paper outstanding, being attracted to its high credit quality and short maturity.[47] 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.[48] His reasons for the low default rate are: 1) commercial paper dealers' extensive investigation of a potential issuer's credit;[49] 2) the careful credit investigations of the banks buying the paper;[50] and 3) the issuer's irreparable loss in reputation among the numerous banks holding its paper should it default. Banks' demand for commercial paper also increased following the 1914 Federal Reserve Act which made prime commercial paper eligible collateral for Discount Window lending. This paper's proposal to back insured account balances with money market instruments is essentially a call to give the FDIC collateral rights that are similar to those enjoyed by the Federal Reserve and the Federal Home Loan Banks.

Deposit insurance appears to have fundamentally changed bank portfolios. Banks now hold virtually no low-risk commercial paper.[51] It has been replaced with more cyclical investments such as loan commitments and loans of much longer maturity than those of the pre-FDIC period.[52] These shifts may indicate excessive exposure to systematic risks, a greater liability by the FDIC, and a reduction in financial system stability.

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[47] Foulke (1931) and Baxter (1966) report that commercial paper became an especially popular after the panic of 1907 when banks met deposit withdrawals with funds from maturing commercial paper.

[48] 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 %.

[49] Chapter IV in Greef (1938) gives a detailed discussion of the credit screening and monitoring of issuers carried out by commercial paper houses. Baxter (1966) states that commercial paper houses often provided financial advice to issuers and assisted in other types of financing. Goldman, Sachs and Co. is an outstanding example of a firm that built a major underwriting business largely from commercial paper connections. As of July 2005, dealer-placed commercial paper was 86 % of all outstanding paper.

[50] Greef (1938) reports that practically all commercial paper sold by dealers to banks includes an initial option period of a week to seventeen days. During this period the bank can return the paper to the dealer if the bank's credit inquiry of the issuer is unsatisfactory. The dealer would pay the bank the face value of the paper less the discount to maturity.

[51] 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.

[52] 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.

VI. Conclusion

Risks that are large and systematic tend to be difficult for some private institutions to insure. Pooling such risks reduces only their idiosyncratic component, leaving systematic risk that could 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 deposit insurance appears to enhance 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 are 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 high volumes of 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 trigger 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

Commercial Bank Vector Auto-Regressions
Weekly Data January 1988 to February 2004

	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			
Growth Equation	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

Commercial Bank Vector Auto-Regressions
Monthly Data January 1988 to December 2004

	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			
Growth Equation	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

Commercial Bank Vector Auto-Regressions
Monthly Data January 1920 to December 1933

	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			
Growth Equation	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

Money Market Mutual Fund Vector Auto-Regressions
Monthly Data January 1975 to December 2004

	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			
Growth Equation	Lag 1	Lag 2	χ^2 (p-value)	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

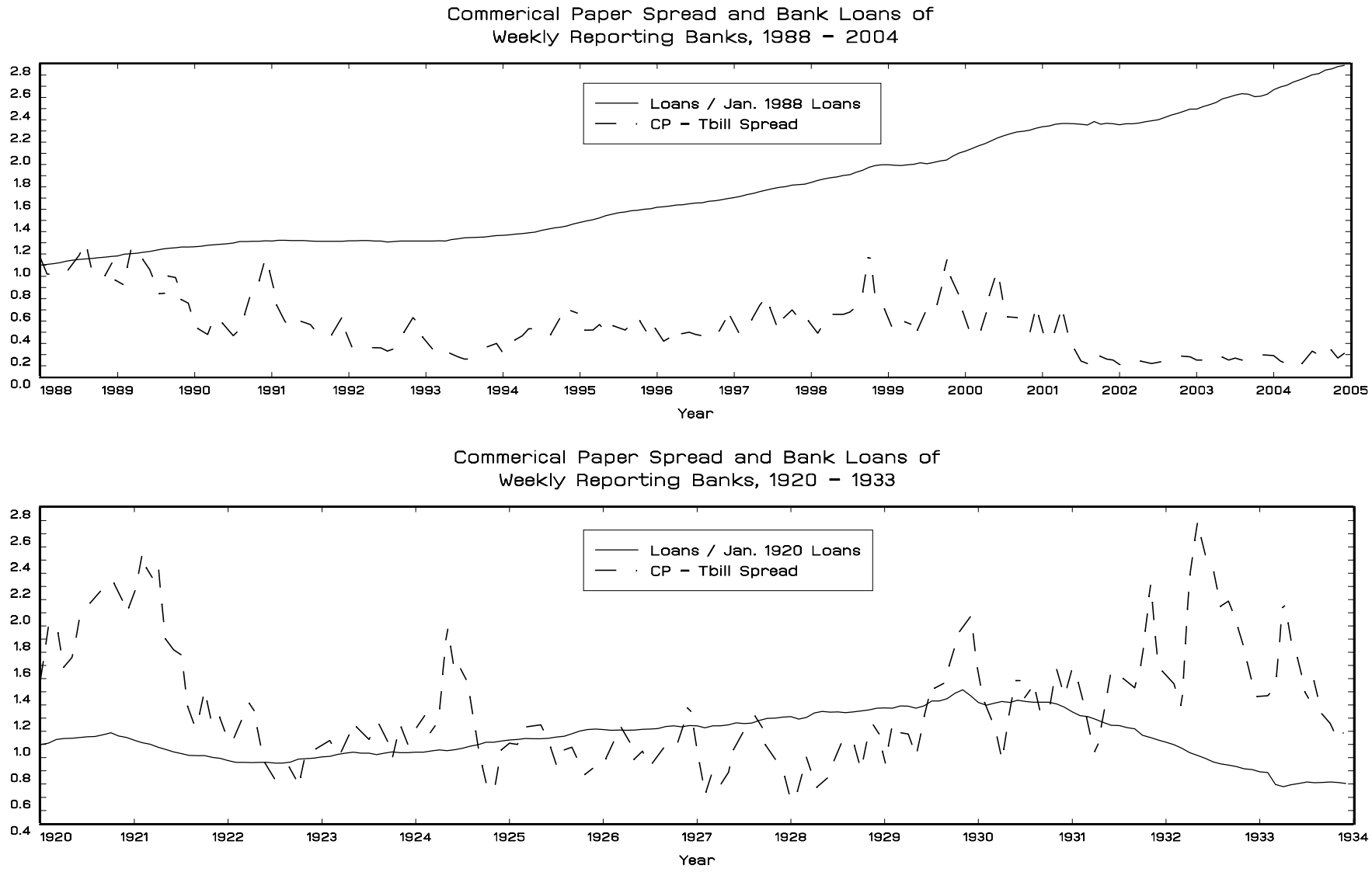
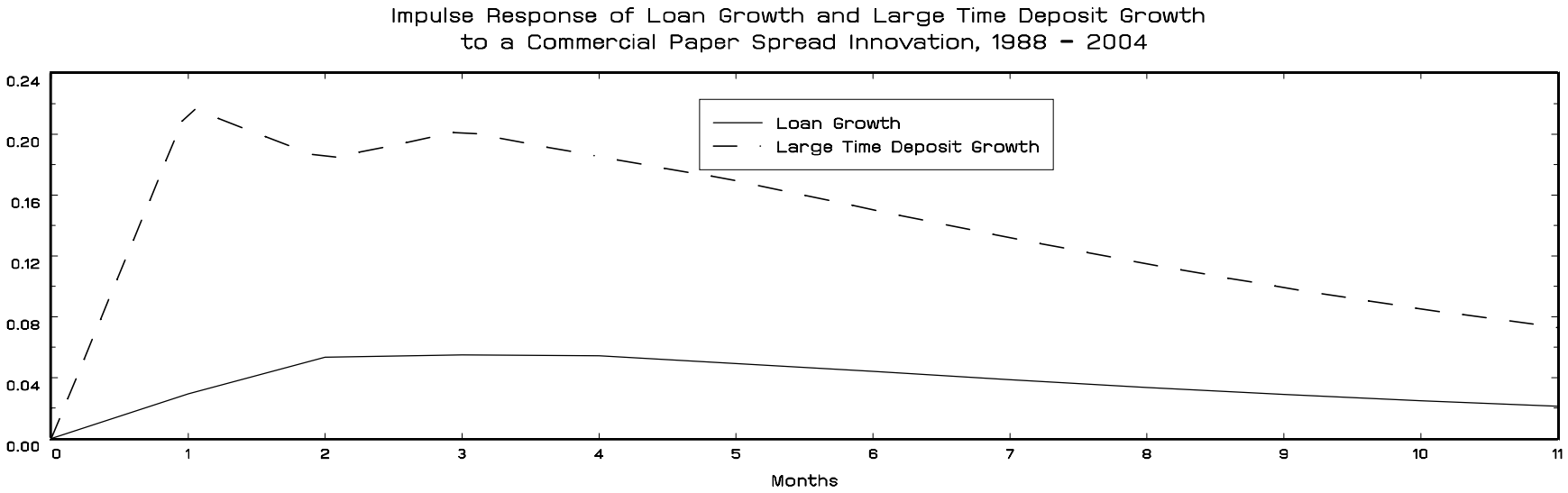

Commerical Paper Spread and Bank Loans of
Weekly Reporting Banks, 1988 - 2004
Loans / Jan. 1988 Loans
CP - Tbill Spread
Year
Commerical Paper Spread and Bank Loans of
Weekly Reporting Banks, 1920 - 1933
Loans / Jan. 1920 Loans
CP - Tbill Spread
Year

Figure 2


Impulse Response of Loan Growth and Large Time Deposit Growth
to a Commercial Paper Spread Innovation, 1988 – 2004
Loan Growth
Large Time Deposit Growth
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
1
2
3
4
5
6
7
8
9
10
11
Months

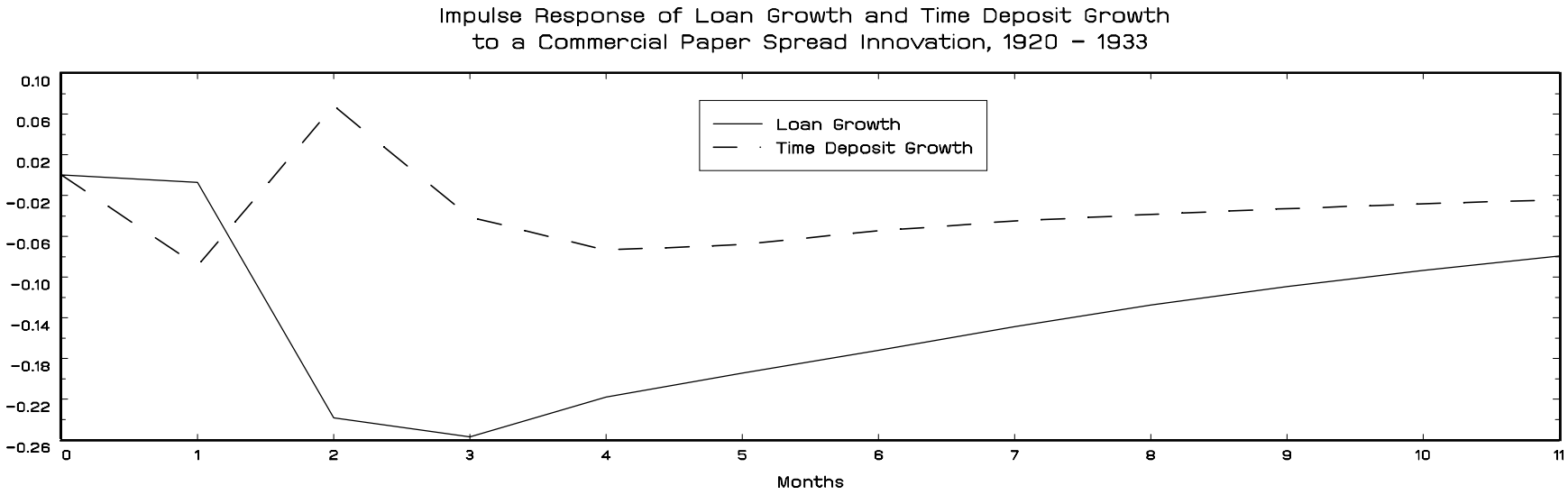

Impulse Response of Loan Growth and Time Deposit Growth
to a Commercial Paper Spread Innovation, 1920 – 1933
Loan Growth
Time Deposit Growth
0.10
0.06
0.02
−0.02
−0.06
−0.10
−0.14
−0.18
−0.22
−0.26
0
1
2
3
4
5
6
7
8
9
10
11
Months

Figure 3

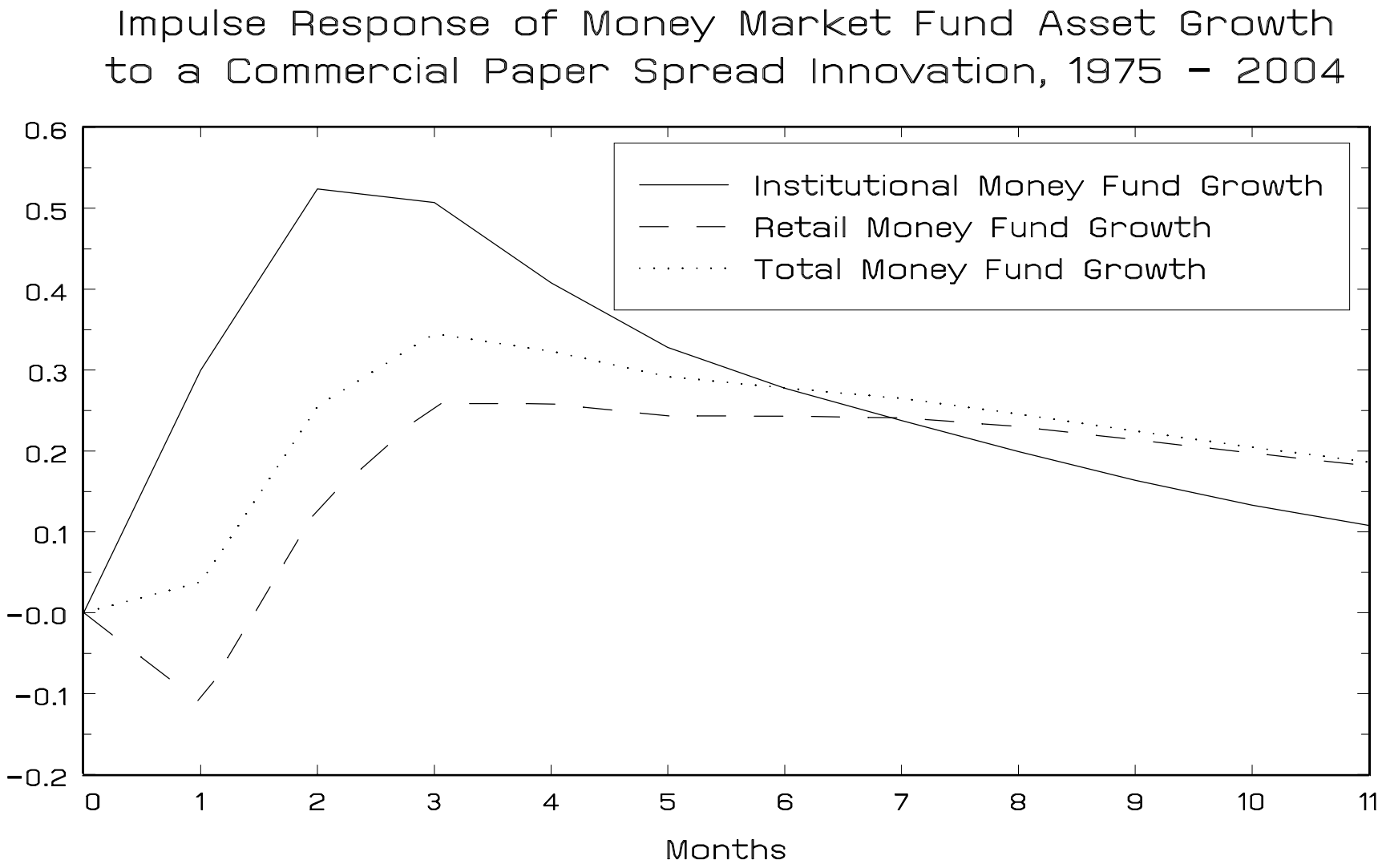
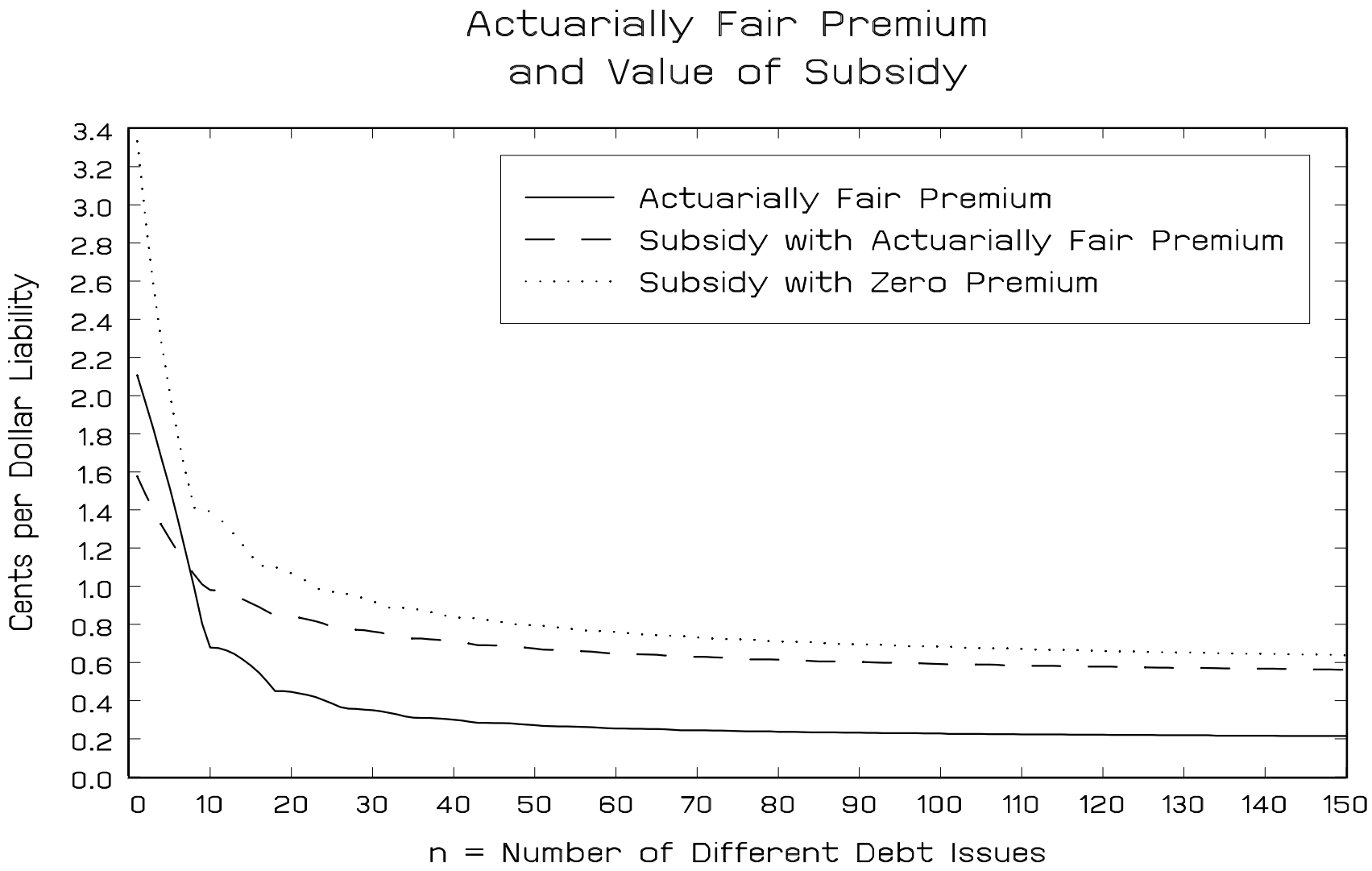

Impulse Response of Money Market Fund Asset Growth
to a Commercial Paper Spread Innovation, 1975 - 2004
Institutional Money Fund Growth
Retail Money Fund Growth
Total Money Fund Growth
0.6
0.5
0.4
0.3
0.2
0.1
-0.0
-0.1
-0.2
0
1
2
3
4
5
6
7
8
9
10
11
Months

Figure 4


Actuarially Fair Premium
and Value of Subsidy
Actuarially Fair Premium
Subsidy with Actuarially Fair Premium
Subsidy with Zero Premium
Cents per Dollar Liability
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
n = Number of Different Debt Issues