LOW INFLATION: THE BEHAVIOR OF FINANCIAL MARKETS AND INSTITUTIONS

By

Anthony Saunders*

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John M. Schiff Professor of Finance,
Stern School of Business – NYU
44 West 4th Street – Suite 9-190
New York, N.Y. 10012

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Abstract

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Anthony Saunders
John M. Schiff, Professor of Finance
Stern School of Business
NYU
44 West 4th Street
New York, N.Y. 10012

This paper provides a broad overview of the potential impact of low inflation (deflation) on US financial markets and institutions. It is argued that the contemporary experience of Japan and the historical experience of the U.S. in the 1920s and 30s offer only limited insights into the potential impact of low inflation (deflation) on today's US financial system. A number of potential implications are discussed including a decline in secondary market trading and a trend towards reintermediation. In addition, low inflation/deflation is likely to have a material effect on bank duration and convexity exposures.

Introduction

At the beginning of 1999 US short-rates were at 4 years lows with 3 month bank C.D. rates at 4.9% and 3 month U.S. T.bill rates at 4.4%.[1, 2, 3] It was not only the US that was experiencing a period of low nominal short rates; in the wake of the introduction of the “Euro” the 3 month "T.bill" rates in France, Germany and Italy stood at respectively 2.9%, 3.0% and 2.65%.[4] In Japan the 3 month "T.bill" rate stood at 0.27%. Indeed, reportedly in November 1998, six-month "T.bills" carried a negative yield of 0.004%[5, 6] with other Japanese money market rates falling into the negative territory including some bank deposit rates.[7]

This paper takes a broad overview of the possible effects of low and falling inflation rates (and potentially deflation)[8] on interest rates, financial markets and institutions. Unfortunately, recent experience is rare apart from contemporary Japan. Nevertheless, the U.S. in the 1920-40 period experienced annual deflation's of various intensities[9] (while Germany and Switzerland in the 1970’s experienced periods of negative nominal rates especially on bank Euro-C.D.’s). One question, of course, is how relevant these episodes are for contemporary U.S. policymakers? Indeed, has there been something special about these episodes that makes drawing inferences about today’s US financial system and economy somewhat problematic?

In part 2 of this paper the link between nominal interest rates and inflation (deflation) rates is discussed in the context of Black’s (1995) model of short-term rates as options. In this context a number of inferences can be drawn regarding the behavior of nominal interest rates, the effects of low nominal rates on the shape of the term structure (the spread between long and short rates), the impact on the real rate of interest as well as on investment and the type of investment in the economy. In Part 2 we also look at how well low or negative nominal interest rates experiences (e.g., in Japan) fit the Black model and how much low (or negative) rates are due to special features of the economy and financial system being analyzed. In part 3 we look at the potential impact of low nominal interest rates on primary and secondary financial markets, again drawing, where possible, inferences from contemporary and historical experience. In part 4, the potential impact of low nominal rates and inflation on banks' risk management and profitability is analyzed. Some speculation is made about potential responses of U.S. banks to this environment and the implications for the supply and price of credit and bank services. Part 5 is a summary and conclusion.

2. Falling Inflation and Nominal Rates

2.1 The Link between Inflation (Deflation) and Nominal Rates

Conceptually, the most useful way to analyze the implications of falling inflation on short-term nominal interest rates is within the context of the Fisher equation where the nominal rate equals a real rate plus an expected rate of inflation. In the context of the Fisher equation, nominal rates will fall due to either (or both) real rates or expected inflation rates falling. Since the real rate reflects the marginal productivity of capital (MPK), a decline in MPK should be reflected in a decline in the required real rate of interest. In particular, the lower the productivity of relatively "safe" investment projects in the economy, the lower will be the ex-ante real rate. A second reason for a decline in the nominal rate is a decline in the expected inflation rate or the emergence of deflationary expectations. However, while conceptually both the expected real rate and expected inflation rate can be negative,[10] the short-term nominal rate is bounded at (or close to) zero, as long as there is currency and "risk-free" deposits available to hold as liquid assets. That is, the observed nominal rate on short-term securities cannot rationally fall below zero. This point has been noted by Black (1995) who draws a distinction between the shadow nominal rate (i^*_t) which can be negative, fully reflecting underlying movements in both expected real rates and expected deflation, and the observed nominal rate (i_t) which is bounded at zero on the downside. This relationship is plotted in Figure 1.

INSERT FIGURE 1 ABOUT HERE

As can be seen, when the shadow nominal rate is negative (due for example to deflationary expectations), the observed nominal rate is bounded at zero. However, when the shadow nominal rate becomes positive, observed nominal rates move upwards in lock-step with the shadow nominal rate. People familiar with options will immediately recognize the shape of the "pay-off" function in Figure 1 as reflecting a call option. That is, conceptually, the observed short-rate (i_t) is a call option on the shadow short rate (i^*_t) or:

$$i_t = \max(0, i^*_t) \quad (1)$$

and

$$i_t = \max(0, r^*_t + \Pi^e_t) \quad (2)$$

Where r^*_t is the real rate and Π^e_t is the expected inflation rate. Thus, from (1): the strike price of the option is zero and the higher the volatility of the underlying "asset" – implicity the real rate and expected inflation rate – the greater the value of this option. Further, the longer the period over which the option can be exercised the greater the value of the option. The importance of this option's value will become clearer later when evaluating the potential effects of low nominal rates on the shape of the term-structure of interest rates.

The lower or zero bound on the nominal rate can also have adverse effects on the real rate and thus on savings and investment. Suppose that to equilibrate savings and investment the required real rate is –2%. If deflationary expectations were –2% then the shadow nominal rate would be –4%. However, if risk free cash or demand deposits are available the observed nominal rate on short term securities is bounded at zero. Thus, if i_t = 0% and deflationary expectations were –2%, the real rate would rise to +2% forcing a disequilibrium between savings and investment. That is, while the "shadow" real rate that clears the market for savings and investment is negative the actual real rate is forced higher and investment is forced lower. Not only is the zero nominal interest rate bound likely to adversely effect investment, it is also likely to affect the composition of investment as well. In particular, the required return on an investment will reflect both the real rate and the market price of risk (or risk premium) on that investment. Those investment projects most sensitive to the real rate component of returns are likely to be most affected (see Black (1995)). Since the dominant return component on relatively safe investments is the real rate, then the wedge between the actual and shadow real rates, caused by the nominal short-rate being bounded at zero, is most likely to have the greatest adverse effect on relatively safe investments. One inference that can be drawn from this is that the relative riskiness of projects selected in the economy should increase. Thus, both the level of investment as well as the composition of investment are potentially affected by the zero bound on nominal rates.

2.2 Low Inflation (deflation) and the Term structure of Interest Rates

The notion that the short-rate is an option also has implications for the slope and shape of the term structure at low short-term nominal interest rate levels. Specifically, consider the expectations theory of interest rates in which the long-rate is a geometric-average of current and future expected spot (forward) rates. Each of these short rates can be viewed as a call option on the underlying shadow rate. Thus the long-rate will reflect the average of the value of a compound option on successive current and expected short-term “shadow” nominal rates, while the current short-rate will reflected the value of the single (one-period) option. Like any options when the current price of the underlying asset is close to its strike price the option has value. Thus, when nominal rates are close to zero the value of the portfolio of short-rate options should also have value. Moreover, the term structure will generally have a positive slope, i.e., long rates will exceed short rates, when inflation and nominal rates are low. In particular, the longer the period over with the option can be exercised the higher the option's value. It is this "time-value" effect which tends to make long rates lie above shorter rates, *i.e.,* even if short-rates are currently "at the money" the probability that short-rates will move into the money (*i.e.,* nominal rates will become positive) increases with time (maturity).[11]

2.3 How well does Japan fit this Model?

Some have argued, see Baz, etal (1998), that this type of model fits Japan quite well (Table 1 reports contemporary inflation rates for Japan). Indeed, it is argued that the zero bound on nominal rates, in a world of low inflation and in some years deflation, has created a type of liquidity trap for nominal rates, making monetary policy increasingly ineffectual and creating a disequilibrium between domestic savings and investment due to actual real rates exceeding shadow real rates. Other, anecdotal evidence, might view the disastrous increase in “risky” real estate investment by Japanese financial institutions as a consequences of the bound on nominal short-rates and its effect in driving real rates above their shadow levels, making risky investments relatively more attractive than safe investments. However, there are some specific institutional features of the Japanese situation that makes one cautious about inferring too much for the U.S. in the late 1990s. Specifically, unlike the US today the Japanese deflation has coincided with a major contraction. Moreover, arguably, part of the blame for the recessionary domestic savings-investment gap and low (negative) economic growth in Japan can be laid at the door of the Japanese banking system and its regulators. Indeed, much of the surge in high-risk real estate investment by Japanese banks came in the 1980s and early 1990's when nominal short rates were historically high (see Table 2). Because of the long gestation period of real estate investments, their "bubble" like nature and the reluctance of regulators to take intervening actions, bad loan problems of Japanese banks mounted in the 1990s exceeding by some estimates over $500 billion. In recent years, because of the fragility of the Japanese banking system, U.S. banks have been reluctant to lend dollars to Japanese banks without a considerable "credit risk" premium.[12] This premium has been most evident in the dollar-yen swap market where U.S. banks have been able to swap dollars for yen at such favorable rates that it amounts to a negative cost of yen funds for the dollar swapping banks (see WuDunn (1998), Tett (1998), WSJ (1998)). Swapping dollars for yen even at such favorable rates has resulted in a quandary for U.S. banks as to where to "park" those yen? Given the fragile nature of Japanese financial institutions, a "flight to quality" has resulted in an exceptional demand for Japanese safe assets especially short-term Treasury bills. While short-yields on yen securities have occasionally been driven marginally negative, U.S. banks and other foreign banks have still been able to profit due to their low (negative) cost of yen funds.[13] Thus, it is arguable that the low nominal rates observed in Japan is as much a consequence of specific problems in the Japanese banking system as a cause.

Finally, Table 2 shows the shape of the Japanese term structure 1980-1998. [Note that "Japlong" reflects the rate on the most liquid long-term Japanese government bond and is viewed as the benchmark long rate]. In the most recent three years 1996, 1997, and 1998 when inflation has been respectively 0.1%, 1.7% and –0.1% the yield curve has sloped upwards quite steeply, with 20 year rates at 2.77% versus one month rate of 0.22% in 1998. This is consistent with Black's (1995) view of short-rates as options on shadow short-rates (see Section 2.2).[14, 15, 16]

2.4 The U.S. Deflation of the 1930's

The U.S. went through a period of very low inflation/deflation 1921-1940, including the dramatic deflation and economic contraction of 1930-33. The debate over the causes of the 1930-33 contraction still rages. As noted by Cecchetti (1992) there are at least three theories of the contraction: (i) the monetary hypothesis of Friedman and Schwartz (1963), (ii) theories based on exogenous declines in consumption and/or investment (Temin 1976) and (iii) debt-deflation theories (Fisher (1933), Bernanke and Gertler (1989, 1990). Arguably, the monetary hypothesis of Friedman and Schwartz, in which a contraction in the money supply and associated deflationary expectations results in high real rates is the closest to that part of the Black (1995) model which reflects persistent disequilibrium. By contrast the debt-deflation model views deflation as largely unanticipated, *i.e.*, borrowers enter into loan and debt contracts at terms that are largely unfavorable in deflationary conditions. In the Bernanke-Gertler (1989, 1990) framework, unanticipated deflation results in a wealth transfer from borrowers to lenders, *i.e.*, the real cost of debt obligations rise. This wealth shock increases real leverage and results in increased investment in risky projects (a similar prediction to that of the Black model). The resulting increase in bankruptcy risk, reduces investment as well as GNP.

Cecchetti (1992) finds evidence, based on some simple ARIMA time-series models, that is consistent with most of the price deflation being anticipated prior to the 1930-33 contraction and that deflationary expectations were being reflected in high real rates possibly as early as 1927. The implication that deflation can be anticipated, aligned with the zero bound on nominal rates, points to the potential of rising real rates, as a consequence of a short period of deflation, having a major adverse effect on contemporary U.S. investment and growth. However, others dispute this finding. For example, Evans and Wachtel (1993) argue that the extent of the deflation in the 1930-33 period was largely unanticipated. Specifically, agents underestimated the extent of the deflation, expecting a reversion to normal inflationary conditions in the near-term, *i.e.*, the great deflation represented a largely unanticipated regime shift. Others, such as Hamilton (1992) have also argued that the deflation during the Great depression was largely unanticipated.

Interestingly, to the extent that any future deflation is fully or even partially *unanticipated* the current debt servicing position of U.S. households looks ominous. As noted by Emmons (1998), American households credit market debt (first and second mortgages, credit-card borrowings and auto-loans) reached over 80% of personal income in 1998.[17] Moreover, this ratio has been growing at about 2% per year since 1984. Consistent with the Bernanke-Gertler (1989, 1990) hypothesis, borrowers currently seem to be entering into medium and long-term debt contracts that do not reflect anticipations regarding falling inflation or deflation (see Figure 2a). Indeed, measured by the four-quarter personal income growth rate minus the beginning of period interest rate on new mortgages the cost of debt service appears to have increased in the 1980s and 1990s compared to the 1970s. These forces suggest that a sudden and unanticipated deflation could cause a major adverse shock to household (consumers) debt servicing abilities, rapidly increasing personal bankruptcies with a significant contractionary effect on the economy.[18]

It is not only U.S. consumers that appear to have increased their leverage in recent years. Figure 2b shows the debt/equity ratios for U.S. non-financial corporations (as well as the outstanding book values of debt and equity) for the 1978-1998 period. As can be seen, long-term debt outstanding exceeded equity outstanding for the first time in 1994, moreover, the debt-equity ratio has almost doubled since the abandonment of reserve targeting (and high nominal interest rates) by the Federal Reserve towards the end of 1982.[19] However, as with consumer leverage, book-value leverage ratios may be misleading. As shown in Figure 2c, the ratio of corporate debt (long-term) to the market-value of equity has actually been falling throughout the 1990s. Specifically from 1.1 in 1989 to 0.5 in 1998.

Finally, how did the price deflation of the 1930-33 period impact the term structure? In another paper Cecchetti (1988) has noted that many "quoted" long rates over the period (such as the quoted yield on a 3.5% coupon liberty bond of –1.74% on December 31st, 1932) were "too low" in that they reflected a valuable exchange option which artificially raised the price and lowered the yields on these bonds, especially as they approached maturity.[20] After adjusting for the "exchange option," Cecchetti produced a set of non-taxable constant maturity yield curves for 1929-49. In all three major deflation years 1930, 1931, 1932 the yield curve tended to slope upwards as per the Black model (1995) (although with some variability of the degree of slope). For example in December 1930 the 3 month bill rate was 1.25% and the 20 year bond rate 3.28%. In December 1932 the 3 month bill rate was 0.05% while the 20 year bond rate was 3.15%. It might be noted that in 1929 prior to the stock market crash the yield curve had been flat or downward sloping.[21]

2.5 <u>The German and Swiss Experience of the 1970s</u>

The low and negative rates on Swiss and German Euro-CD's in periods during the 1970s appears to have been principally attributable to capital controls on non-resident investors in Swiss francs and German DMs. These controls were introduced following the further freeing of exchange rates, after the Smithsonian Agreements 1971, and the dramatic inflow of capital to Switzerland and Germany. This inflow had the effect of rapidly appreciating these countries currencies. To offset this, in the early 1970's, the German and Swiss authorities imposed heavy interest-rate penalties on non residents with on-shore German and Swiss franc accounts. To avoid these controls foreign investors increasingly deposited DM and Swiss francs offshore. (These controls were lifted in 1974 in Germany and at the end of 1979 in Switzerland (see Levich (1998))). As a result of these controls Euro-Swiss franc and Euro-DM CD rates became negative for periods during 1973. For example on February 9th, 1973 1 month and 3 month Euro-DM CD's were being quoted at respectively -3.5% and -4% (bid quote). The Euro-Swiss CD rate also became negative for a number of weeks during 1978, when controls applied to nonresident accounts became binding again.[22] For example, on December 22nd 1978, Swiss Franc Euro-CD's of 1-3 month maturity were being quoted at -0.125%. Thus the low and negative rates experienced by Switzerland and Germany in 1970s should be attributed as much to capital controls as low inflation or deflationary expectations.

3. Low Inflation, Currency, Banks and Financial Markets

3.1 Banks versus Currency

In the above discussion it was implied that credit risk-free deposits and currency were perfect substitutes as liquidity alternatives to short-term securities. However, holding liquidity in the form of currency can be costly. Specifically, there are at least three costs of holding currency that need to be weighed against the benefits of holding liquidity in the form of currency. These costs reflect the fact that currency needs to be stored,[23] currency can be stolen and currency holdings involve a convenience cost (or negative convenience yield).[24] As such individuals facing such costs may prefer a small negative yield on deposits compared to a zero yield on currency. Of course, to the extent that holding deposits is risky (in the presence of bank fragility and/or weak deposit insurance systems), currency holdings may be preferable to deposits even when the latter have positive nominal interest rates. As will be discussed later in Section 4 this appears to be happening in Japan.

3.2 Banks versus Markets

Faced with a choice between holding liquidity in non-interest bearing securities or in non-interest bearing deposits, the investor may well choose the latter as long as there is a widespread belief that bank deposits are "safe." In recent years there have been a number of theories of what makes banks special *viz a viz* financial markets and direct lending to borrowers by savers. Boyd and Prescott (1986) have argued that it is the ability of banks to diversify across risky projects that allows banks to offer, in a credible fashion, low default risk deposit contracts. More recently Diamond and Rajan (1998) have focused on the ability of banks versus financial markets to create (though their monitoring expertise) loan contracts that are more attractive, liquid and flexible than direct debt contracts offered by lenders to borrowers in financial markets. This enhanced liquidity on the asset side of bank balance-sheets is bolstered by banks' ability to attract liquidity on the liability side of their balance sheets. Specifically, should a bank suddenly need funds it does not necessarily have to "call in" loans (as might a direct investor) but rather can attract additional deposits to fund its loans. Its ability to do this is aided by a precommitment to pass earnings on loans through to its depositors *via* a "fragile" capital structure that has a very high degree of leverage (*i.e.*, by holding relatively low amounts of owner equity). Although not discussed by Diamond-Rajan (1998) one (perhaps very loose) interpretation of their model is that the liquidity advantage of banks in attracting funds will increase in a low interest rate environment, because of the relatively smaller amount of earnings that would need to be generated so as to attract additional depositors and maintain liquidity services on the asset side of the balance-sheet. Of course, to the extent that banks cannot provide a credible (risk free) deposit contract, as currently in Japan, the impact on financial markets of deflation and falling nominal rates may be less.[25]

3.3 <u>The Impact on Primary and Secondary Security Markets</u>

In general one might expect a number of impacts of low nominal rates on the operations and depth of primary and secondary markets. To the extent that the nominal rate bound of zero is binding, such that savings and investment are forced into disequilibrium (*i.e.*, the shadow market clearing real rate is negative) then domestic savings will exceed domestic investment and the volume of domestic new primary issues of securities -- such as IPO's -- will be lower than otherwise (*i.e.*, in a world where the nominal rate can go negative). Of course, in an international economy this may be reflected in a capital outflow, e.g., excess Japanese domestic savings being invested in foreign securities.

There is also a potentially interesting impact on the volume of trading in the secondary market for securities, which has been noted by Silber (1977) in the context of Friedman's optimum quantity of money theory (1969). This is that since more currency (and potentially deposits) will be held for liquidity services at low inflation rates there will be a lesser need to trade securities for liquidity purposes. This has the following potential implications: First, low interest rate regimes may exhibit periods of low volumes of secondary market trading in securities. Second, to the extent that there are market-makers at the heart of the "micro-structure" of securities markets, bid-ask spreads may be expected to widen and trading and other transaction costs to increase (especially if there are diseconomies of scale in trading). Third, less frequent trading may also have adverse implications regarding market efficiency. In particular, the speed with which information is impounded into securities prices may be slower and the deviation of transaction prices from equilibrium prices may be greater. These effects may also be viewed as socially costly.

What is the evidence of low interest rate periods being associated with low transactions volume? One problem is that since most contemporary bonds (government and corporate) are traded over-the-counter (OTC) it is difficult to get accurate figures on volume traded. Interestingly, in the deflation period of the 1930's most bonds traded (if at all) on organized exchanges such as the New York Stock Exchange (Cecchetti (1988)).[26] Cecchetti reports one example that of the 3.375% coupon T.bond of 1940-43. The outstanding value of this issue was $360 million. On January 30, 1932 when 3 month T.bills were yielding .05% and 10 year bonds 3.29%, only $130,000 was traded. Unfortunately, without knowing how many of these T.bonds were traded on other exchanges on that day and what turnover volume was like prior to 1930 it is difficult to seriously evaluate these figures in terms of them being "high" or "low." Figures on trading volume in Japanese bonds in recent years are also difficult to get since they also trade OTC. Table 3 presents some very anecdotal evidence based on turnover of shares on the Japanese stock market (in terms of 000's of shares). From Table 2 the period 1984-1994 was a relatively high short-term interest rate period relative to 1995-1998, when one month T.bill rates fell to 0.5% or below. As can be seen turnover rates were much higher in the relatively high nominal interest rate period. It could be argued that these figures simply reflect the low level of the Nikkei index during this period, however, there is no consistent empirical evidence linking the level of an index to the volume of turnover. A more persuasive argument might be that equities carry little in terms of liquidity services and that any reduction in volume of trading will be because of fundamental factors other than relative attractiveness of cash as a liquid asset.

Finally Table 4 shows stock volume turnover on the NYSE 1920-1998. As can be seen stock volume (turnover) grew up to 1929. Following the crash stock volume fell dramatically reaching a low in 1941. Indeed it was not until the 1960s the stock volumes reached the levels of the late 1920s. The relatively high inflation (nominal rate) years of the 1970s and 1980s saw a surge in volume of trading. Nevertheless, the late 1990s have witnessed a surge in trading volume despite relatively low short-term nominal rates and inflation. Again, there appears at best a weak positive link between stock market turnover activity and the level of short-term nominal rates. Indeed the correlation coefficient (ρ) between the annual volume of stock trading on the NYSE and the level of inflation/deflation was 0.04 for the 1920-1995 period.[27]

4. Low Inflation, Bank Balance-Sheets and Profitability

4.1.1 Low Inflation and Risk Management

There are some potentially important implications of low nominal rates for the way bank's need to manage their interest rate risk and credit risk in such environments. As is well known, see for example, Kaufman (1984) Saunders (1997), a bank's net worth or capital exposure to interest rate risk can be expressed as an approximation in equation (3).[28] That is:

$$\Delta E = -(MD_A - kMD_L) . A. \Delta i \qquad (3)$$

where ΔE = the change in a bank's net worth

MD_A = the modified duration of its assets

MD_L = the modified duration of its liabilities

A = asset size

k = L/A (or leverage)

Δi = the shock (surprise) to nominal interest rates.

Most banks (with the exception of some large regional and money center banks[29]) have tended to have a positive duration gap, in that the average duration of their assets (MD_A) has been longer than that of their liabilities (MD_L) (see Federal Reserve (1992)[30]. As nominal rates are bounded on the downside at zero, and unbounded on the upside, the closer is the level of nominal rates to the lower bound the more exposed to interest rate risk will the average bank be with $MD_A > kMD_A$. In the limit, at the zero nominal rate bound, any nominal rate shock must be positive (and its impact on ΔE negative). Because of greater exposure to interest-rate risk at low nominal rates, banks may seek to hedge their interest rate risk exposure in a more active fashion.[31] This could include seeking to shorten their average MD_A (e.g., by moving out of long-term bonds, fixed rate mortgages and commercial loans) and into shorter duration assets, and changing their rate structures by encouraging increasingly floating rate contracts such as ARMs. This may lower the supply of long-term credit instruments to households and corporations. Alternatively, they could seek to lengthen MD_L by offering more long-term fixed rate deposit contracts.

Some current methods of hedging, such as through derivative contracts and securitzation (pooling, packaging and selling loans as securities) may also become more costly. If short rates are options and their option value increases at rates close to the zero strike price (see Section 2.2), hedging that risk with interest rate derivatives such as caps or interest rate options may become very expensive in terms of required option premiums. Also the ability of banks' to securitize may be hampered if the supply of "long-term fixed rate" mortgages and commercial loans shrink.[32]

4.1.2 <u>The Convexity Trap</u>

Section 4.1.1. discussed the importance of duration matching, such as reducing MD_A to better match MD_L, in a low interest rate level environment. However, equation (3) is a simplification of the true potential interest rate risk exposure of banks and other FIs in low rate environments -- especially when asset and liability embedded options are recognized as is the effect of such options on the "convexity" of bank asset and liability values. Indeed, in recent papers Gilkeson and Smith (1992) and Gilkeson and Ruff (1996) and Mimeo (1998) have recognized the fact that banks may face a convexity trap at low interest rates if they have large amounts of fixed rate mortgages (or fixed rate loans) on their books financed with large amounts of fixed rate retail CDs and other liabilities. This is because fixed rate mortgages can be "called" by the mortgagees as interest rates fall, turning them into assets that exhibit negative convexity (see Figure 3) while fixed rate CDs can be "put" back to the bank at a fixed withdrawal penalty as interest rates rise turning them into highly positive convex liabilities. Indeed, Figure 3a indicates that the prepayment rate on mortgages of January 1996 (with a coupon of 7.497%) showed a dramatic increase in the final months of 1998 as mortgage rates fell. This relationship between negatively convex assets (A), positively convex liabilities (L), the level of interest rates (i) and bank net worth (E) is shown in figure 3b.[33]

From Figure 3b, with fixed withdrawal penalties on CDs and fixed refinancing penalties on mortgages, the value of these embedded options increase at low and falling interest rates. As a result, bank net worth (E) can become negative as assets become (more) negatively convex and liabilities (more) positively convex with falling nominal rates. Gilkeson and Smith (1992) have called this the convexity trap. This suggests that banks that have generated a lot of these types of embedded options will need to hedge *both* their duration and convexity risks at low interest rate levels (i.e., duration matching may not be enough). Policies that might be followed include buying putable bonds on the asset side of the balance sheet (assets that have positive convexity) and issuing callable bonds on the liability side of the balance sheet (liabilities with negative convexity -- see Mimeo, 1998).[34] Alternatively, the bank could issue more ARMs with floors and floating rate retail CDs with caps.[35]

4.2 The Effects on Bank Profitability

The effect of low nominal rates on bank profitability can be analyzed in the context of a very simple gross profit (Π) function as shown in equation (4):

$$\Pi = (\text{Interest Income} - \text{Interest Expense}) + (\text{Other Income} - \text{Other Expense}) - \text{Provisions for Loan Losses} \quad (4)$$

Before looking at equation (4), it can be seen from Table 5 that the late 1990's have been extremely profitable for U.S. banks (measured by average ROA (Π/A) and ROE (Π/E)). To what extent this can be explained by falling rates as opposed to (i) an expanding economy, (ii) falling default rates and (iii) a major restructuring of the banking industry in terms of M and A is extremely difficult to disentangle, especially as default risk and the level of nominal (and real) rates tends to be positively correlated (Stiglitz and Weiss (1981)). At best one can speculate as to the likely effects on (4), for U.S. banks, of continually falling nominal rates and inflation.

The first component of the profit function is the spread between interest income and interest expense.[36] The effects of falling nominal rates will in part depend on the sensitivity of deposit rates versus lending rates to falling short-term rates and the distance the level of rates is from the zero nominal interest rate boundary. As discussed earlier, the term-structure is likely to be increasingly steeply sloped as short rates fall, and given that most banks still maintain existing deposit liability and asset structures (such that $MD_A > MD_L$) then spreads may well increase.[37] This is likely to be bolstered by the fact that evidence suggests that bank base lending rates such as "prime" are more sticky when rates are falling than when they are rising (Mester and Saunders (1995))[38]. However, this positive spread effect is likely to diminish (and even reverse) as the zero bound on the level of nominal rates is approached. In addition to a potential widening in spreads—at least over some range of “low” interest levels--the deposit (and asset base) of banks is likely to expand as savers reintermediate and hold liquidity in the form of deposits.

There should also be a material effect on the second component of the profit-function, the spread between Other Income and Other Expense.[39] Traditionally, U.S. banks have offset regulatory restrictions on paying explicit interest on demand deposits (such as the post- 1933 restriction that demand deposits bear zero rates) and other frictions on rates on transaction accounts, through the mechanism of paying implicit interest. Implicit interest can be viewed as the subsidy arising from the tendency of bank’s to charge less in fees than the economic cost of the provision of deposit account services (such as check clearing, etc.). If nominal short-rates go to zero, the explicit (restricted) rate on risk-free demand deposits would be fully competitive with the rates produced on short-term securities, so that banks' would no longer have to compete for funds with securities markets by paying implicit interest. For example, banks’ might seek to charge customers fees related to the marginal cost of service provision so as to reflect their payment system resource usage. Further, as deposit rates go to zero it will be harder and harder for banks to pass on regulatory taxes to depositors through deposit rate cuts. That is, regulatory taxes such as non-interest bearing reserve requirements and deposit insurance premiums will have to be borne by either bank stockholders and/or loan customers. To the extent that banks remain "special," as loan monitors (see James (1987) and Fama (1985)), this may not be a problem as borrowers will be willing to pay for bank certification *via* lending decisions. Indeed, empirical evidence for relatively high interest rate/inflation periods such as the 1980s (see James (1987) and Fama (1985)) seems to suggest that bank borrowers are willing to bear a significant portion of the regulatory tax burden. Nevertheless, increasing access to the capital market (e.g., for commercial paper) and competition from non-bank financial institutions may have weakened the ability of banks to pass regulatory taxes through to borrowers in recent years. In which case the zero bound on nominal deposit rates (if binding) may mean a larger share of the regulatory tax cost burden being faced by bank shareholders through profit erosion.

There is likely to be an important effect on the "other expense" component of the profit function which, in part, reflects the total (and average) cost of payment service provision by the banking system. Recent studies of check processing scale efficiencies by Bauer (1993), Bauer and Hancock (1993) and Bauer and Ferrier (1996) suggest that economies of scale may be significant. In addition, recent studies by Bauer and Ferrier (1996) and Hancock, Humphrey and Wilcox (1999) have found similar potential scale efficiencies on Fedwire (the wholesale payment network). Thus if the banking system expands due to liquidity reintermediation, banks and the banking system will have an increased potential to exploit economies of scale in providing payment services both at the retail (check payment) level and the wholesale (Fedwire) level. Although, this positive effect on other (net) income is likely to be ameliorated if higher direct fees discourage payment volume (e.g., the number of checks people write shrink).[40]

Finally, the effect of low nominal rates on loan loss provisions (credit risk) will depend largely on whether lower inflation (deflation) is anticipated or not, and thus is reflected in debt contracts, as well as the degree of information imperfection in credit markets. In a Stiglitz-Weiss (1981) world of asymmetric information between lenders and borrowers there is an inverted U shaped relationship between the level of interest rates and the expected return on loans. Specifically, if interest rates rise beyond some region (or point) credit risk increases (and the expected returns on loans falls) due to enhanced risk-shifting incentives of borrowers and enhanced adverse selection effects (good borrowers self-finance rather than borrow from banks). To the extent that current loan rates are in the "high rate" region, falling loan rates can potentially lower adverse selection and moral hazard (risk-shifting) incentives of borrowers.

However, in a Bernanke-Gertler (1989, 1990) world, deflation can have an opposing effect on default risk if borrowers have not anticipated such deflation. In this world deflation increases the real cost of outstanding medium and long-term debt contracts and increases borrower default and credit risk. As noted earlier, the huge amount of household and corporate debt that has been built up in recent years and the rising contractual rates on some of that debt suggests that this real cost of debt effect may be quite substantial.

Finally, deflation may also result in a decline in real asset values (such as property values) and thus the value of collateral backing loans. Declining collateral values, in the presence of fixed rate or sticky-rate loan contracts, will increase the credit risk exposures of banks.

In sum, there are likely to be a wide variety of effects impacting U.S. bank profitability in a world of falling inflation rates (deflation). The major impact will clearly be an increased orientation of banks towards fee income and more aggressive charging for payment services.[41]

4.3 <u>The Effects of Low Inflation on Banking: Contemporary and Historical Experience</u>

It may be of some relevance to look at how the current Japanese banking system is reacting to, and the U.S. banking system in the 1920's, 1930's and 40's reacted to, low inflation/deflation.

4.4.1 <u>Japan</u>

In 1997 the ROA of Japanese banks was 0.37% and in 1998 0.47% (Goldman Sachs (1998)). This is roughly comparable to U.S. banks ROAs in the last recession of 1991-92 (see Table 5).[42] As noted earlier, Japanese banks current performance has been severely hampered by accumulated adverse outcomes from lending decisions made over the last decade,[43] making interpretation of the separate effect of low nominal rates on current bank profitability difficult. Table 6, however, shows the (fiscal year) 1997 revenues and costs of major Japanese banks relative to non-Japanese banks. As can be seen, scaled by Assets both revenues and costs are relatively low for Japanese banks as would be expected if nominal rates are low. Unfortunately, it is hard to separate out the independent effects of interest rates and fees, etc.. on these revenues and costs. Nevertheless, Goldman-Sachs (1998) reports that the average spread between loan and deposit rates for Japanese banks in September 1998 was 1.63% versus 1.65% in September 1997, that is, loan spreads have marginally fallen despite the steeply sloping yield curve.[44] The main reason for this appears to be that banks have shortened the average duration of their loans. Indeed, a narrowing of bank duration gaps was one of the predictions of Section 4.1.1 of this paper. Goldman-Sachs (1998) also reports that rather than banks' deposit base expanding it is actually contracting. Thus the liquidity reintermediation effect discussed above has largely been offset by adverse perceptions of Japanese savers *viz a viz* the safety of banks and the banking system.[45] As a consequence, deposits have flowed into accounts at the Japanese Post Office, into currency and into domestic and overseas government bonds – as might be expected in a "flight to quality." This has required Japanese banks to rely more on purchased (money market) funds with related adverse effects on spreads.[46]

With respect to operating efficiency (i.e., other income and other expense) this appears to have remained relatively flat in recent years and there is little sign of Japanese banks more aggressively seeking out higher fees, as nominal rates fall, due perhaps to the stronger hold that “customer relationship” effects have in the Japanese banking system through keiretsu and other such ties. Most banks have, however, announced severe cost-cutting exercises as part of government agreed restructuring plans involving branch closings and rolling back overseas operations (especially full-service branches).[47] Nevertheless, Japanese banks appear to lag behind their foreign competitors in technology and technology related investments. As such the potential to realize enhanced economies of scale and scope, and thus expense savings, may be limited.[48] Moreover, their ability to expand assets has been constrained by the recession and their accumulated bad-debt problems.[49]

4.4.2 U.S. 1921-1940

How did U.S. banks respond to the low inflation environment of the 1920s and 1930’s? Figure 4 shows the inflation/deflation experience for the U.S. economy from 1914-1995. Between 1921 and 1940 deflation or low inflation rates characterize the period. For example, in 10 individual year's there was actual deflation (including the major deflation years of 1931, 1932, and 1933). The highest inflation rate was 3.61% and the average inflation rate over the 20 year period was -1.67%.

Figure 5 shows the ratio of currency outside banks to demand deposits 1921-1940. As can be seen the currency-deposit ratio was quite stable for much of the low inflation 1920's varying between 15.6% and 21.5%. With the stock market crash and the 1930-33 banking panic the currency-deposit ratio rose to as high as 31.8% in 1933 before declining back to 1921 type levels by the end of the 1930s. Arguably, deposit insurance (introduced in 1934) had a considerable stabilizing effect on the currency-deposit ratio that offset concerns abut bank stability after 1933. Figure 6 also shows the powerful effect of deposit insurance on the attractiveness of demand deposits. The annual turnover rate (debits divided by average annual demand deposits) rose throughout most of 1920's peaking at 53.6 in 1929. With the banking panic of 1930-33 both the amount of demand deposits and their turnover declined. The introduction of deposit insurance in 1933 aligned with low nominal interest rates on short-term securities (3 month T.bill rates were always less than 1% over the 1936-40 period), led to a rapid growth in demand deposits as well as a decline in the demand deposit turnover rate as depositors appeared to be less inclined to economize on their demand deposit balances (the reintermediation effect). These data suggest that to the extent that a period of deflation is associated with economic contraction (and concerns about bank safety), "credible" deposit insurance has a powerful stabilizing effect.[50]

How did the low inflation/deflation period affect the structure of bank balance sheets and their duration characteristics?

Figure 7 shows the loan/total asset, securities/total asset and cash/total asset ratios of member banks 1919-1941. As can be seen, deflation, low interest rates and economic contraction had quite dramatic effects on the structure and duration of bank asset portfolios in this period. For example, in the relatively high inflation year of 1920 the loan to asset ratio was 51.9%, the securities to asset ratio was 22.4% and the cash assets to total asset ratio was 21%. Throughout the next 20 years of deflation and low inflation the loan ratio trended down while the securities and cash ratios trended up. Indeed by 1941, the loan ratio was 25.7, the securities ratio was 36.5% and the cash ratio was 35.5%. The decline in the loan ratio and the increase in the cash ratio are consistent with a reduction in banks' asset durations (MD_A) as might be expected at low interest rate levels (see earlier discussion).

Figures 8 and 9 show, respectively, member banks ROE, ROA and net charge-off for the 1919-1941 period. While the 1931-1934 period was clearly disastrous for bank profitability, the ROE's earned by banks over the remainder of the period were not that dissimilar from those reported by U.S. banks during the 1990-91 period and that being earned by Japanese banks today. Moreover, the ROAs, if anything, were somewhat better.[51] One reason for the ability of U.S. banks to maintain profitability in this period was the decline in explicit interest costs on deposits as securities market rates fell and the explicit rate on demand deposits was constrained by regulation to zero post-1933. As shown in Figure 10 the ratio of interest on deposits to total earnings for member banks declined from 29.4% in 1919 to only 9.9% in 1941. Interestingly, offsetting this cost saving was the dramatic relative increase in bank salaries and wages to total earnings. At least part of this rise may be attributable to the increased provision of bank services (and the payment of implicit interest) in the face of constraints on paying explicit interest to demand deposit holders in the face of marginally positive rates on securities. Overall, total expenses to total earnings remained remarkably stable over the whole period.

5. Summary and Conclusions

This paper provides a broad overview of the impact of low inflation, and potentially, deflation on US financial markets and institutions. It can be concluded that the contemporary experience of Japan and the historical experience of the US in the 1920s and 1930s offer relatively limited insights into the likely impact of deflation on contemporary US financial markets and institutions. A major reason being that these deflationary periods were associated with demand-side economic contractions rather than supply-side economic expansion as currently being enjoyed by the US economy. Indeed, perhaps the closest historical period to the present would be the US economy of the late 19th century. Unfortunately, the structural differences between the 19th century US banking and financial market system and today's US banking and financial system are so great as to make drawing insights from this period somewhat tenuous. Moreover, data for this period is rather limited.

The theoretical effects of anticipated low inflation/deflation were also analyzed in the context of Black's (1995) model of short-rates as options. Black's model was found to yield three important insights regarding (i) the level of investment (ii) the risk versus riskless composition of that investment and (iii) the slope of the term structure. Empirical evidence suggests that while Black's implications regarding the slope of the term structure seem to have some support for contemporary Japan, and for the US in the 1920s and 1930s, there is a body of evidence (at least for the US in the 1920s and 1930s) that suggests that deflation was largely unanticipated. This implies an alternative mechanism by which deflation might adversely impact the financial system and ultimately the economy today. Specifically, unanticipated deflation may increase the real debt burden of borrowers (the debt-deflation hypothesis), increasing their bankruptcy risk and ultimately adversely impacting the stability of the financial system and the real economy. Current (book-value) based ratios of leverage for U.S. consumers and corporations suggest that an unanticipated deflation might have a profound effect on increasing these agents real debt burdens. However, it was argued that this ignores the dramatic increase in corporate and personal wealth levels as a result of the boom in equity markets. Indeed, corporate leverage ratios, when measured using the market, rather than book, value of equity show that corporate leverage has actually declined throughout the 1990s.

The effects of deflation on the relative provision of liquidity by banks and financial markets was also discussed. One potential implication of low inflation (deflation) is that there may well be a "reintermediation" effect from financial markets and currency into "safe" bank deposits. Such a reintermediation effect might in turn adversely impact the degree of secondary market trading activity in securities markets with an associated adverse effect on bid-ask spreads and market efficiency. Using data on stock market turnover (in the absence of data on bond market turnover) and inflation (deflation) rates this effect for both Japan and the US appears to be somewhat limited.

Finally, the effects of low inflation/deflation on bank net worth and profitability were analyzed. A number of interesting potential effects were identified. These included the likelihood of banks (i) reducing the duration gaps between their assets and liabilities, (ii) facing a rising cost of hedging in derivatives markets and (iii) facing a convexity “trap” unless they more accurately priced the embedded options in their mortgage (asset) and deposit (liability) portfolios. With respect to pricing and profitability it was also argued that banks can be expected to more aggressively change for services provided to customers given the decreased need to provide payment service subsidies as a form of implicit interest return to depositors. These and other insights were then examined in the context of the behavior of banks in contemporary Japan and those in the U.S. over the 1920-1940 period.

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TABLE 1

JAPANESE INFLATION RATES

Year	Index	Inflation Rate
80	76.3	
81	80	4.85%
82	82.2	2.75%
83	83.8	1.95%
84	85.7	2.27%
85	87.4	1.98%
86	88	0.69%
87	88.1	0.11%
88	88.7	0.68%
89	90.7	2.25%
90	93.5	3.09%
91	96.5	3.21%
92	98.2	1.76%
93	99.4	1.22%
94	100.1	0.70%
95	100	-0.10%
96	100.1	0.10%
97	101.8	1.70%

Table 1 cont'd…….

Q1 98	102.2
Q2 98	102.7

Q3 98	102.1

Source: Data Stream

TABLE 2

JAPANESE TERM-STRUCTURE

	JAP1MBL	JAP3MBL	JAP1YBL	GBJP02Y	GBJP03Y	GBJP05Y	GBJP07Y	GBJP10Y	GBJP20	JAPLONG
80	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
81	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
82	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	7.82000
83	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	7.39000
84	6.34375	6.28125	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.70000
85	7.84375	7.71875	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.14000
86	4.28125	4.34375	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	5.37400
87	4.03125	3.90625	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	4.96000
88	4.71875	4.65625	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	4.79000
89	6.59375	6.78125	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	5.56600
90	8.09375	8.03125	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.70900
91	5.75000	5.84375	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	5.56400
92	4.00000	3.78125	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	4.63900
93	2.37500	2.25000	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	3.17800
94	2.31250	2.31250	2.68750	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	4.52300
95	0.50000	0.59375	0.62500	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	3.04800
96	0.25000	0.37500	0.43750	0.72000	0.98700	1.78900	2.33900	2.77300	3.45000	2.60500
97	0.21875	0.43750	0.40630	0.61600	0.79000	1.23700	1.57700	1.90100	2.55300	1.90100
98	0.21875	0.21875	0.25000	0.79200	1.15500	1.58200	1.84100	2.00400	2.76700	1.87800

Source: DataStream

TABLE 3

TURNOVER OF SHARES ON THE TOKYO STOCK EXCHANGE (‘000S OF SHARES)

74	1,003,168
75	46,937,488
76	51,389,424
77	63,261,200
78	62,290,000
79	86,510,000
80	96,246,000
81	98,812,672
82	67,744,448
83	87,077,760
84	87,692,416
85	107,674,544
86	177,958,224
87	249,950,080
88	263,226,112
89	215,801,264
90	119,879,248
91	94,066,432
92	65,246,032
93	86,669,376
94	79,841,536
95	91,336,576
96	94,951,552
97	104,677,904

Source: DataStream

TABLE 4

STOCK VOLUME ON THE NYSE 1920-1964 (000,000'S OF SHARES)

Year	Volume
1920	227.8
1921	172.8
1922	260.9
1923	236.5
1924	284.0
1925	459.7
1926	451.9
1927	581.7
1928	930.9
1929	1,124.8
1930	810.6
1931	576.8
1932	425.2
1933	654.8
1934	323.8
1935	381.6
1936	496.0
1937	409.5
1938	297.6
1939	262.0
1940	207.6
1941	170.6
1942	125.7
1943	278.7
1944	263.1
1945	377.6
1946	363.7
1947	253.6
1948	302.2
1949	272.2
1950	524.8
1951	443.5
1952	337.8
1953	354.9
1954	373.4
1955	649.6
1956	556.3
1957	559.9
1958	747.1
1959	820.8
1960	766.7
1961	1,021.3
1962	962.2
1963	1,146.3
1964	1,236.6

Con'd…………….

Table 4 cont'd…..

1965	1,556.3
1966	1,899.5
1967	2,530.0
1968	2,931.5
1969	2,850.8
1970	2,937.4
1971	3,891.3
1972	4,138.2
1973	4,053.2
1974	3,517.7
1975	4,693.4
1976	5,360.1
1977	5,273.8
1978	7,205.1
1979	8,155.9
1980	11,352.3
1981	11,853.7
1982	16,458.0
1983	21,589.6
1984	23,071.0
1985	27,510.7
1986	35,680.0
1987	47,801.3
1988	40,849.5
1989	41,698.5
1990	39,664.5
1991	45,266.0
1992	51,375.7
1993	66,923.3
1994	73,420.4
1995	87,217.5
1996	104,636.2
1997	133,312.1
1998	169,144.6

Source: NYSE

TABLE 5

ROE AND ROA OF INSURED US COMMERCIAL BANKS

Year	ROA	ROE
1990	0.49%	7.64%
1991	0.54	8.05
1992	0.95	13.24
1993	1.22	15.67
1994	1.17	14.90
1995	1.17	14.68
1996	1.19	14.40
1997	1.24	14.71

Source: FDIC

TABLE 6

GLOBAL BANK REVENUES AND COSTS

	Revenues	Costs	Profits	Equity	Assets	ROA	ROE
BankAmerica	3,827,460	2,209,610	1,617,850	5,282,778	67,544,491	0.024	0.306
Citcorp	2,690,111	1,740,682	949,429	2,637,842	41,118,280	0.023	0.360
Deutsche/Bankers	2,549,336	1,959,743	589,594	3,047,826	108,164,620	0.005	0.193
HSBC	2,376,567	1,276,251	1,100,316	3,419,27	60,433,176	0.018	0.321
UBS	2,311,844	1,647,050	664,794	2,955,957	89,840,391	0.007	0.224
Chase Manhattan	2,091,756	1,253,087	838,669	2,705,792	45,511,365	0.018	0.310
Credit Suisse	1,858,101	1,267,192	590,909	1,615,763	60,944,020	0.010	0.366
Deutsche Bank	1,768,288	1,449,857	428,431	2,337,465	88,563,745	0.005	0.183
ABN AMRO	1,535,413	1,060,603	474,810	1,669,587	54,034,089	0.009	0.284
Barclays	1,522,891	958,280	564,611	1,584,655	50,367,912	0.011	0.357
Lloyds TSB	1,490,241	764,461	725,780	1,300,582	29,052,012	0.025	0.558
National Westminster	1,475,060	1,088,047	387,014	1,512,701	36,638,968	0.011	0.256
Societe Generale	1,185,105	873,863	311,242	1,448,539	67,734,992	0.005	0.215
Dresdner Bank	1,013,853	718,957	294,897	1,315,817	59,023,070	0.005	0.224
Bayerische Hypo-und-Vereinst	965,772	564,296	401,476	1,638,834	62,760,275	0.006	0.245
Tokyo-Mitsubishi	**952,071**	**485,700**	**466,371**	**2,423,500**	**81,946,229**	0.006	0.192
BNP	937,014	673,689	263,325	1,436,352	45,812,800	0.006	0.183
J.P. Morgan & Co., Inc.	898,529	630,464	268,065	1,298,387	33,788,175	0.008	0.206
ING	895,983	652,202	243,781	858,211	19,574,834	0.012	0.284
Bankers TrustN.Y. Corp.	781,048	619,885	161,163	710,361	19,600,875	0.008	0.225
Royal Bank of Canada	750,026	486,574	263,452	705,434	21,328,594	0.012	0.373
Sakura	**725,286**	434,895	290,391	1,726,737	51,650,386	0.006	0.169
Commerzbank	720,414	450,359	270,055	1,026,165	43,826,560	0.006	0.263
Dai-Lchi Kangyo	**712.344**	**394,177**	**318,167**	**1,840,063**	**53,798,398**	0.006	0.173
Sumitomo	**707,401**	**373,755**	**333,646**	**1,671,593**	**58,076,795**	0.006	0.200
Sanwa	**691,025**	**348,141**	**342,884**	**1,830,000**	**52,708,359**	0.007	0.187
Canada Imperial	674,121	439,441	234,680	681,581	22,681,099	0.010	0.344
Fuji	**668,879**	**378,527**	**290,352**	**1,576,455**	**51,088,094**	0.006	0.184
Halifax	617,225	250,800	366,426	1,500,431	27,866,640	0.013	0.244
Bank of Montreal	584,856	371,980	212,876	625,349	18,795,721	0.011	0.340
Abbey National	573,554	248,304	325,249	920,847	33,835,092	0.010	0.353
BankBoston Corp.	499,916	288,973	210,943	580,808	8,885,730	0.024	0.363
Bank of Nova Scotia	491,328	310,093	181,236	650,022	18,254,719	0.010	0.279
Standard Chartered	457,928	235,619	222,309	489,330	10,065,264	0.022	0.454
Toronto Dominion	445,671	274,927	170,744	554,691	17,049,760	0.010	0.308
Tokai	**436,266**	**249,381**	**186,885**	**1,065,787**	**31,943,567**	0.006	0.175
Mitsubishi Trust	**411,116**	**156,507**	**254,609**	**786,688**	**18,158,026**	0.014	0.324
Ashai	**405,179**	**262,200**	**142,979**	**962,079**	**29,267,330**	0.005	0,149

Note: Most recent fiscal year ends

Source: Goldman Sachs (1998)

FIGURE 1

THE RELATIONSHIP BETWEEN THE OBSERVED AND SHADOW NOMINAL RATE

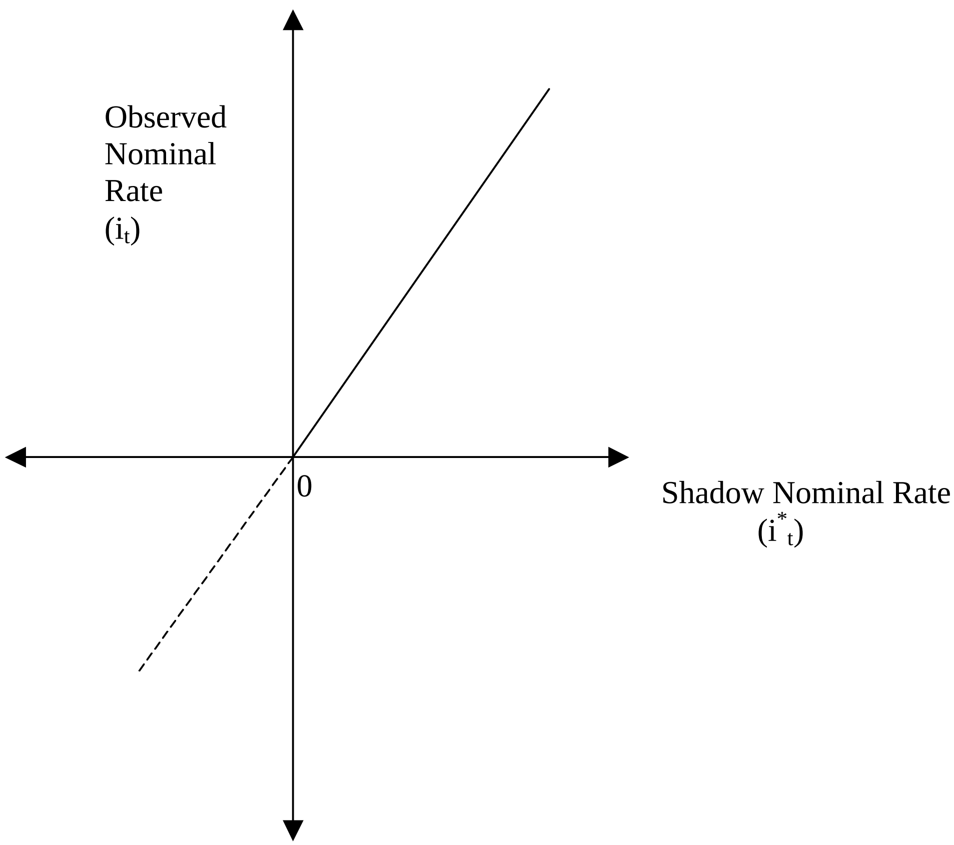
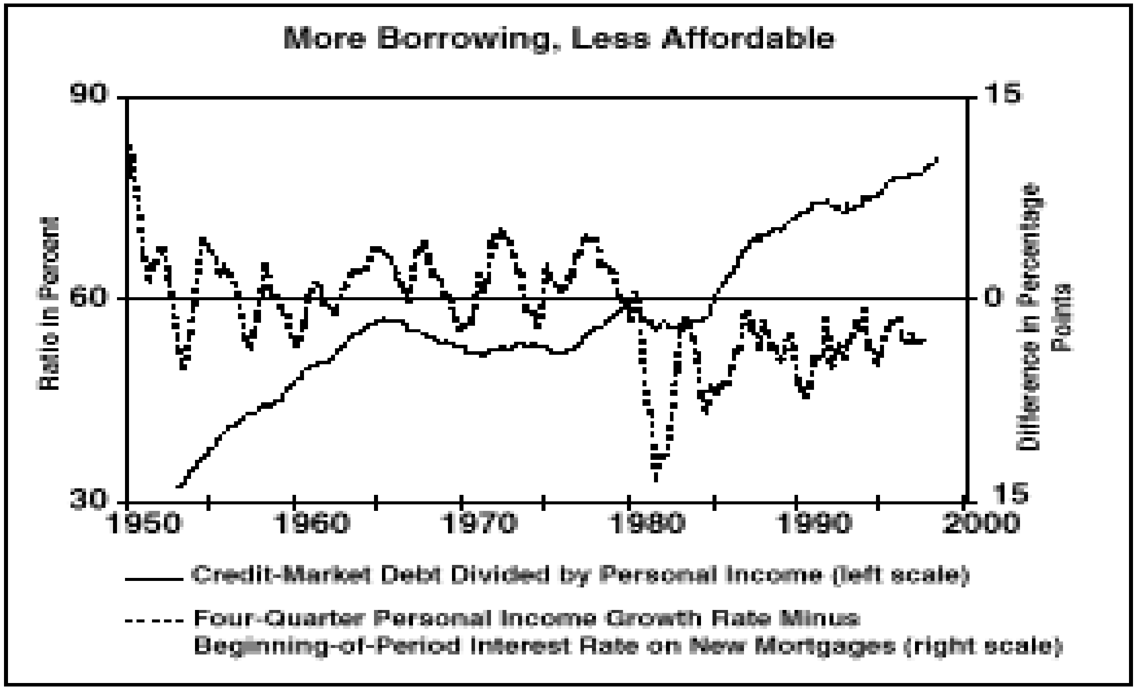


Figure 2a



SOURCE: Emmons (1998)

FIGURE 2c

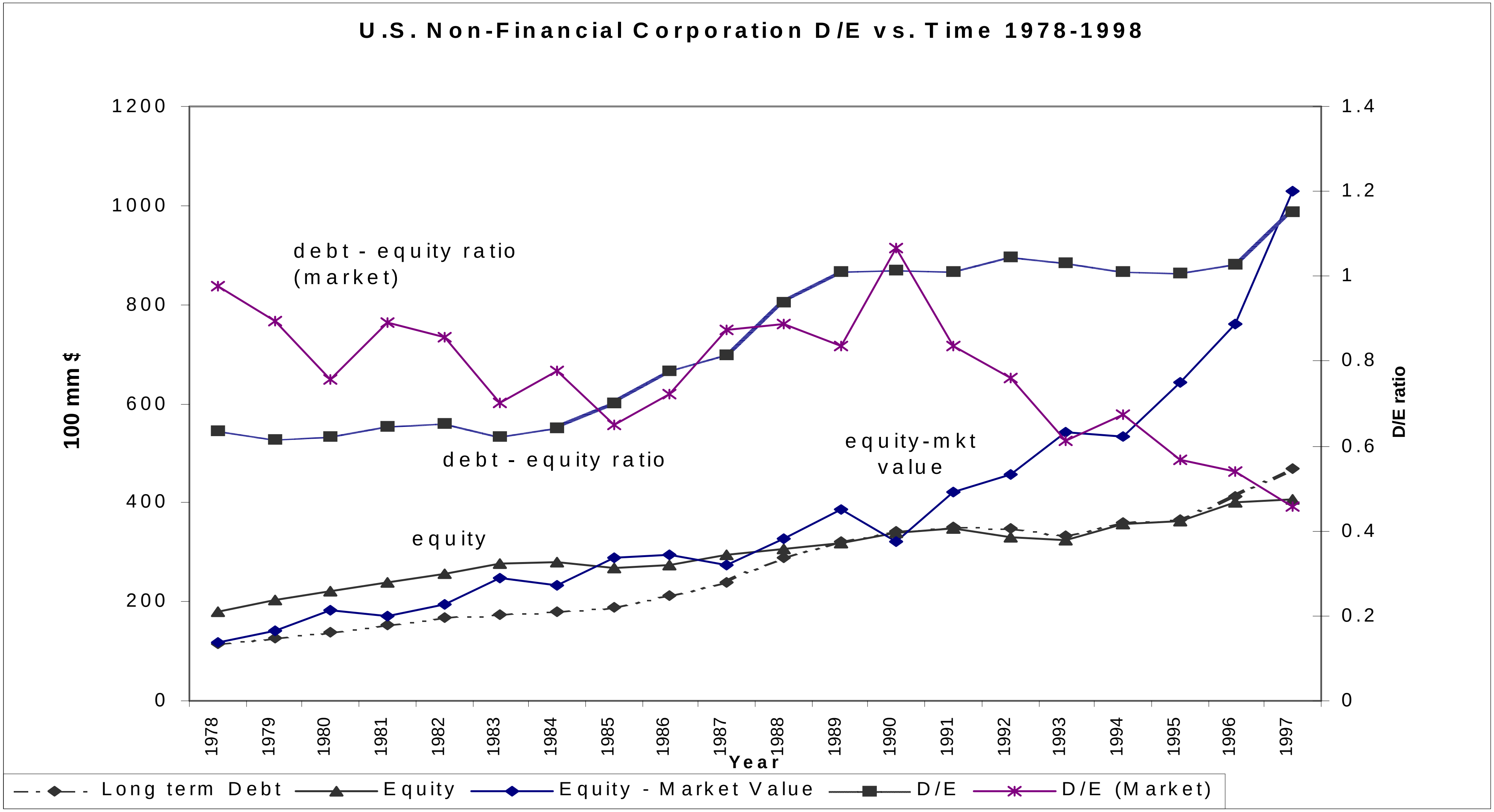
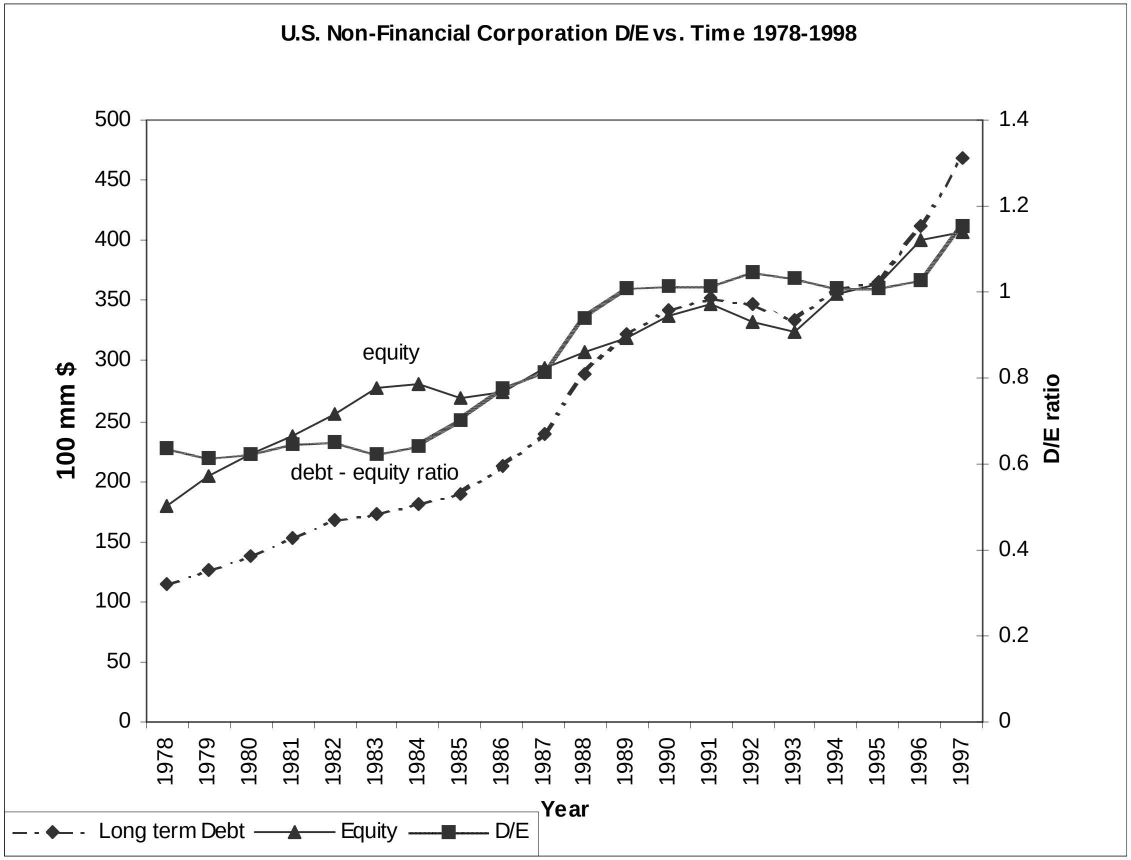

U.S. Non-Financial Corporation D/E vs. Time 1978-1998
100 mm $
D/E ratio
1200
1000
800
600
400
200
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
debt - equity ratio (market)
debt - equity ratio
equity-mkt value
equity
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
Year
Long term Debt
Equity
Equity - Market Value
D/E
D/E (Market)

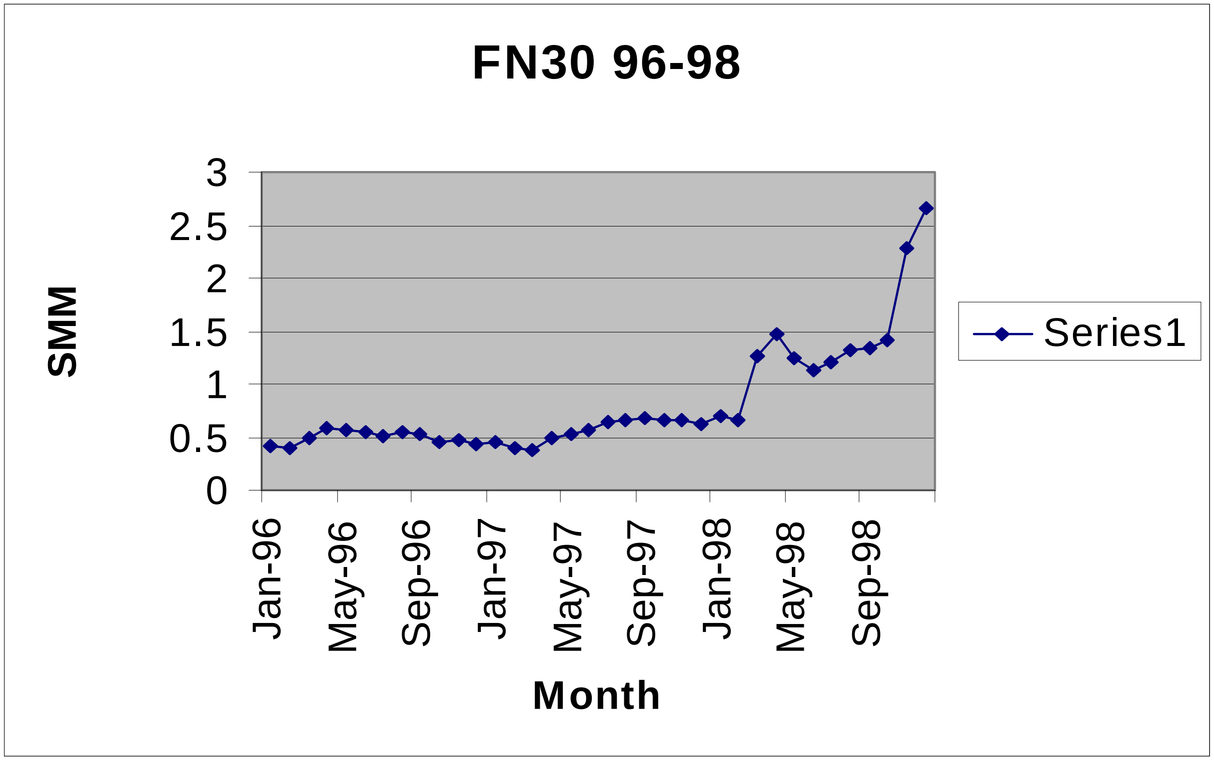
FIGURE 2b



SOURCE: Compustat

FIGURE 3a

Prepayment rates (SMM) on 30 year FNMA mortgage pools



Source: BARRA

FIGURE 3b

The Convexity Trap

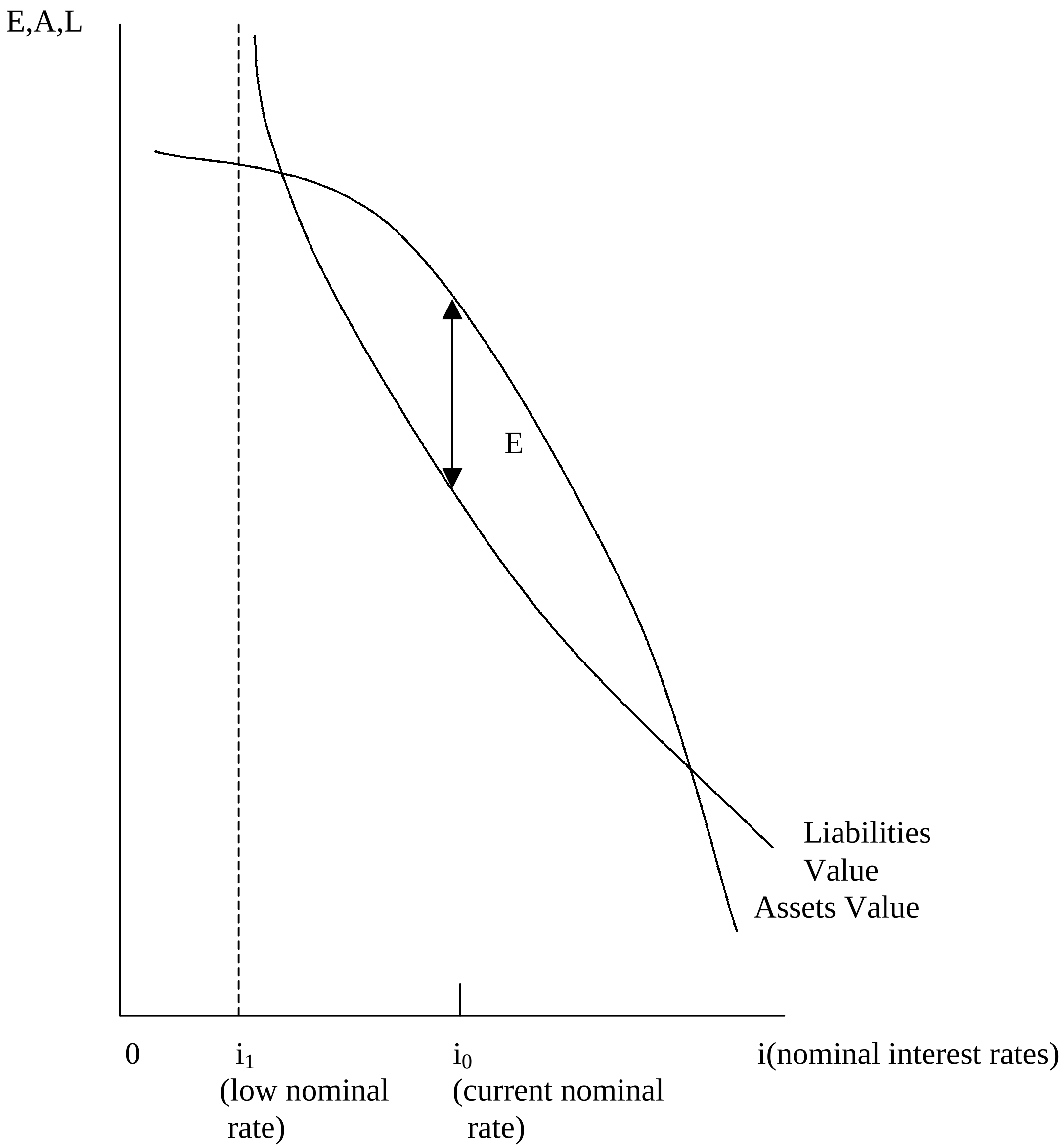
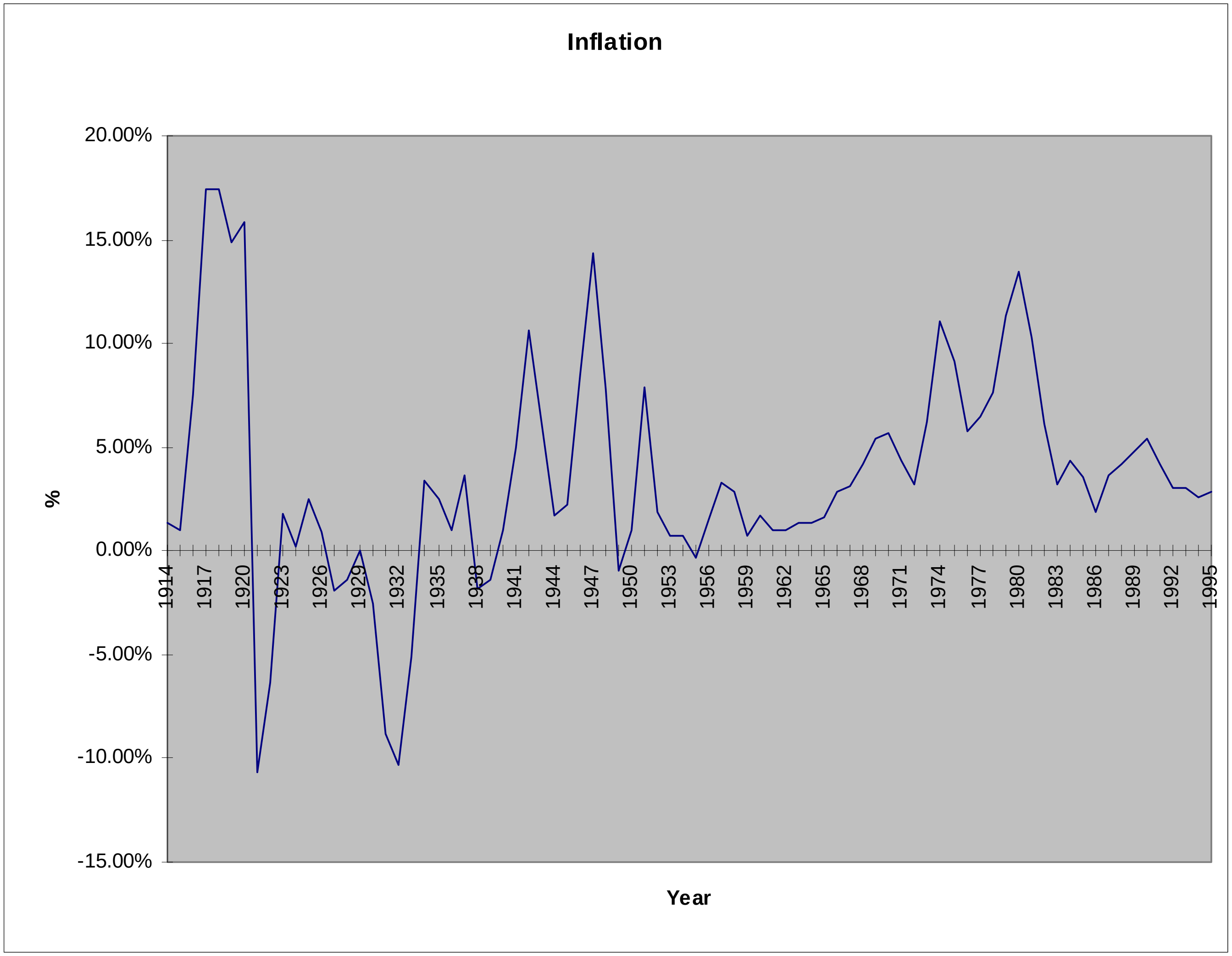


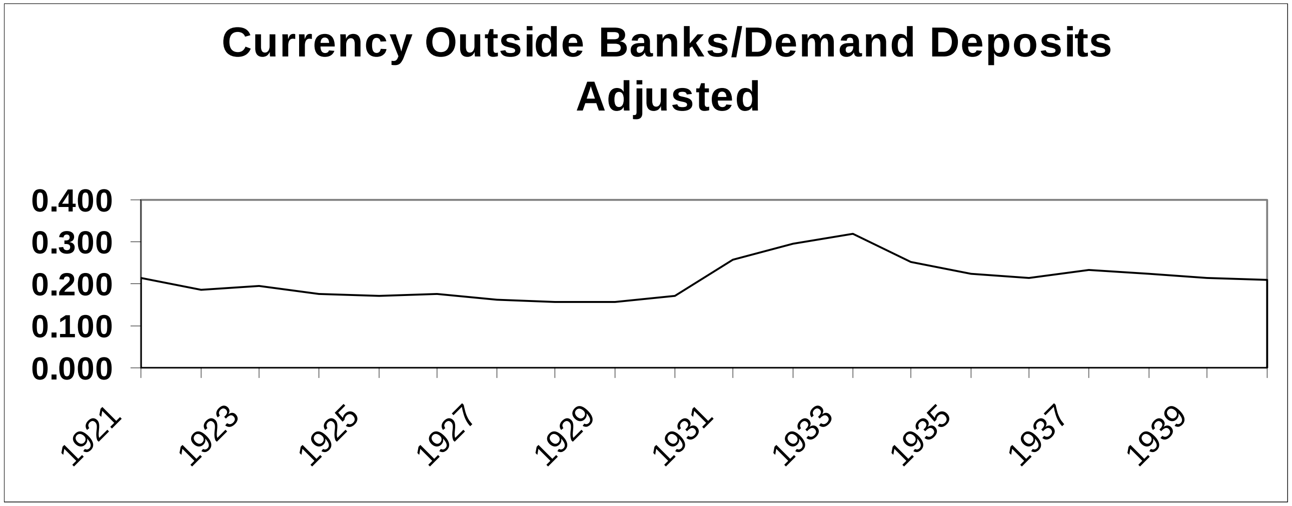
FIGURE 4



Inflation
20.00%
15.00%
10.00%
5.00%
0.00%
-5.00%
-10.00%
-15.00%
%
1914
1917
1920
1923
1926
1929
1932
1935
1938
1941
1944
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
Year

FIGURE 5

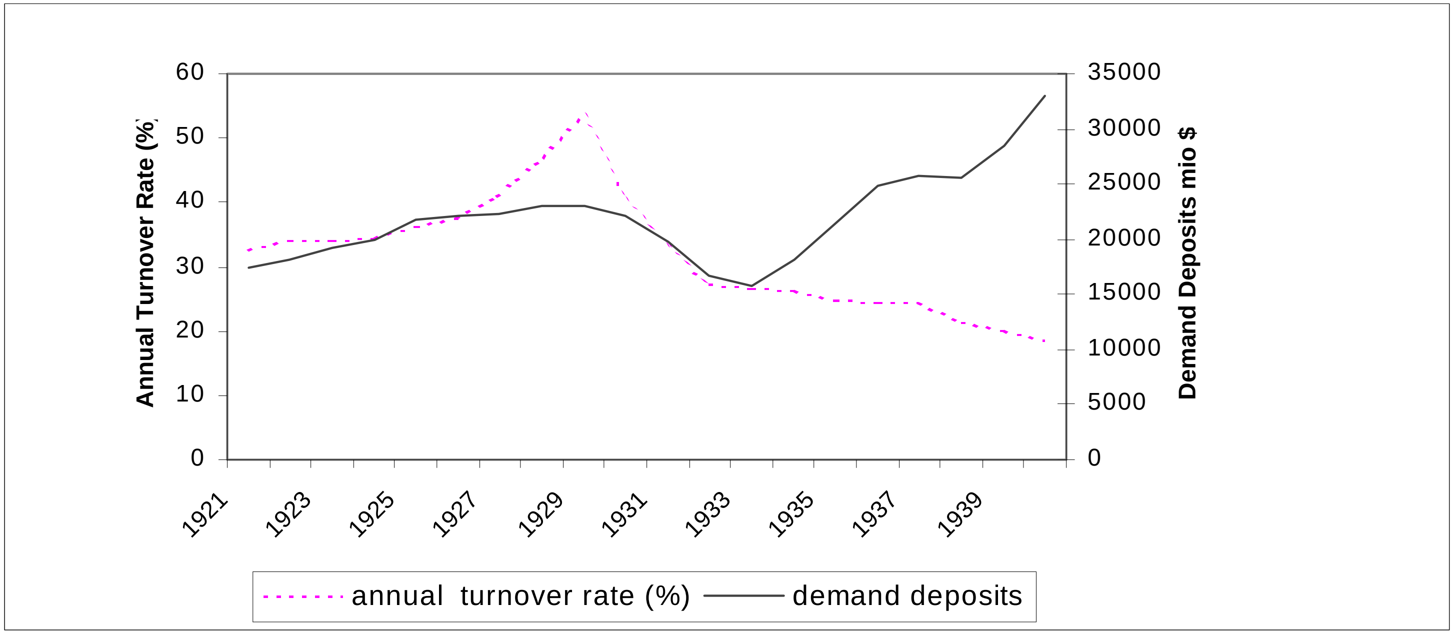
Currency -Deposit ratio for all Banks 1921-1940



SOURCE: Federal Reserve, Banking and Monetary Statistics (November 1943), pp. 34.35.

FIGURE 6

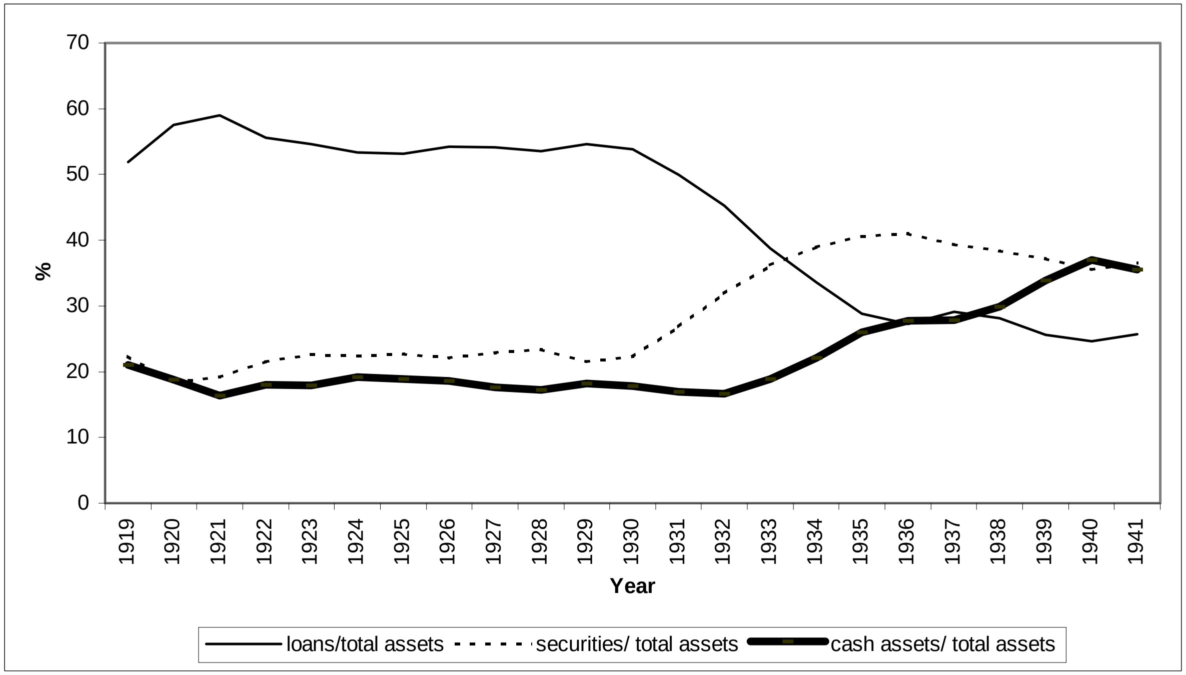
Demand Deposits and Demand Deposit turnover: All Commercial Banks 1921-40



SOURCE: Federal Reserve, Banking and Monetary Statistics (November 1943), pp. 254.

FIGURE 7

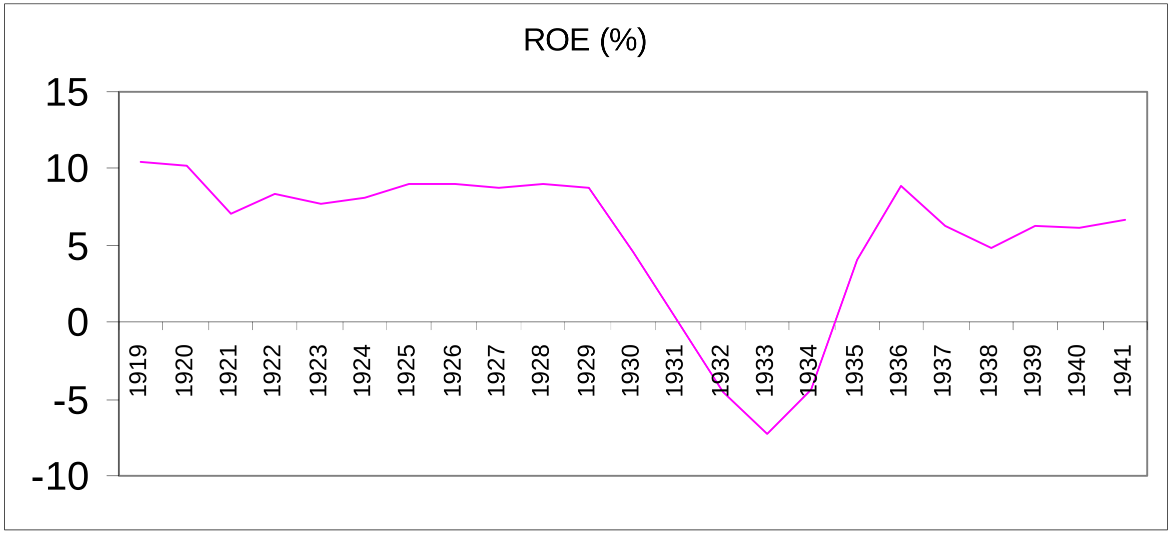
Member Bank Asset Ratios 1919-1941



SOURCE: Federal Reserve, Banking and Monetary Statistics (November 1943), pp. 264-265.

FIGURE 8

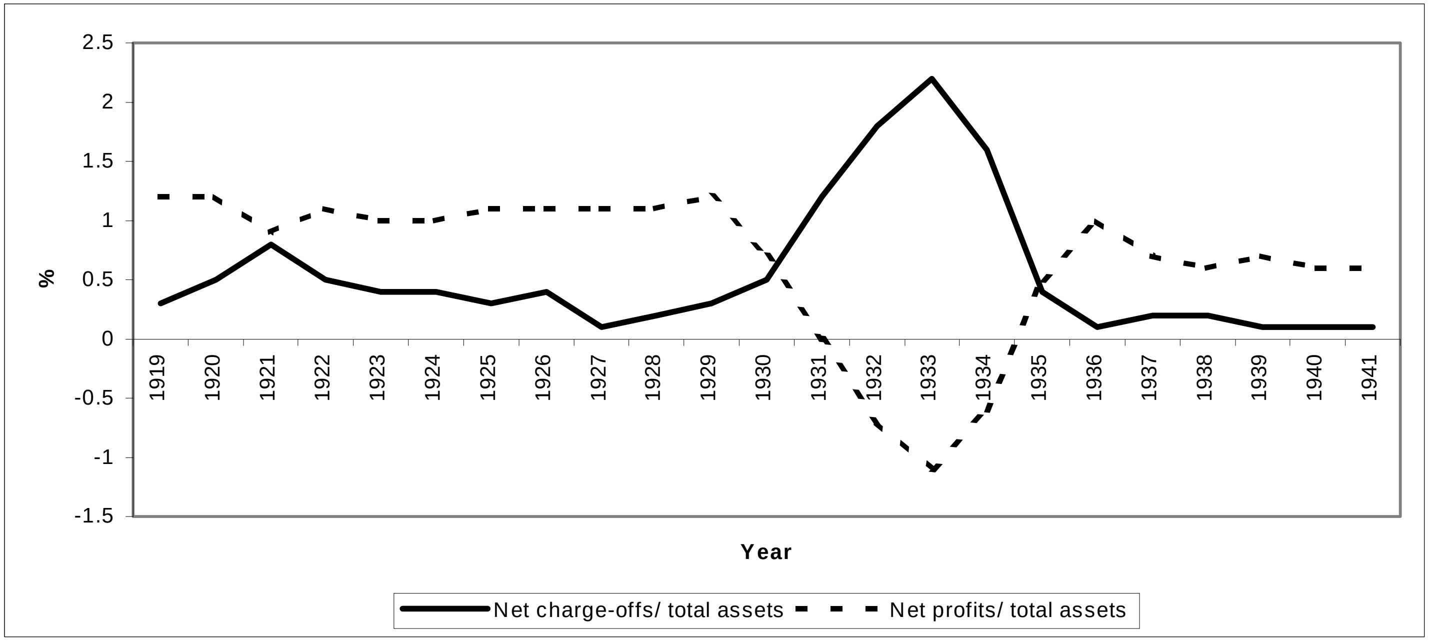
Member Bank ROE 1919-1941



SOURCE: Federal Reserve, Banking and Monetary Statistics (November 1943), pp. 264-265.

FIGURE 9

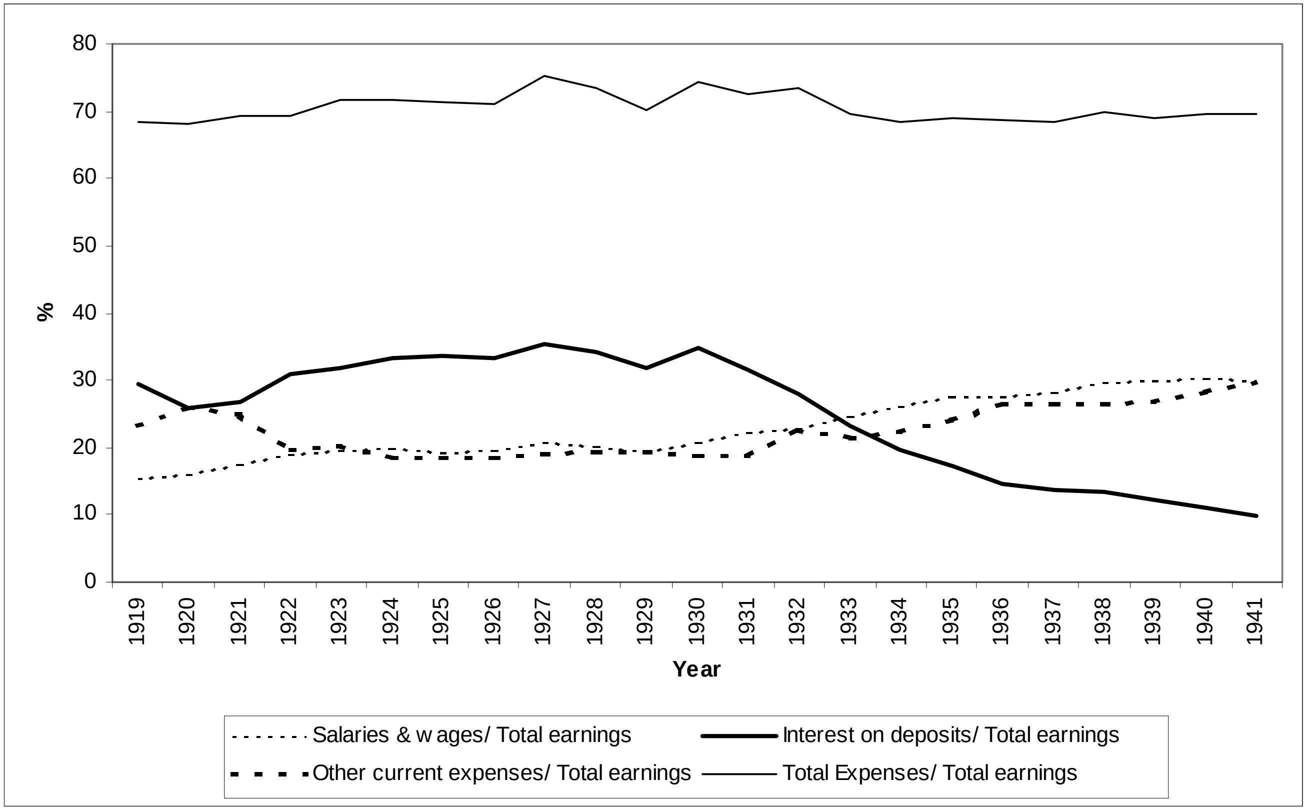
Member Bank ROA and Net Charge Offs/Assets 1919-1941



SOURCE: Federal Reserve, Banking and Monetary Statistics (November 1943), pp. 264-265.

FIGURE 10

Member Bank Expense to Earning Ratios 1919-1941



SOURCE: Federal Reserve Banking and Monetary Statistics (November 1943) pp. 264-265.

ENDNOTES

[1] Source, Bloomberg, 1/14/98 "Some Bank C.D. Rates Hit Four Year lows."

[2] The US CPI inflation rate for 1998 was 1.5% (not seasonally adjusted)

[3] Moreover, 30 year T.bond yields were at 35 years lows.

[4] The 1998 CPI inflation rates in these countries were respectively: 0.3%, 0.5% and 1.5% -- ***Source***: The Economist, January 23rd 1999, pg. 96.

[5] WuDunn (1998), Tett (1998).

[6] The Japanese inflation rate (not seasonally adjusted) was -0.1% for 1998.

[7] The overnight inter-bank lending rate fell to 0.02% in early March 1999. This implies a cost of 27 cents for borrowing $1 million overnight -- "Japan Lowers Rates Again, And for Banks It's a Big Zero," NYT, March, 6th, pp. D1-2.

[8] Technically, deflation is a drop in the general price level. Currently, we have rising prices (but at low rates), i.e., falling inflation rates.

[9] Also, the US experienced a period of price deflation in the late nineteenth century along with a period of sustained economic expansion. Arguably, this is the closest historical approximation to today's US economy of high growth-low inflation. Unfortunately, historical data on financial markets and institutions during this period is somewhat limited.

[10] Although, there has been some debate as to whether the real rate and implicity the MPK can ever become negative in an economy.

[11] Also, it can be shown that if i follows a log-normal diffusion process (with a skewed right tail), while i* is Gaussian, the term structure tends to slope upwards. Moreover, this upward sloping effect is generally consistent with any model that exhibits mean reversion when rates are low. However, the key difference between the Black model and model's such as CIR is that the latter model predicts that volatility declines as interest rates fall, reaching zero when the short-rate is 0% (in order to get a reflecting boundary at zero). Black's model does not require this condition.

[12] Japanese banks have needed dollars to finance their overseas operations.

[13] The negative yield, in part, reflects the "convenience" yield of holding large yen amounts in book-entry form rather than in physical form (e.g., in cash with its related storage costs).

[14] It might be noted that short-rate volatility has increased relative to the level of short rates over this period, which is also consistent with the Black "option" model explanation of an upward sloping term-structure. Specifically, the annual volatility of one-month Japanese T.bill rates (measured as the standard deviation of weekly rates on 1 month bills) was .09% in 1996, .144% in 1997 and .156% in 1998.

[15] The increased steepness of the slope of yield curve is also causing concern for Japanese policymakers -- see, for example, "An Unlikely Fear for Japan: Stiflingly High Interest Rates" New York Times, 2/3/1999, p. D.7.

[16] The Japanese government's interpretation of the steeply sloping yield curve, however, appears to be more consistent with a "preferred habitat" view of yield curve determination. In their view, the slope reflects the government's expansion programs of tax cuts and public works spending financed by long-term bond issues. Indeed, the finance minister has called for "operation twist" like interventions from the BOJ. See New York Times "Japan Is Urged to Halt Surge In Long-Term Rates" New York Times, 2/6/1999 (although the Central Bank appears to be resisting such pressure). In 1998 Japan's budget deficit was 10% of national output, while at its peak, in 1983, the US federal budget deficit reached 6.1%.

[17] Arguably, with the rise in the market value of equities in the 1990s a better measure of exposure might be households ratio of credit market debt to personal income plus the net market value of financial assets. To the extent that the net market value of household assets are insulated from deflation, then households are better able to meet debt obligations. To the extent that consumer liquidity constraints and bankruptcies negatively impact corporate profits and equity returns, then financial asset positions will provide less of a debt-service cushion. Further, to the extent that consumers can refinance debt such as mortgages through early prepayment they are I part hedged against unanticipated decreases in interest rates and inflation.

[18] Anderson (1999) looking at two survey measures of expected inflation -- the quarterly survey of professional forecasters conducted by the Federal Reserve Bank of Philadelphia and the monthly survey of consumers conducted by the University of Michigan, reported that despite the continuing fall of inflation (to 1.6% in 1998), no significant decrease in expected inflation seems to have occurred. These surveys suggest that inflation expectations for 1999 remain at approximately 2.5%. Also while the spread between TIPS (Treasury inflation-protected securities) and similar maturity treasuries narrowed in 1998, this seems to be more a result of illiquidity effects in the TIPS market than a decrease in expected inflation.

[19] The Economist also asserts that the ratio of private sector debt to GDP is currently much higher in Japan than the US (at 200% GDP versus 130% of GDP) -- see the Economist, February 20th, 1999 pp. 22.

[20] The exchange option allowed the bond owner, on maturity, to buy a newly issued T.bond at par with a higher coupon than that of a similar bond in the market. This raised the price of the new bond above par on issue and on occasion made nominal yields negative.

[21] For example in September 1929, 3 month T.bills were 4.89% and 20 year bond yields were 3.50%.

[22] This reflected the deep fall in the value of the dollar and the flight to strong currencies such as the Swiss Franc towards the end of 1978. (Data source: Harris bank data).

[23] According to Baz (1998) the sale of safes is at record levels in Japan.

[24] See Thornton (1999).

[25] Arguably, even slightly risky deposits may be preferable to T.bills to the extent that holding deposits gives better access to other bank services such as loans and payment services. The more risky are deposits, the lower the net benefits of holding then relative to T.bills at the same nominal rate level.

[26] Although, even in the 1920s some bonds traded OTC. For example, Salomon Bros. reportedly shifted bond-trading "upstairs" in the 1920s.

[27] A regression of stock market turnover on inflation produced a slope coefficient that was positive but with a t-ratio of 0.3, *i.e.,* statistically insignificant. For the low inflation/deflation period 1921-1940 ρ was 0.02.

[28] This is also consistent with the BIS (1993) model of measuring interest rate risk exposure. It should be noted that the accuracy of MD as a measure of interest rate sensitivity gets weaker at low rate levels because Δi is no longer symmetric and the yield curve effect is stronger (i.e., it is more problematic to assume parallel shifts in flat yield curves as per the assumptions of Macauley duration). In fact a higher-order measure of duration that takes into account the slope of the yield curve would be preferable (see Saunders (1997)).

[29] These heavily rely on very sort-term purchased funds such as Fed Funds and RPs..

[30] A Federal Reserve (1992) study of 11,916 banks found that the mean modified duration gap was 0.58 years and all but 10% of banks had a positive duration gap.

[31] Also *expected* interest rate changes will be increasingly positive ($\Delta i > 0$) as i goes to zero, thus banks with positive duration gaps may expect to lose net worth with a positive probability. As such they are more likely to take hedging actions to reduce their interest rate risk exposures.

[32] In the context of the duration gap model, securitization reduces the risk to ΔE by shrinking assets (A) in equation (3).

[33] In a world where convexity matters: $\Delta E = -(MD_A - kMD)\, \Delta i + \frac{1}{2}\, (CX_A - k(CX_L))\, \Delta i^2$, where CX_i measures the convexity of respectively assets and liabilities (see Saunders (1997)).

[34] Interestingly, this policy may be consistent with the view held by some analysts that to increase market discipline, banks should issue more subordinated debt (such as callable bonds) as part of their capital structures--see mimeo (1998)

[35] Of course, the bank could recognize the optionality is such contracts and set the refinancing and withdrawal penalties at levels that reflect the fair value of those options.

[36] When divided by earning assets, this becomes the bank's net interest margin.

[37] While wider spreads may produce more "current income" banks will be increasingly exposed to capital losses (shocks to net worth) on any long-term fixed-rate assets. This effect is not captured in profit functions like equation (4).

[38] Although the importance of the prime rate as a base-lending rate has declined over time.

[39] The ratio other income/other expense is a measure of overhead or operational efficiency.

[40] To the extent that cash usage is a substitute to check usage people may make more frequent users of ATMs. Banks are already charging more aggressive fees for ATM usage and studies (e.g., by Humphrey (1994)) have shown economies of scale exist for ATM's.

[41] The impact of low nominal rates on derivatives and off-balance sheet activities has not been discussed here. However, to the extent that hedging through interest rate derivatives becomes more costly (as discussed earlier) due to the asymmetric nature of rate shocks as nominal rates approach the zero bound, the rapid and dramatic growth of these markets may begin to slow down and possibly contract.

[42] Some care has to be taken in interpreting Japanese bank profit figures in recent years. For example, under current financial Reconstruction Commission guidelines, banks are required to make provisions for only 70% of their 7000 billion yen in loans to customers in default and 15% of their 66,000 billion yen in loans to customers who require careful monitoring -- see Financial Times, March 18, 1999, p. 15.

[43] Fiscal year 1998 loan losses are estimated at yen 7.9 trillion.

[44] In 1991 and 1995 spread was respectively 2.3% and 1.9% -- see Goldman Sachs, *Portfolio Strategy*, December 11, 1998, p. 14.

[45] As well as willingness of the MOF and BOJ to bail-out these banks. That is, "Too-Big-To-Fail" and other implicit deposit insurance guarantees no longer appear to be credible in the Japanese context. (Japan has had explicit deposit insurance guarantees since 1971).

[46] Also given near zero rates on Japanese bank deposits and the low-certification value of loan renewal decisions by (low quality) Japanese banks, it is likely that Japanese banks have had to bear an increasing burden of regulatory taxes such as deposit insurance premiums. (Currently 8.4 basis points until March 2001).

[47] The top 15 banks have promised to cut staff by 15% and their branches by 12% in return for public funds as part of the Financial Reconstruction bailout package -- see "A second lease of life" *Financial Times*, March 18, 1999, p. 15.

[48] Goldman Sachs (1998) estimates that U.S. banks are spending annually 0.49% of GDP on technology versus 0.22% in Japan.

[49] Securitization is also difficult in Japan because of the "quality" issue surrounding bank assets and the reluctance of banks to make new loans.

[50] One possible reason for the differential post-crisis response of depositors in Japan compared to the U.S. 1930-33 is the (lower) credibility of implicit and explicit deposit insurance guarantees in contemporary Japan compared to post-1933 U.S.

[51] This of course includes the major assumption that accounting systems are comparable overtime.