Commercial Bank's Off-Balance Sheet Activities and Their Relationship With Market-Based Risk Measures

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The commercial banks in the present deregulated environment are confronted with a number of risk related issues. Management of interest rate risk which was largely ignored until the volatile interest rate period of the 1980s became an important concern, as a result of which a number of new financial products have been developed. These products are mostly off-balance sheet instruments, such as interest rate swaps, futures and forward contracts, options, and securitization. These financial products, in addition to providing fee income, do manage to hedge interest rate risk. However, use of these instruments have led to a plethora of different types of risks for banking institutions. In this study a two stage model is developed. In the first stage, commercial bank stock returns obtained through CRSP files is regressed against a two index model which comprises CRSP equally weighted index and an interest rate proxy. In the second stage of analysis, various on- and off-balance sheet risk measures are regressed against the market-based risk measures obtained through two index model. Containment of heteroskedasticity is achieved through White's adjustment to OLS model. It is evident that size based classification is important in the context of management of interest rate risk by the commercial banks. Large banks are in a stronger position of managing their interest rate risk, whereas small banks are unable to achieve interest rate risk reduction. Furthermore, unsystematic risk provides important risk related information which is significant from the point of view of regulators, managers, uninsured depositors, and undiversified stockholders.

Les activités hors bilan des banques commerciales et leurs relations avec les mesures des risques basées sur le marché

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Résumé

Dans le contexte actuel déréglementé, les banques commerciales font face à un certain nombre de questions ayant trait au risque. La gestion du risque du taux d'intérêt a été largement ignorée jusque dans les années 1980, marquées par une grande volatilité des taux d'intérêt, ce qui a donné lieu à l'élaboration d'un certain nombre de nouveaux produits financiers. Ces produits sont pour la plupart des instruments hors bilan tels que les swaps de taux d'intérêt, les contrats à terme et à terme ferme, les options, et la sécuritisation. Outre les revenus des commissions provenant de ces produits financiers, ceux-ci permettent de se prémunir contre le risque de taux d'intérêt. Toutefois, leur utilisation a provoqué une pléthore de différents types de risques pour les institutions bancaires. La présente étude élabore un modèle à deux phases. Dans la première phase, les rendements des actions des banques commerciales obtenus par les fichiers CRSP sont soumis à une opération de régression selon un modèle à indice double de pondération égale comprenant l'indice CRSP et un indice de taux d'intérêt. Dans la seconde phase de l'analyse, diverses mesures du risque sur bilan et hors bilan font l'objet d'une analyse régressive par rapport aux mesures du risque basées sur le marché obtenues par le modèle à double indice. Le contrôle de l'hétéroskedasticité est obtenu par l'ajustement de White au modèle OLS. Il est évident que la classification d'après les dimensions est importante dans le contexte de la gestion du risque du taux d'intérêt par les banques commerciales. Les grandes banques sont mieux à même de gérer leurs risques de taux d'intérêt, tandis que les petites banques ne parviennent pas à réduire ce risque. De plus, la nature non systématique du risque fournit des informations importantes ayant trait au risque, qui sont significatives du point de vue des régulateurs, des gestionnaires, des déposants non assurés, et des actionnaires non diversifiés.

Commercial Bank's Off-Balance Sheet Activities and Their Relationship With Market-Based Risk measures

1. Introduction

The dramatic rise in bank failures over the past several years along with the perception that banks are resorting to increased risk taking has led to a number of recent regulatory reforms. Several important risk related issues such as, interest rate risk were largely unrecognized until the 1980s. As a result a number of new financial instruments have been developed to offset the increased riskiness of banking institutions. These instruments tend to mitigate interest rate risk. However, use of these financial products have led to completely different types of risks for banking institutions.

There are a number of underlying factors that have caused changes to occur in the riskiness of banking institutions. Beebe (1985) indicates that since 1979 there has been increased volatility in the financial markets and significant regulatory changes have been instituted. Similarly, Santomero (1989) identifies four major forces that have impacted the banking sector, namely, technological innovations in telecommunications and the computer industry, globalization of the market place, advances in financial theory, and important deregulatory changes. These developments led to two major banking reforms, namely, the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980 and the Garn St. Germain Act of 1982. According to Allen and Wilhelm (1988) and Cornett and Tehranian (1990), these

regulatory changes were mandated by the fact that there was growing awareness that financial institutions were inadequately equipped to meet the challenges arising from technological advances, shifting consumer demand for financial services, and volatile interest rates[1].

Another major issue which is likely to significantly impact the riskiness of banking institutions relates to shifts in the monetary policy regimes. The Fed shifted from a federal funds interest rate target to a non-borrowed reserve procedure in October 1979 and then just a few years later, in 1982, a decision was made to deemphasize monetary targeting. These, along with other changes, lead to increased volatility of interest rates (Saunders, Strock and Travlos, 1990). Thus, overall banks now face broader categories of risks, leading to greater variability of returns. These developments have made the issue relating to bank risk a matter of great concern.

Hence, this study develops an analysis of the different components of risk pertaining to banking and their potential impact on the health and viability of an industry which was traditionally a heavily regulated industry. In order to achieve this goal, the study integrates both market-based and the accounting-based risk measures. This study addresses another pertinent question, namely, the proliferation of "off-balance sheet" activities and their impact on the riskiness of banking institutions. These activities

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[1]/ Some critics point out that DIDMCA (1980) increased the power of the Federal Reserve System (Fed) with respect to its ability to conduct monetary policy and therefore increased the regulation on the financial institutions (Allen and Wilhelm).

have allowed banks to avoid certain regulatory costs such as minimum reserve, deposit insurance, and capital adequacy requirements. While, some of the off-balance sheet instruments lead to risk reduction, others increase the risk exposure of the commercial banks. Therefore, the overall impact of off-balance sheet activities on the riskiness of banking institutions is an important empirical question from the point of view of managers, regulators, depositors, uninsured large depositors, investors, and undiversified investors.

The remaining sections are organized as follows. The literature review is presented in the next section. The research hypotheses and methodology is discussed in section 3 while discussion of results is provided in section 4. The paper gives conclusion and implications of the study in the final section.

2. Literature Review

2.1 Market Risk

Risk in the most general sense is defined for a class of utility functions held by risk avertors. In an operational sense, risk illustrates the notion of uncertainty or dispersion associated with an outcome. In the CAPM framework, risk is measured by the variance of possible returns. However, variance is not a universal measure of riskiness.

The first definition of risk is derived from the CAPM framework. If the return generating process is described by the following equation:

Where, $\tilde{R}_{it}$ is the ith banks holding period return in the month

$$\tilde{R}_{it}=\alpha_{oi}+\beta_{mi}\tilde{R}_{mt}+\tilde{u}_{it} \qquad (1)$$

t, $\tilde{R}_{mt}$ represents the holding period return for the market portfolio in month t, and β_{mi} represents the <u>systematic risk</u> which measures the security's sensitivity to market wide events which cannot be diversified away. Flannery and James (1984) and Kwan (1991) report that interest rate volatility has become a major concern. They found that a two index model with a proxy for both interest rate returns and market return may be the most appropriate way to model commercial banks stock returns. Their model is as follows:

$$\tilde{R}_{it}=\alpha_{oi}+\beta_{mi}\tilde{R}_{mt}+\beta_{ki}\tilde{R}_{kt}+\tilde{u}_{it} \qquad (2)$$

Where $\tilde{R}_{it}$ is the ith banks holding period return in the month t, $\tilde{R}_{mt}$represents the holding period return for the market portfolio in the month t, $\tilde{R}_{kt}$ represents the holding period return on a proxy for the risk-free interest rates in month t, β_{mi} represents the systematic risk which measures the security's sensitivity to market wide events, and β_{ki} measures the effect of nominal interest rate changes on bank stock returns, and $\tilde{u}_{it}$ is the error term.

Similarly, including a proxy for interest rate risk $(\tilde{R}_{kt})$, the relationship between total risk and the market-based measures of both interest rate and market risk can be estimated by expanding and taking variance of equation 2 as follows:

$$\sigma^2(\tilde{R}_{it})=\beta_{mi}^2\sigma^2(\tilde{R}_{mt})+\beta_{ki}^2\sigma^2(\tilde{R}_{kt})+2\beta_{mi}\beta_{ki}Cov(\tilde{R}_{mt},\tilde{R}_{kt})+\sigma^2(\tilde{\varepsilon}_{it}) \qquad (3)$$

From equation (3) we can estimate total market risk $\sigma^2(\tilde{R}_{it})$ and two measures of unsystematic risk: one related to short-term rates

and one for long-term rates $[\sigma^2(\tilde{\epsilon}_{it})]$. From equation (2) we derive two measures of systematic market risk: one estimated in conjunction with short-term rates (β^S_{mi}), the other estimated in conjunction with long-term rates (β^L_{mi}) . Finally equation (2) provides two measures of systematic interest rate risk: one for short-term rates (β^S_{ki}) , the other for long-term rates (β^L_{ki}) . Thus, a total of seven risk measures reflecting both systematic, unsystematic, and total risk generated by both market and interest rate movements.

2.2 On-Balance Sheet Risk

In studies by Avery et al. (1988), Furlong (1988), Flannery and James (1984), Jahankhani and Lynge (1980), Brewer and Lee (1986), Flannery (1980), Whalen and Thompson (1988), Avery and Belton (1987), and Saunders, Strock and Travlos (1990) a number of on-balance sheet risk measures have been utilized. There seems to be a general consensus on the following accounting based risk measures.

2.2.1 Gap (GAP)

In a number of studies[2], it has been pointed out that interest rate risk arises since the maturity composition of assets and liabilities may be different and therefore banks may be affected adversely, as changing market interest rates may have a differentiated impact on the value of assets and liabilities. Sensitivity of commercial bank stock returns can also be explained

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[2]/ *See for example studies by Stone (1974), Lynge and Zumwalt (1980), Chance and Lane (1980), Flannery and James (1984), Booth and Officer (1985), Aharony, Saunders, and Swary (1988), and Tarhan (1987).*

by the nominal contracting hypothesis (French, Ruback, and Schwert 1983). Nominal contracts are those assets which have cash flows that are fixed in nominal terms. On the other hand, cash flows generated by real assets fluctuate with the price level. Overall, most of the assets and liabilities of depository financial institutions can be postulated to be nominal contracts. Thus, according to nominal contracting hypothesis, a firms holding of nominal assets is important in order to achieve the objective of maximizing stockholder's wealth. Studies by Fama (1975,1976), Nelson and Schwert (1977), and Fama and Gibbons (1982), established that unexpected changes in interest rate are directly related to inflationary expectations. Hence, the nominal contracting hypothesis supports the notion that unanticipated changes in interest rate would affect a banks' equity value depending on the duration of nominal assets and liabilities held by the firm. The greater the amount of net nominal assets and the longer the duration of these assets, the higher would be the interest rate sensitivity of bank's common stock. The measure used in this study is the difference between interest rate sensitive assets subject to repricing and interest rate sensitive liabilities subject to repricing normalized by the book value of equity.

2.2.2 Credit Risk (CR)

Credit risk relates to the risk associated with the quality of a bank's earning assets, namely its loans. Asset quality is also the second component of a bank's CAMEL rating. Since banks are highly leveraged, Brewer and Lee (1986) contend that large non-performing loans or large security losses can bring about

insolvency. Furthermore, major fluctuations in interest rates can greatly influence the market value of long-term fixed rate assets. Similarly, a decline in asset quality can lead to writeoffs and reduced earnings from the loan portfolio. The measure used in this study is calculated by dividing loan loss provision with total loans.

2.2.3 Capital Adequacy Risk (CAPI)

This is the first component in the bank's CAMEL rating. Capital provides a cushion to protect the position of creditors, depositors, regulators, and insurers (FDIC) in the event of bank failure. Moulton (1987) advocates that bank capital provides a stabilizing influence on the risks faced by the banks. Hence, there is a need to have some minimum level of capital. The relationship between capital levels and market index and interest rate measures of risk is expected to be negative. The measure used in this study is the book value of total capital divided by total assets.

2.2.4 Liquidity Risk (LIQ)

Liquidity risk arises if the bank has to pay a premium over market value in order to fund its assets (see Brewer and Lee 1986). Beaver, Kettler, and Scholes (1970) argue that liquidity risk is reduced if a bank holds greater levels of current assets. Evidently, current assets have less volatile return than long-term assets. On the other hand, banks that have greater holdings of short-term liabilities (deposits and purchased funds), are potentially exposed to liquidity problems if asset quality declines. Jahankhani and Lynge (1980) measure liquidity by taking the ratio of cash and dues plus U.S. treasury securities to total

assets. The liquidity variable used in this study is constructed by taking the ratio of liquid assets net of liquid liabilities to total assets. Liquid assets include cash less required reserves, federal funds sold, U.S. treasury securities, and repurchase agreements (repos). Liquid liabilities include federal funds purchased and reverse repurchase agreements.

2.2.5 Leverage and Operating Risk (OLEV & FLEV)

As indicated by Beaver, Kettler, and Scholes (1970), as additional debt is added the earnings stream of common stock holders shows increased volatility. Hamada (1972) reports that approximately one quarter of systematic risk is explained by the degree of financial leverage. Whereas, Lev contends that operating leverage as measured by fixed cost is the real determinant of the systematic risk. On the other hand, Mandelker and Rhee (1984) find that both operating and financial leverage jointly determine systematic risk. Therefore, if these leverage ratios increase, it may lead to higher variability of bank stock returns and therefore its market risk. Financial leverage is constructed by taking a ratio of total liabilities and total assets while operating leverage is the ratio of interest expense and interest income.

2.2.6 Management Risk (MANGMT)

One of the important causes cited for increased riskiness of banking firm relates to the insiders' improprieties (see for example (Kummer, Arshadi, and Lawrence (1989)). Furthermore, the nature of the fixed rate deposit insurance premium which is similar to the put option issued by the FDIC and held by insured banks, provides incentive to the stockholders and managers to increase the

riskiness of assets. Hence, according to Saunders, Strock, and Travlos (1990) stockholder controlled banks are riskier than owner controlled banks and this difference is more pronounced in a deregulated environment (post DIDMCA period), compared to a regulated environment. Management risk can also be viewed in the context of the expense preference model initially developed by Williamson (1963). According to this theory managers have a tendency to magnify their tangible perquisites which would lead to excess staff and employee benefits, salaries, and other facilities. This aspect was also studied by Scott, Gardner, and Mills (1988) who found that non-profit-maximizing behavior tends to be prevalent under imperfect market structures as a result of which regulated firms such as commercial banks tend to exhibit expense preference behavior. Following these studies on managerial expense behavior a proxy for management risk is constructed by dividing salaries and other benefits with interest + noninterest expense. This measure is expected to be positively related to interest rate and market risk.

2.2.7 Diversification Risk (DIVR)

Diversification risk arises if bank management invests largely in one category of assets. A case in point is the Penn Square bank failure. This bank failed to diversify its loan portfolio as most of its loans were heavily concentrated in the oil industry. The downturn in the energy industry led to heavy loan defaults and thus ultimate failure of the bank (see for example Peavy and Hempel 1988). The Herfindahl Index (HI) can be used to measure the degree of loan portfolio diversification. This increased levels of loan

concentration associated with large HI values (i.e. less loan diversification). Since, greater diversification is expected to lead to less variability in earnings, the HI measure of loan concentration should be positively related to interest rate, market, total, and unsystematic risk measures.

2.2.8 Earnings Variability (ROA)

According to Brewer and Lee (1986), bank equities are affected by the earning power of bank assets. Therefore, if the rate of return on assets is high, the greater would be the equity that would be available to cushion further losses arising from bank operations. Furthermore, a bank's stock price is negatively related to the variability of its rate of return. The proxies suggested by Brewer and Lee are: 1) after tax net income / assets which would have a negative relationship to market-based risk measures, and 2) the ratio of the standard deviation of after-tax net income to total assets, which is expected to have a positive relationship with market risk. The measure used in this study is constructed by dividing net income by total assets (ROA). This measure should be negatively related to the interest rate and market based risk measures.

2.2.9 Bank Size (SIZE)

According to Saunders, Strock, and Travlos (1990), the larger is the size of a bank holding company, the greater will be its ability to diversify away its asset risk. Furthermore, the "too big to fail" doctrine enables large banking firms to maximize the value of implicit failure guarantees associated with deposit insurance and bank closure policy. Hence, the larger bank size,

the lower the riskiness of banking institution on account of asset diversification. To allow for non-linearity in the size-risk relationship, this variable is constructed by taking log of total assets.

2.3 Off-Balance Sheet Activities

Bank's off-balance sheet activities have become an important issue in recent years. According to Johnson and Murphy (1987) and Reichert (1985), in response to increased competitive pressure provided by non-banking firms and foreign financial institutions, commercial banks are increasingly relying on non-traditional earnings sources. Off-balance sheet activities are activities which are not formally reflected on financial statements. These are largely loan commitments and contingencies that generate income and/or hedge risks.

2.3.1 Credit Risk (COMM)

Bennett (1986) claims that off-balance sheet activities lead to credit risk since these activities provide an opportunity to increase leverage significantly without additional regulatory requirements. Cates and Davis (1989) suggest that credit risk due to off-balance sheet activities may be transferred to other bank assets. As an example, if a bank buys an option, interest rate risk may be reduced but credit risk can increase. Of the activities that are likely to contribute significantly to credit risk, loan commitments may be the largest contributor.

2.3.2 Liquidity Risk (COMM)

Bennett (1986) identifies liquidity risk as another element that may contribute to the riskiness of the banking firm when

exposed to off-balance sheet activities. Nevertheless, the bank is exposed to liquidity risk due to these loan commitments. Liquidity risk arises because of the possibility that many customers may decide to borrow from the bank at the same time. This will be especially true in the event that alternative sources of funds may be costlier or simply not available. In order to satisfy this unexpected need of funds, banks may have to compete for funds aggressively. This will raise their funding costs.

2.3.3 Interest Rate Swaps (SWAP)

A swap is a contract that allows banks to change (swap) the interest payment stream from fixed-rate to variable-rate or from variable-rate to fixed-rate between two parties. Loeys (1985) defines an interest rate swap as a transaction whereby two counter parties to the transaction change their exposure to interest rate variability in the opposite direction. Hence, interest rate risk is reduced as this strategy of converting fixed-rate income stream to variable-rate income stream, and vice versa, would shorten the duration of assets or liabilities (see Shaffer 1991 and Bicksler and Chen 1986). The major drawback of swaps is that if the borrower defaults the variable rate/ fixed-rate payment stream stops and it may be difficult for the bank to find a counterparty with equally favorable terms. Hence, McNulty (1990) indicates that interest rate swaps do suffer from credit risk. In this study the riskiness associated with the swap transaction is measured by taking the ratio of interest rate swap exposure to total assets. A negative relationship is expected between the swap measure and interest rate risk.

2.3.4 Interest Rate Futures (FUTUR)

Shaffer (1991) defines interest rate futures contract as one in which a party decides to buy (or sell) a fixed income asset, such as a Treasury security, at a specified price and date in the future. Hence, futures tend to create offsetting cash flows in the future and cash markets to compensate for losses that may arise due to market interest rate movements. Shaffer (1991) indicates that futures on U.S. Treasury securities, apart from hedging interest rate risk, also provide the benefits of negligible default risk, high liquidity, and the fact that Treasury securities tend to move in tandem with general market movement. On the other hand, futures suffer from basis risk and operational problem, but credit risk is minimaly. Hence, in this study the ratio of interest rate futures and total assets should be negatively related to interest rate risky.

2.3.5 Securitization (SECUR)

Benveniste and Berger (1987) define securitization as the process in which illiquid bank assets are pooled and later sold to third parties. The growth of asset securitization can be traced to increasingly costly reserve and capital adequacy requirements. Shaffer (1991) suggests that securitization may reduce interest rate risk since the traditional loan is converted into a stream of payments which has a strong resemblance to a bond. Hence, the assessment of risk for an instrument with the characteristics of a bond makes risk reduction efforts easier. Furthermore, the bank is exposed to interest rate risk only for the period between loan origination and sale. This in turn shortens the duration of the

banks assets. Johnson and Murphy (1987) assert that securitization keeps assets off the balance sheet. But this process creates a contingent claim on banks assets. Nevertheless, through diversification this process should lead to risk reductiony. Thus, the ratio of securitization exposure and total assets should be negatively related to interest rate risk.

3 Methodology

This section describes the research design and methodology. The primary objective of this study is to analyze and assess the potential impact of various off- and on- balance sheet risk measures on the market based measures of risk. Seven alternative market based measures of risk are employed as the dependent variables while various on- and off-balance sheet risk measures are utilized as the independent variables as follows.

To test the hypotheses, that whether increased interest rate risk management through off-balance sheet activities does lead to interest rate risk reduction, the regression model based on equation (4) below will include various on and off-balance sheet variables identified above.

$$BANKRISK_{kt}=\alpha_1+\beta_1 GAP_{kt}+\beta_2 CR_{kt}+\beta_3 CAPI_{kt}+\beta_4 LIQ_{kt}+\beta_5 OLEV_{kt}+\beta_6 FLEV_{kt}+\beta_t MANC$$

$$\beta_8 DIVR_{kt}+\beta_9 ROA_{kt}+\beta_{10} COMM_{kt}+\beta_{11} SWAP_{kt}+\beta_{12} FUTUR_{kt}+\beta_{13} SECUR_{kt}+\beta_{14} SIZE_{kt}+$$

$$\beta_{15} HCPHCM_{kt}+\beta_{16} HCPLCM_{kt}+\beta_{17} LCPLCM_{kt}+\epsilon_{kt} \quad (4)$$

Additionally, the test of this hypothesis enables study of

loan commitments which represents the largest single off-balance sheet activity. However, loan commitments may involve both credit and liquidity risk. But according to the moral hazard and adverse selection hypotheses, the exposure to loan commitments leads to a reduction of credit risk in the spot market.

The data for the accounting based on- and off- balance sheet risk measures were obtained from the FDIC annual call report data. Data on market returns were obtained from the NYSE and OTC CRSP monthly tapes. The time period covered is from 1987-1991. Thus, our estimates of the seven risk measures are generated based upon 60 monthly returns from 1987-91. The accounting measures are an average of the ratios calculated on an annual year-end basis for the same time period (1987-91). The corresponding monthly data for short-term, and long-term interest rates are obtained from Ibbotson and Associates. Short-term interest rates are measured by the 3-month treasury bill rate, and long-term interest rates are measured by 10-year Treasury note rates consistent with Saunders, Strock, and Travlos (1990) approach.

The sample of banks used in the study are those bank holding companies whose stocks are traded in the NYSE or the OTC markets. Hence, generally larger bank holding companies are employed in the study. The data set is further sub-divided into two groups comprising large money center and super-regionals (with total assets > $ 10 billions) and smaller bank holding companies (BHC's) with total assets less than $ 10 billions. Categorization of BHC's on the basis of any scale-related classification will help in identifying impact to hedging techniques adopted by these

institutions.

4 Data Analysis and Results

This section describes the analysis of data and results of the research. Overall, 135 Bank Holding Companies (BHC's) are examined to determine the effect of balance sheet and off-balance sheet risk measures upon total, systematic, and unsystematic risk measures. A number of risk related issues of BHC's are examined incorporating asset management risk, interest rate risk, liability management risk, capital management risk and off-balance sheet activities and securitization.

First, systematic (both market and interest rates based), unsystematic, and total risk measures are constructed. In order to obtain a measure of unanticipated changes in interest rates, the autocorrelation functions of both short-term and long-term interest rates upto lag 12 are reported in Table 1. Also reported is the autocorrelation check of residuals for lag 6 and 12 to ascertain if the interest rate series is a white noise process.

Table 1
Autocorrelations of Tbond and Tbill Series (ARIMA)

Lag (mths)	Tbond	TBill
Lag 1	0.003	0.786
lag 2	0.004	0.740
lag 3	-0.034	0.642
Lag 4	-0.003	0.591
Lag 5	-0.002	0.503
Lag 6	-0.139	0.470
Lag 7	-0.051	0.395
Lag 8	-0.061	0.329
Lag 9	-0.050	0.267
Lag 10	-0.116	0.230
Lag 11	0.101	0.180
Lag 12	0.165	0.128
Chi Square	1.41	156.45*

Autocorrelation Check of Residuals
(Chi-Square)

Lags (mths)	Tbond (AR1)	Tbill (AR1)	Tbill (AR2)	Tbill (AR3)	Tbill (AR4)
6	1.40	12.19**	0.54	0.54	0.38
12	5.98	16.55	7.46	7.48	7.17

The following equation is used to estimate the model:

$$y_t = \theta y_{t-1} + e_t$$

*,** indicates significance at 1 percent and 5 percent level respectively.

The chi-square tests clearly rejects the hypothesis that short-term series is a white noise process, while it is unable to reject this hypothesis for long-term series. Hence, to construct the proxy for unanticipated changes in interest rate series, the short-term series is estimated as a second order autoregressive (AR) process. The residuals from the AR(2) model are used as a proxy for unanticipated changes in short-term interest rates.

These unanticipated changes in interest rates and a market performance index using CRSP equally weighted index returns are employed in a two index model.

Table 2 summarizes the mean, standard deviation, minimum, and maximum of the systematic and unsystematic risk measures.

Table 2
Summary of Systematic and Unsystematic risk measures

	Market Risk		Int. Rate Risk		Unsystematic	
	(LT)	(ST)	(LT)	(ST)	(LT)	(ST)
Overall Sample						
Mean	0.886	0.902	0.242	4.664	0.076	0.077
St.dev.	0.305	0.311	0.468	17.693	0.034	0.034
Maximum	1.672	1.619	1.419	65.432	0.323	0.325
Minimum	0.212	0.196	-1.460	-36.096	0.036	0.036
Large BHC's						
Mean	1.071	1.093	0.600	4.343	0.071	0.073
Std.dev.	0.239	0.230	0.337	14.238	0.018	0.017
Maximum	1.660	1.596	1.419	38.207	0.117	0.118
Minimum	0.654	0.624	-0.190	-36.096	0.043	0.044
Small BHC's						
Mean	0.805	0.818	0.087	4.715	0.079	0.079
Std.dev.	0.296	0.305	0.427	19.057	0.039	0.038
Maximum	1.672	1.619	0.907	65.432	0.323	0.325
Minimum	0.212	0.196	-1.460	-34.959	0.036	0.038

As expected, the average market risk coefficient (beta measure) for large BHC's is closer to unity (1.071) whereas, for small BHC's the average value is around 0.81 indicating that the unsystematic and total risk measures are also important in analyzing the risk profile of these institutions. Interest rate risk coefficient is much larger for large BHC's (0.60) as compared to the small BHC's (0.087). However, the coefficient associated with short-term interest rates on an average is comparable between the two sized based categories. Table 3 provides summarized number and signs of significant coefficients obtained from the two index

market model of the 135 BHC's in the sample.

Table 3
Summary of Number of Significant Interest-rate Coefficients Obtained From Two Index Model

	Interest-Rate Risk (LT rates)	Interest-Rate Risk (ST rates)
No. of positively significant results	37	14
No. of negatively significant results	4	3
Overall Sample Size	135	135

The coefficients associated with CRSP equally weighted index measures systematic market risk, while the coefficients pertaining to interest rate index measures the effect of nominal interest-rate changes on stock returns. Since holding period returns on bonds are negatively correlated with changes in interest rates, therefore a positive interest-rate coefficient implies that equity values are negatively related to interest rate changes. As noted in a number of previous studies, these significant relationships clearly highlight the importance of interest rate movements as they relate to bank stock performance.

With a view to assess the impact of balance sheet and off-balance sheet commercial bank activities upon total, market, interest rate, unsystematic risk measures, heteroskedasticity-adjusted ordinary least square (OLS) regression method was employed. The results for the two size categories and the total sample are presented in the Tables 4, 5 and 6 respectively.

For total sample presented in table 4 the overall fit of the

model can be discerned from the level of R-square. For most of the models R-square is around 40 to 50 percent which indicates that these models are quite well specified. Results for GAP measure demonstrates that it significantly impacts LT interest rate. As expected, the GAP measure shows relationship only with the interest rate risk measure. Another important variable which consistently impacts most of the risk measures is return on assets. It indicates a statistically significant and negative relationship with most of the risk measures. Hence, if a bank holding company generates large and steady profits, its variability of earnings will be reduced, which in turn would significantly reduce its systematic, interest rate, and unsystematic risk. Likewise, loan diversification variable consistently affects most of the risk measures indicating that higher the level of this measure less diversified will be the loan portfolio. Inverse relationship of liquidity with the ST market measure confirms our notion that liquidity's impact should be largely felt on market risk associated with the short-term interest rates. Furthermore, liquidity significantly impacts both total and the unsystematic risk. This result may be expected from the point of view of bankers, regulators, deposit insurers, uninsured creditors, and bank analysts who pay close attention to the liquidity of bank holding companies due to large number of liquidity related bank and thrift failures in 1980's. Credit risk, which indicates quality of bank assets, shows a positive and statistically significant relationship with market risk. Again this may be expected because market would penalize a firm which has lower quality of assets. Finally,

dominant off-balance sheet risk measure is loan commitment which has a positive relationship with the market and interest rate risk measures. Since the sample is skewed in favor of small BHC's, other off-balance sheet activities such as forward and interest rate futures contracts, interest rate swaps and loans securitization which are largely associated with the money center banks and super-regional bank holding companies get averaged out. Hence, the coefficient values associated with these hedging activities are not statistically significant. The significant coefficients for loan commitments suggest that banks entry into these transactions tends to increase both market and interest rate risk arising from higher credit, interest rate, and liquidity risks.

For large BHC's presented in table 5 R-square for most of the models varies between 40 to 60 percent indicating general overall fit of the models. The best model however is the one associated with LT interest rate risk. From Table 5 it may be observed that R-square for this model stood at 58.21 percent and twelve out of the seventeen regression coefficients are statistically significant and have the expected signs. A noteworthy feature of these results is the statistically significant and negative GAP coefficients for both LT and ST interest rate models. It indicates that large BHC's have a tendency to maintain a mismatched GAP position with a view to employ off-balance sheet hedging techniques to reduce their exposure to interest rate risk. On the other hand, return on assets is no longer consistent in terms of reducing the overall risk indicating

that large BHC's tend to have higher variability of earnings as compared to small BHC's. It may also be observed that liquidity measure which impacted the ST market, total, and unsystematic risk measures for the total sample significantly affects the LT interest rate risk for large BHC's. This is indicative of the fact that large BHC's stock price is less sensitive to liquidity risk. Furthermore, the uninsured depositors, management, regulators, and undiversified stock holders are less concerned about large banks liquidity position due to their ability to raise liquidity from the capital markets. The capital risk significantly affects LT and ST interest rate risk since higher capital levels should make a large BHC resilient to interest rate risk. But, capital levels leave market risk largely unaffected which implies that from the point of view of market, large BHC's may not possess capital levels which would reduce riskiness of these institutions. As expected, loan commitments significantly impact both market as well as interest rate risk measures. More importantly, the various hedging techniques seem to have a hypothesized impact on the interest rate risk measures. For instance, SWAP significantly reduces the LT interest rate risk, although it has a positive relationship with ST interest rate risk, implying that main impact of SWAP transactions is upon the LT interest rate risk. On the other hand, loan securitization tends to reduce (statistically significant at 1 percent level) both LT and ST interest rate risk. This finding suggests that use of loan securitization is an effective technique for interest rate risk reduction of large BHC's. With regard to interaction of loan commitments with capital levels, it may be

observed from Table 5 that high capital in conjunction with low loan commitments (best case scenario) significantly reduces interest rate risk when variable relating to low capital in conjunction with high loan commitments (worst case) is the base. Thus, it can be argued that the capital dominates when the capital adequacy hypothesis is tested. Since, small BHC's are less effective in hedging their interest rate risk, it can be argued that they will maintain a GAP measure which is closer to zero. From the Table 5 it may be noted that GAP measure has a weak relationship with only LT interest rate risk.

For small BHC's given in Table 6 the level of R-square is less consistent with values ranging from 20 to 60 percent. As noted earlier, diversification consistently affects all risk measures implying that irrespective of size, diversified portfolio of loans is an important determinant of risk profile of BHC's. For small BHC's however, maintenance of optimal liquidity is important from the point of view of regulators, managers, uninsured depositors, and undiversified investors. This result is expected in view of inability of small BHC's to meet liquidity needs by raising funds from the capital markets. Credit risk is another important risk related measure from the point of view of small BHC's since it significantly impacts the market risk. In contrast, total and unsystematic risk measures were significantly affected for large BHC's. Hence, market tends to penalize small BHC's if their asset quality deteriorates, while it is regulators and managers who are more concerned about the quality of assets for large BHC's. The return on assets significantly influences the total and

unsystematic risk, hence variability of earnings is an important issue from the point of view of managers, regulators, uninsured depositors, and undiversified stockholders for small BHC's. Another notable result pertains to the test of "too big to fail" doctrine. This test can be performed only if small BHC's are considered with varying sizes. The results clearly suggest that the total and unsystematic risks are significantly reduced indicating that it is the regulators, managers, and uninsured depositors who are concerned about the risk reduction due to the size of a BHC. For a diversified stockholder this may not be an important risk related issue. Finally, for small BHC's their exposure to loan commitments significantly increases the total, interest rate, and market risk. Furthermore, these BHC's are unable to hedge their interest rate risk through interest rate swap, interest rate futures and securitization activities. Infact swap transactions tend to increase their market and interest rate risk instead of reducing the risk.

5. Conclusion

The commercial banks in the present deregulated environment are confronted with a number of risk related issues. Management of interest rate risk which was largely ignored until the volatile interest rate period of 1980's became an important concern, as a result of which a number of new financial products have been developed. These products are mostly off-balance sheet instruments, such as: interest rate swaps, futures and forward contracts, options, and securitization. These financial products

in addition to providing fee income, do manage to hedge interest rate risk. However, use of these instruments have led to a plethora of different types of risks for banking institutions. In this study a two stage model is developed. In the first stage, commercial bank stock returns obtained through CRSP files is regressed against a two index model which comprises CRSP equally weighted index and an interest rate proxy. In the second stage of analysis, various on- and off-balance sheet risk measures are regressed against the market-based risk measures obtained through two index model. Containment of heteroskedasticity is achieved through White's adjustment to OLS model. It is evident that size based classification is important in the context of management of interest rate risk by the commercial banks. Large banks are in a stronger position of managing their interest rate risk, whereas small banks are unable to achieve interest rate risk reduction. Furthermore, unsystematic risk provides important risk related information which is significant from the point of view of regulators, managers, uninsured depositors, and undiversified stockholders.

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Table 4

On and Off-Balance Sheet Risk-Measures Against
Market-Based Risk Measures
Heteroskedasticity Adjusted Model

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
			Total Sample				
On-Balance Sheet Variables							
GAP(-)	-0.0014	0.0019	-0.0353	-0.0022	-0.421	-0.0011	0.0001
	(-1.43)	(0.17)	(-2.01)**	(-0.19)	(-0.42)	(-1.14)	(0.04)
CR(+)	0.829	11.385	-1.815	10.828	317.46	0.566	0.447
	(0.93)	(1.65)*	(-0.20)	(1.55)	(0.61)	(0.68)	(0.50)
CAPI(-)	-0.143	-4.422	1.363	-4.757	-5.134	0.161	-1.025
	(-0.35)	(-1.07)	(0.34)	(-1.16)	(-0.02)	(0.43)	(-0.87)
LIQ(-)	-0.087	-0.497	-0.850	-0.575	-8.019	-0.075	-0.145
	(-2.86)***	(-1.47)	(-1.41)	(-1.64)*	(-0.24)	(-2.62)***	(-2.06)**
OLEV(+)	-0.014	-0.252	0.067	-0.355	-30.301	-0.051	-0.256
	(-0.35)	(-0.47)	(0.09)	(-0.68)	(-1.04)	(-1.20)	(-1.29)
FLEV(+)	-0.0088	-0.028	0.117	-0.007	2.289	0.0012	-0.003
	(-1.19)	(-0.45)	(1.18)	(-0.12)	(0.50)	(0.15)	(-0.38)
MANGMT(+)	0.095	-0.279	3.121	-0.007	-14.21	0.028	-0.134
	(1.14)	(-0.33)	(3.40)***	(-0.01)	(-0.26)	(0.35)	(-0.72)
DIVR(+)	0.69	6.884	0.414	8.702	668.910	0.862	0.523
	(2.15)**	(1.98)**	(0.07)	(2.40)**	(2.51)***	(2.52)***	(0.89)
ROA(-)	-3.806	-16.054	31.482	-16.301	-271.18	-4.348	-4.104
	(-2.22)**	(-1.71)*	(2.97)***	(-1.81)*	(-0.46)	(-2.70)***	(-2.69)***
SIZE(?)	-0.0048	0.068	0.118	0.062	-1.537	-0.0079	-0.012
	(-1.52)	(2.01)**	(2.81)***	(1.95)**	(-0.91)	(-2.66)***	(-2.18)**
Off-Balance Sheet Variables							
COMM(+)	0.037	0.797	2.359	1.091	64.81	0.031	0.102
	(1.02)	(1.72)*	(3.78)***	(2.35)**	(2.22)**	(1.03)	(1.41)
SWAP(-)	-0.0013	-0.0031	-0.237	0.002	8.591	-0.0006	0.014
	(-0.19)	(-0.03)	(-1.46)	(0.02)	(1.29)	(-0.07)	(0.83)

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
FUTUR(?)	0.011	-0.294	-0.115	-0.254	-6.714	0.0014	-0.005
	(0.41)	(-0.90)	(-0.21)	(-0.78)	(-0.28)	(0.04)	(-0.14)
SECUR(-)	0.021	-0.329	-2.505	-0.328	10.297	-0.077	0.011
	(0.26)	(-0.43)	(-1.51)	(-0.40)	(0.16)	(-1.05)	(0.08)
Interaction Variables							
HCPHCM	-0.0027	0.055	-0.021	0.103	10.918	-0.0047	0.007
(?)	(-0.59)	(0.88)	(-0.23)	(1.88)*	(2.45)**	(-1.07)	(0.57)
HCPLCM	-0.0069	0.093	0.057	0.127	4.273	-0.0067	0.012
(-)	(-0.10)	(0.95)	(0.37)	(1.36)	(0.60)	(-1.05)	(0.61)
LCPLCM	-0.003	0.017	0.123	0.054	8.106	0.0018	0.027
(?)	(-0.41)	(0.21)	(1.09)	(0.64)	(1.26)	(0.27)	(1.08)
R^2	54.16	36.30	41.20	38.89	6.94	59.72	11.69
N	135	135	135	135	135	135	135

Following Equation is used to estimate the model:

$$BANKRISK_{kt}=\alpha_1+\beta_1 GAP_{kt}+\beta_2 CR_{kt}+\beta_3 CAPI_{kt}+\beta_4 LIQ_{kt}+\beta_5 OLEV_{kt}+\beta_6 FLEV_{kt}+\beta_t MANGMT_{kt}+$$

$$\beta_8 DIVR_{kt}+\beta_9 ROA_{kt}+\beta_{10} COMM_{kt}+\beta_{11} SWAP_{kt}+\beta_{12} FUTUR_{kt}+\beta_{13} SECUR_{kt}+\beta_{14} SIZE_{kt}+$$

$$\beta_{15} HCPHCM_{kt}+\beta_{16} HCPLCM_{kt}+\beta_{17} LCPLCM_{kt}+\epsilon_{kt}$$

Where, GAP represents the gap measure, CR is the credit risk measure, LIQ stands for liquidity, OLEV is a measure for operating leverage, FLEV measures the financial leverage, MANGMT provides a measure for management risk, DIVR stands for loan diversification, ROA is the return on assets. The off-balance sheet risk measures are, COMM which stands for loan commitments, SWAP represent the swap transactions, FUTUR refers to the forward and future contracts, and SECUR stands for securitization. The other measures include SIZE which is log of total assets, and the interaction dummy variables given by, HCPHCM which measures interaction between high capital associated with high commitments. Other measures include, HCPLCM and LCPLCM representing a dummy variable for high capital associated with low commitments and low capital related to low commitments respectively.

*,**,*** represents significance at 10 percent, 5 percent, and 1 percent level respectively.

Table 5
On and Off-Balance Sheet Risk-Measures Against
Market-Based Risk Measures
Heteroskedasticity Corrected Model

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
			Large BHC's				
On-Balance Sheet Variables							
GAP(-)	0.0001	0.028	-0.0625	0.005	-4.105	0.0002	0.00001
	(0.07)	(1.10)	(-3.76)***	(0.22)	(-4.22)***	(0.16)	(0.01)
CR(+)	2.346	16.211	-0.469	9.342	-806.201	2.643	2.612
	(2.63)***	(1.40)	(-0.04)	(0.82)	(-1.94)*	(4.74)***	(4.74)***
CAPI(-)	0.198	-1.298	44.292	0.207	-1048.60	-0.163	0.161
	(0.23)	(-0.13)	(2.52)***	(0.02)	(-2.24)**	(-0.27)	(0.28)
LIQ(-)	-0.044	1.061	-1.630	0.566	-19.381	-0.070	-0.081
	(-0.49)	(0.80)	(-1.95)*	(0.43)	(-0.33)	(-1.32)	(-1.55)
OLEV(+)	-0.002	-1.928	2.512	-1.773	-10.821	-0.041	-0.024
	(-0.03)	(-2.41)**	(3.95)***	(-2.39)**	(-0.29)	(-0.96)	(-0.60)
FLEV(+)	-0.014	-0.033	0.147	0.059	9.602	-0.015	-0.015
	(-2.49)**	(-0.40)	(1.80)*	(1.03)	(2.83)***	(-3.75)***	(-3.93)***
MANGMT(+)	0.135	-4.045	8.681	-1.943	98.861	-0.039	0.027
	(0.98)	(-1.96)**	(7.07)***	(-1.32)	(1.29)	(-0.41)	(0.30)
DIVR(+)	1.238	1.980	19.232	11.656	1140.624	0.709	0.761
	(3.41)***	(0.24)	(3.56)***	(2.59)***	(3.89)***	(2.73)***	(2.97)***
ROA(-)	-1.739	-10.601	19.336	-22.548	-1538.443	-0.346	-0.239
	(-1.15)	(-0.54)	(0.88)	(-1.19)	(-2.42)**	(-0.42)	(-0.28)
SIZE(?)	0.006	-0.013	0.095	-0.050	0.905	0.003	0.003
	(1.27)	(-0.21)	(1.34)	(-0.94)	(0.35)	(0.68)	(0.87)
Off-Balance Sheet Variables							
COMM(+)	-0.010	0.867	1.585	1.296	92.498	0.026	0.029
	(-0.24)	(1.69)*	(3.69)***	(2.74)***	(4.28)***	(1.37)	(1.55)
SWAP(-)	-0.007	0.109	-0.328	0.130	9.708	-0.010	-0.012
	(-0.86)	(1.10)	(-3.34)***	(1.38)	(2.02)**	(-1.35)	(-1.81)*

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
FUTUR(?)	0.019	-0.403	-0.010	-0.436	-22.192	0.040	0.043
	(0.58)	(-0.97)	(-0.03)	(-1.05)	(-1.18)	(1.51)	(1.77)*
SECUR(-)	0.008	0.759	-3.342	-0.062	-133.212	0.113	0.103
	(1.00)	(0.71)	(-3.68)***	(-0.06)	(-2.63)***	(1.90)*	(1.80)*
Interaction Variables							
HCPHCM	-0.0004	-0.098	-0.122	0.004	24.843	-0.001	-0.002
(?)	(-0.04)	(-0.93)	(-0.94)	(0.04)	(5.66)***	(-0.29)	(-0.49)
HCPLCM	-0.0021	0.031	-0.636	0.005	10.306	0.017	0.012
(-)	(-0.21)	(0.24)	(-5.18)***	(0.04)	(0.90)	(3.05)***	(2.32)**
LCPLCM	-0.0032	0.034	0.289	0.006	-0.984	0.002	0.004
(?)	(-0.42)	(0.31)	(2.46)**	(0.61)	(-0.18)	(0.39)	(0.89)
R^2	40.76	3.20	58.21	11.50	46.03	61.10	61.81
N	40	40	40	40	40	40	40

Following Equation is used to estimate the model:

$$BANKRISK_{kt}=\alpha_1+\beta_1 GAP_{kt}+\beta_2 CR_{kt}+\beta_3 CAPI_{kt}+\beta_4 LIQ_{kt}+\beta_5 OLEV_{kt}+\beta_6 FLEV_{kt}+\beta_t MANGMT_{kt}+$$

$$\beta_8 DIVR_{kt}+\beta_9 ROA_{kt}+\beta_{10} COMM_{kt}+\beta_{11} SWAP_{kt}+\beta_{12} FUTUR_{kt}+\beta_{13} SECUR_{kt}+\beta_{14} SIZE_{kt}+$$

$$\beta_{15} HCPHCM_{kt}+\beta_{16} HCPLCM_{kt}+\beta_{17} LCPLCM_{kt}+\epsilon_{kt}$$

Where, GAP represents the gap measure, CR is the credit risk measure, LIQ stands for liquidity, OLEV is a measure for operating leverage, FLEV measures the financial leverage, MANGMT provides a measure for management risk, DIVR stands for loan diversification, ROA is the return on assets. The off-balance sheet risk measures are, COMM which stands for loan commitments, SWAP represent the swap transactions, FUTUR refers to the forward and future contracts, and SECUR stands for securitization. The other measures include SIZE which is log of total assets, and the interaction dummy variables given by, HCPHCM which measures interaction between high capital associated with high commitments. Other measures include, HCPLCM and LCPLCM representing a dummy variable for high capital associated with low commitments and low capital related to low commitments respectively.

*,**,*** represents significance at 10 percent, 5 percent, and 1 percent level respectively.

Table 6
On and Off-Balance Sheet Risk-Measures Against
Market-Based Risk Measures
Heteroskedasticity Corrected Model

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
			Small BHC's				
On-Balance Sheet Variables							
GAP(-)	-0.0019	-0.006	-0.035	-0.008	-0.182	-0.0013	-0.0001
	(-1.95)**	(-0.46)	(-1.71)*	(-0.58)	(-0.16)	(-1.23)	(-0.07)
CR(+)	0.814	14.939	-4.995	17.457	1372.804	0.027	-1.603
	(0.87)	(1.65)*	(-0.33)	(1.91)*	(1.84)*	(0.03)	(-0.94)
CAPI(-)	-0.139	-3.266	-1.043	-3.040	138.131	0.353	-1.480
	(-0.39)	(-0.72)	(-0.22)	(-0.67)	(0.45)	(0.97)	(-0.87)
LIQ(-)	-0.089	-0.425	-0.125	-0.415	7.929	-0.084	-0.155
	(-3.44)***	(-1.20)	(-0.18)	(-1.08)	(0.19)	(-3.06)***	(-2.05)**
OLEV(+)	0.068	0.676	-0.781	0.719	38.451	-0.052	-0.542
	(1.33)	(0.84)	(-0.60)	(0.90)	(0.62)	(-0.86)	(-1.20)
FLEV(+)	-0.018	-0.038	-0.012	-0.055	-8.672	0.013	-0.009
	(-0.95)	(-0.28)	(0.06)	(-0.41)	(-0.86)	(0.62)	(-0.35)
MANGMT(+)	0.129	0.544	2.855	0.720	28.561	0.006	-0.317
	(1.95)**	(0.64)	(2.30)**	(0.93)	(0.39)	(0.07)	(-1.02)
DIVR(+)	0.635	7.455	-6.525	8.293	560.65	0.927	0.099
	(2.11)**	(1.83)*	(-0.98)	(1.87)*	(1.86)*	(2.72)***	(0.10)
ROA(-)	-3.648	-10.258	23.989	-7.728	766.93	-5.069	-6.604
	(-2.34)**	(-0.98)	(1.39)	(-0.75)	(0.96)	(-3.07)***	(-3.47)***
SIZE(?)	-0.012	0.006	0.025	0.002	-2.717	-0.010	-0.007
	(-2.79)***	(0.12)	(0.32)	(0.04)	(-0.95)	(-2.49)**	(-1.04)
Off-Balance Sheet Variables							
COMM(+)	0.044	1.174	2.244	1.423	78.075	-0.031	-0.007
	(1.03)	(1.86)*	(2.18)**	(2.17)**	(1.57)	(-0.66)	(-0.08)
SWAP(-)	-0.049	1.559	0.860	2.113	260.05	-0.190	-0.060
	(-0.43)	(1.27)	(0.48)	(1.61)	(3.39)	(-1.76)*	(-0.25)

Variables	Total Risk	Mkt. Rsk (LT Rate)	Int. Rsk (LT Rate)	Mkt. Rsk (ST Rate)	Int. Rsk (ST Rate)	Unsys. (LT Rate)	Unsys. (ST Rate)
FUTUR(?)	-0.103	0.960	0.841	1.075	40.157	-0.074	-0.451
	(-0.98)	(1.26)	(0.46)	(0.85)	(0.62)	(-0.74)	(-0.95)
SECUR(-)	-0.449	-1.909	-2.362	-2.290	-141.072	-0.508	-0.302
	(-1.37)	(-0.58)	(-0.70)	(-0.61)	(-0.42)	(-1.76)*	(-0.50)
Interaction Variables							
HCPHCM	-0.009	0.098	-0.042	0.093	-1.743	-0.013	0.017
(?)	(-1.37)	(0.98)	(-0.24)	(0.91)	(-0.23)	(-2.00)**	(0.60)
HCPLCM	-0.015	0.164	0.141	0.165	-2.448	-0.024	0.008
(-)	(-1.62)	(1.08)	(0.57)	(1.08)	(-0.22)	(-2.67)***	(0.24)
LCPLCM	-0.007	0.120	0.129	0.137	5.675	-0.012	0.019
(?)	(-0.87)	(0.96)	(0.73)	(1.05)	(0.60)	(-1.46)	(0.60)
R^2	59.65	24.13	20.72	24.95	5.33	63.23	8.19
N	95	95	95	95	95	95	95

Following Equation is used to estimate the model:

$$BANKRISK_{kt}=\alpha_1+\beta_1 GAP_{kt}+\beta_2 CR_{kt}+\beta_3 CAPI_{kt}+\beta_4 LIQ_{kt}+\beta_5 OLEV_{kt}+\beta_6 FLEV_{kt}+\beta_t MANGMT_{kt}+$$

$$\beta_8 DIVR_{kt}+\beta_9 ROA_{kt}+\beta_{10} COMM_{kt}+\beta_{11} SWAP_{kt}+\beta_{12} FUTUR_{kt}+\beta_{13} SECUR_{kt}+\beta_{14} SIZE_{kt}+$$

$$\beta_{15} HCPHCM_{kt}+\beta_{16} HCPLCM_{kt}+\beta_{17} LCPLCM_{kt}+\epsilon_{kt}$$

Where, GAP represents the gap measure, CR is the credit risk measure, LIQ stands for liquidity, OLEV is a measure for operating leverage, FLEV measures the financial leverage, MANGMT provides a measure for management risk, DIVR stands for loan diversification, ROA is the return on assets. The off-balance sheet risk measures are, COMM which stands for loan commitments, SWAP represent the swap transactions, FUTUR refers to the forward and future contracts, and SECUR stands for securitization. The other measures include SIZE which is log of total assets, and the interaction dummy variables given by, HCPHCM which measures interaction between high capital associated with high commitments. Other measures include, HCPLCM and LCPLCM representing a dummy variable for high capital associated with low commitments and low capital related to low commitments respectively.

*,**,*** represents significance at 10 percent, 5 percent, and 1 percent level respectively.