

Interest Rate Sensitivity of Banking Stock Returns in India

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Abstract

Besides market risk, banking stocks are also subject to interest rate risk due to the simple fact that banking profitability is a function of prevailing interest rate. This paper examines the effects of interest rate changes on banking stock returns in India using the multivariate OLS and GARCH estimation models over the period 1st April 1996-31st March 2011. The sample consists of 18 commercial bank stocks comprising BANKEX listed on Bombay stock exchange. We find a negative but weak relationship between Bank stock returns and interest rate changes in India. As expected, banking stock returns exhibit significant positive relationship with market returns. However interest rate volatility is found to affect significantly the stock volatility in case of most of the banks in India. Hence although interest rate movements may not significantly affect banking stock returns in India but stock's volatility is significantly affected by the interest rate volatility. These results have important implications for policy regulators, bank managers and investing community at large. The investing community should refrain from investing in banking stocks in times of high interest rate volatility. The bank managers may adopt policies and strategies so as to lower the impact of interest rate volatility on stock return. The policy regulators need to ensure that interest rate volatility does not get transmitted into banking stock returns for the stability of financial system in India.

Keywords: Bank Stock Returns, Interest Rate Sensitivity, Market Risk, GARCH.

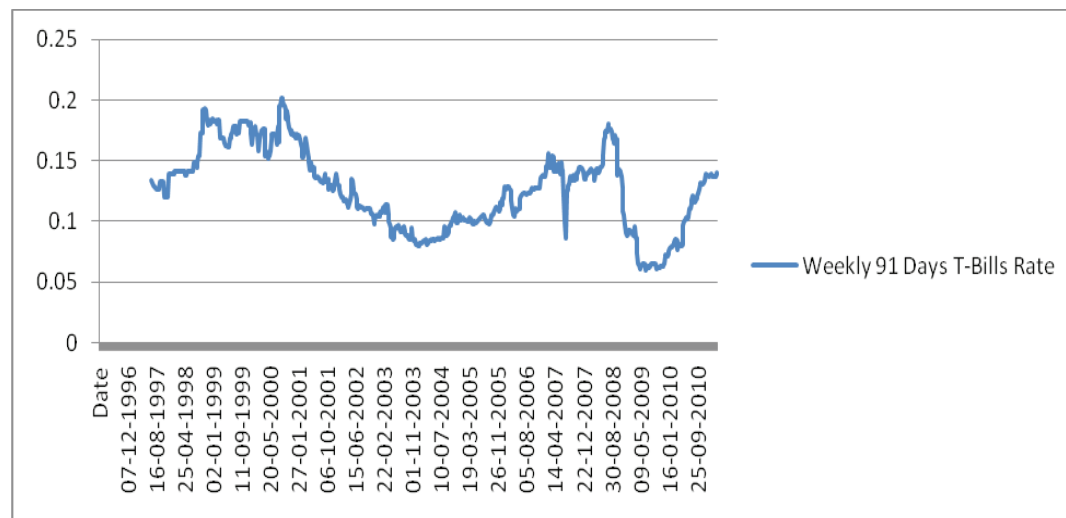
1. Introduction

A sound and effective banking system is a pre-requisite for the rapid development of any economy. India being one of the advanced emerging economies has a well-developed banking system. The banking system of India has grown manifold and extended its reach to the remote corners of the country due to the rigorously followed financial inclusion policy of the Government of India. Since its origin in the 18th century the government of India nationalized 14 large commercial banks in the year 1969. A second phase of nationalization of 6 more commercial banks followed in 1980. In the early 1990s, Narasimham Rao Government embarked on a policy of financial liberalization, which witnessed entry of private banks and foreign banks. This move, along with rapid growth of the economy, revitalized banking sector in India which in turn leads to rapid growth of banking sector with strong contributions from all the three sectors of banking industry i.e. Government banks, private banks and foreign banks.

Before financial liberalization, interest rates were administered and exhibited near-zero volatility. The easing of financial repression and deregulation of interest rate since 1990s has now generated some experience with interest rate volatility in India. Administrative restrictions on interest rates in India have been steadily eased since 1993. This has led to increased interest rate volatility. Figure 1 show the recent time series of 91-days T-bills implicit yield which indicates towards increased volatility of interest rate in India.

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Figure 1: Time Series of Weekly 91 Days T-Bills Implicit Yield at Cut-Off Price

Arbitrage Pricing Theory (APT) as developed by Ross (1976) argued that a number of systematic factors, and not just market factor (captured by market risk premium) explain significantly stock returns. A number of systematic factors which have been shown to have empirical relationship with stock returns include- unanticipated changes in interest rates, inflation rate, index of industrial production, trade deficit etc. Since banking companies costs and revenues depend heavily on interest rates, it is obvious to assume that banking stocks are vulnerable to interest rate movements. The nominal contracting hypothesis postulates that a firm's holding of nominal assets plays an important role in explaining the behavior of common stock returns through the redistributive effects of unanticipated inflation and unanticipated changes in expected inflation (French et al., 1983). If movements in the term structure of interest rates (i.e. unanticipated changes in the level of interest rates) result primarily from changes in inflationary expectations, then the nominal contracting hypothesis implies a relation between common stock returns and interest changes. In particular the interest rate sensitivity of a firm's common stock returns will depend upon the firm's holding of net nominal assets and maturity composition of net nominal assets held. The higher the proportion of net nominal assets and the longer the maturity of net nominal assets held, the more sensitive should be the firm's common stock returns to interest rate changes. The co-movement of stock returns and interest rate changes is positively related to the size of the maturity difference between the firm's nominal assets and liabilities (Flannery and James,

1984). Common stock returns of banks listed in Athens stock exchange exhibit significant sensitivity to interest rate movements. Working capital was found as the variable that may account for the cross-sectional variation of the interest rate sensitivities providing evidence for the nominal contracting hypothesis (Drakos, 2001).

The relationship between interest rate movements and bank common stock returns has been the focus of a considerable amount of research in recent years. The impact of interest rate on bank stock returns provides important implications for monetary policy, risk-returns analysis, financial securities valuation and government policy towards financial markets. Interest rate is one of the important macroeconomic variables which are closely related to economic growth in the country. Interest rate is generally regarded as the cost of capital as it is the price paid for using the money for a certain period of time. From the point of view of a borrower, interest rate is the cost of borrowing money and from the point of view of a lender, interest rate is the fee charged for lending money. Therefore, if the rate of interest paid by banks to depositors increases, people will switch their money from capital market to banks. This in turn, will decrease the demand of shares and capital investment in an economy (Ologunde et al., 2006). Hence, theoretically there is inverse relationship between Stock returns and Interest rate. Stock returns sensitivity to interest rates was theoretically advocated by Long (1974) and Stone (1974). The Stone's model includes an interest rate change factor in addition to the traditional market index for explaining bank stock returns.

The issue of interest rate sensitivity of bank common stock returns is of major interest for regulators, banks and academics and hence a voluminous amount of research has explored the issue. Empirical studies have provided substantial evidence for bank stock returns exhibiting statistically significant inverse relationship with interest rate changes (Alam and Uddin, 2009; Aspren, 1989; Ballester et al., 2011; Benink and Wolff, 2000; Brewer et al., 2007; Choi et al., 1992; Choi and Jen, 1991; Dinesis and Staikouras, 1998; Elyasiani and Mansur, 1998; Flannery and James, 1984; Lyngne and Zumwalt, 1980; Singh and Arora, 2010). The recent studies for the US banking sector have concluded that interest rate sensitivity has decreased in the late 1980's and early 1990's due to the availability of interest rate derivative contracts for hedging purposes (Benink and Wolff, 2000).

The bulk of the research has almost exclusively focused on the developed countries especially US banking sector. Hence, the objective of this study is to investigate the interest rate sensitivity of the banking stock returns in India, which is one of the advanced emerging markets of the world. We also examine whether there is any impact of interest rate volatility on banking stock volatility in India. The contribution of this paper to the related literature is two folds; First, it provides empirical evidence regarding the relationship between interest rate changes and banking stock returns in India, the financial system of which is considered to be relatively more stable than those of other Asian and European countries. Second, we apply robust econometric methodology to examine such a relationship. Besides using multivariate OLS regression, we also use GARCH (1, 1) model to capture the impact of interest rate volatility on banking stocks volatility in India.

2. Literature Review

Kasman et al. (2011) investigated the effects of interest rate and foreign exchange rate changes on Turkish banks stock returns using the OLS and GARCH estimation models. The results suggest that interest rate and exchange rate changes have a negative and significant impact on the conditional bank stock return. Bank stock return sensitivities are found to be stronger for market return than interest rates and exchange rates. The results further indicate that interest-rate and exchange rate volatility are the major determinants of the conditional bank stock return volatility. Leon (2008) investigated the effect of interest rate volatility on stock market returns and found that conditional market return have a negative and significant relation with interest rates while the conditional variance of returns has a positive but

not significant relation with interest rates. Christie (1982) in his study found that the riskless interest rate has a strong positive effect on volatility.

In the Australian context, Faff et al. (2004) investigated the dual impact of changes in interest rate and interest rate volatility on the distribution of Australian financial sector stock returns. They also analyze the impact of deregulation and found that the deregulation has changed the fundamental relationship between interest rate and large bank stock excess returns from positive in the pre-deregulation period to negative in the post-deregulation period.

In the Spanish context, Ballester et al. (2011) analyzed the interest rate exposure of the Spanish banking industry by employing both parametric and non-parametric estimation models and found that the Spanish banking sector exhibits a remarkable degree of interest rate exposure, although the impact of interest rate changes on bank stock returns have significantly declined following the introduction of the Euro.

Simpson and Evans (2003) utilised the cointegration and Granger causality test to examine the long term relationship between bank stock returns and macroeconomic variables including interest rates and exchange rates and found that there exist a cointegration relationship. Evidence is presented that causality runs from bank stock returns to interest rates and exchange rates. Sweeney and Warga (1986) addressed the issue that whether firms are required to pay an ex-ante premium to investors for bearing the risk of interest-rate changes by using two factor APT model and found that most of the interest-sensitive stocks are in the utility industry and interest factor is priced in the sense of the APT.

Therefore, studying the effects of interest rate movements on bank stock returns in India is one of the advanced emerging markets of the world is of great significance for policy design. Additionally, knowledge about the nature of this relationship can also provide valuable information for portfolio management purpose.

3. Data and Methodology

The sample consists of 18 commercial bank stocks comprising BANKEX a sectoral index of bank stocks listed on BSE. These major banks represent banking industry in India and have continuous available prices. The study period spans from 1st April 1996 to 31st March

2011 (i.e. 782 weekly observations). However, for each bank the sample period varies for closing share prices due to data availability constraints. The sample period for each bank is reported in Table 1. The banks included in the sample are Allahabad Bank, Axis Bank, Bank of Baroda, Bank of India, Canara Bank, Federal Bank, HDFC Bank, ICICI Bank, IDBI Bank, Indian Overseas Bank, Indusind Bank, Karnataka Bank, Kotak Mahindra Bank, Oriental Bank of Commerce, Punjab National Bank, State Bank of India, Union Bank of India, Yes Bank. The return on the BANKEX i.e. banks index in India is used as a proxy for the aggregate returns for the banking sector in India. The prime index of Bombay Stock Exchange (BSE Sensex) is used as the proxy for market portfolio. Sensex comprises of 30 stocks listed on BSE and is considered to be the nerve of Indian stock market. The weekly share prices of banks, Bankex index values and Sensex values are obtained from prowest database. There are various interest rates prevailing in India which could affect bank stock returns namely Bank rate, Repo rate, Reverse repo rate, Deposit rate, Call money rate and Treasury bill rate. The central bank of India (the Reserve Bank of India) administers repo rate, reverse repo rate and bank rate through its monetary and credit policy. Deposit rate is aligned to the repo rate and is decided by individual banks. Call money rate is very short term interest rate and hence not useful for the purpose. T-bill rate is the only interest rate in India which is not regulated and hence determined by the forces of demand and supply. Hence, the interest rate variable used in the study is weekly 91 days T-bills implicit yield at cut-off price obtained from RBI website (rbi.org). The continuously compounded weekly returns for the data are computed as $r_t = 100 \ln(p_t/p_{t-1})$. p_t is the stock price at time period t and p_{t-1} is the stock price at time $t-1$.

Table 1: Sample Period

Variables	Sample period
Allahabad Bank	30/11/2002-31/03/2011
Axis Bank Ltd.	28/11/1998-31/03/2011
Bank of Baroda	01/03/1997-31/03/2011
Bank of India	10/05/1997-31/03/2011
Canara Bank	28/12/2002-31/02/2011
Federal Bank Ltd.	01/04/1996-31/03/2011
HDFC Bank Ltd.	01/04/1996-31/03/2011
ICICI Bank Ltd.	27/09/1997-31/03/2011
IDBI Bank Ltd.	01/04/1996-31/03/2011

Variables	Sample period
Indian Overseas Bank	16/12/2000-31/03/2011
Indusind Bank Ltd.	31/01/1998-31/03/2011
Karnataka Bank Ltd.	27/04/2002-31/03/2011
Kotak Mahindra Bank Ltd.	01/04/1996-31/03/2011
Oriental Bank Of Commerce	01/04/1996-31/03/2011
Punjab National Bank	27/04/2002-31/03/2011
State Bank of India	01/04/1996-31/03/2011
Union Bank of India	28/09/2002-31/03/2011
Yes Bank Ltd.	16/07/2005-31/03/2011
Bankex	01/01/2002-31/03/2011
Sensex	01/04/1996-31/03/2011

The data has been analyzed using descriptive statistics, unit root test, multivariate OLS regression analysis and GARCH (1, 1) model. In order to check for the stationarity property of the time series, we applied Augmented Dicky Fuller (ADF) unit root test.

3.1. Multivariate OLS Regression Analysis

The following model is employed to test the impact of market return and interest rate changes on stock returns.

$$r_t = \beta_0 + \beta_1 MRK_t + \beta_2 \Delta INT_t + \mu_t \quad (1)$$

Where r_t is the return of bank stock at time t ; β_0 is the intercept term; MRK_t is the return on the market index i.e. sensex returns; ΔINT_t is the changes in interest rate and μ_t is the error term.

3.2. GARCH (1,1) Model

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) process, introduced by Bollerslev (1986), is estimated as follows:

$$r_t = \gamma_0 + \gamma_1 MRK_t + \gamma_2 \Delta INT_t + \varepsilon_t \quad (2)$$

$$\sigma^2_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \sigma^2_{t-1} \quad (3)$$

Where r_t is the return of bank stock at time t ; γ_0 is the intercept term; MRK_t is the return on the market index i.e. sensex returns; ΔINT_t is the changes in interest rate; α_0 is the average volatility; α_1 is the previous period's residual variance the ARCH term and α_2 is the previous

period's forecast variance the GARCH term. The GARCH specification requires that in the conditional variance equation, parameters α_0 , α_1 and α_2 should be positive or non-negative and the sum of α_1 and α_2 should be less than one to secure the covariance stationarity of the conditional variance. Moreover the sum of coefficients α_1 and α_2 must be less than or equal to unity for stability to hold.

Again, the following GARCH (1, 1) model is used to examine the effect of interest rate volatility on individual bank stock returns volatility and Bankex returns volatility.

$$r_t = \gamma_0 + \varepsilon_t \quad (4)$$

$$\sigma^2_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \sigma^2_{t-1} + \theta_1 INT_t^2 \quad (5)$$

Where r_t is the return of bank stock at time t ; γ_0 is the intercept term; α_0 is the average volatility; α_1 is the previous period's residual variance the ARCH term; α_2

is the previous period's forecast variance the GARCH term and θ_1 is the measure for sensitivity of stock return volatility to interest rate volatility.

4. Empirical Results

Table 2 reports the descriptive statistics for the weekly returns of the individual bank stock, Bankex, Market index and changes in the interest rate for the period 1st April 1996- 31st March 2011. The mean rate of return is highest for the Punjab National Bank and the standard deviation which shows variability in returns is highest for the Kotak Mahindra Bank during the sample period. The return distribution is positively skewed in 13 out of 21 cases. The large value of kurtosis statistics (>3) indicate that the data is leptokurtic and sharply peaked about the mean, whereas for a value of (<3) the curve is less peaked than the normal curve i.e. platykurtic. The assumption of normality of stock returns is strongly rejected for all the

Table 2: Descriptive Statistics

Name	Mean	Max	Min	SD	Skewness	Kurtosis	Jarque-Berra	ADF(t-value)
Allahabad Bank	0.0071	0.2902	-0.2681	0.0640	0.1784	5.9525	159.9505*	-21.6829*
Axis Bank Ltd.	0.0068	0.3807	-0.2411	0.0681	0.2838	5.4003	162.9879*	-26.3058*
Bank of Baroda	0.0030	0.2683	-0.3201	0.0695	0.1169	4.7272	92.9121*	-27.9778*
Bank of India	0.0025	0.2684	-0.2920	0.0714	0.1109	4.6245	81.0954*	-28.5061*
Canara Bank	0.0058	0.2500	-0.2868	0.0645	-0.2070	4.2683	31.8899*	-22.2231*
Federal Bank Ltd.	0.0023	0.3094	-0.3417	0.0711	0.0874	6.3989	376.9500*	-27.0661*
HDFC Bank Ltd.	0.0054	0.3589	-0.2250	0.0518	0.5319	6.9311	539.7346*	-30.4215*
ICICI Bank Ltd.	0.0043	0.3818	-0.3261	0.0737	0.2268	6.4520	355.5842*	-17.3683*
IDBI Bank Ltd.	0.0009	0.3587	-0.3377	0.0725	0.2868	6.4137	389.9258*	-26.3894*
Indian Overseas Bank	0.0051	0.2450	-0.3992	0.0679	-0.4235	6.7164	324.4811*	-23.9798*
Indusind Bank Ltd.	0.0027	0.3774	-0.2573	0.0774	0.3716	4.9786	127.6855*	-25.8742*
Karnataka Bank Ltd.	0.0039	0.4456	-0.2294	0.0693	1.0963	8.1686	610.7460*	-19.3448*
Kotak Mahindra Bank Ltd.	0.0050	0.3841	-0.3655	0.0873	0.5522	6.3056	395.2718*	-26.3676*
Oriental Bank of Commerce	0.0021	0.2208	-0.3148	0.0630	-0.1011	4.9313	122.7210*	-27.1029*
Punjab National Bank	0.0074	0.2806	-0.3320	0.0627	0.1056	5.9284	167.0167*	-13.7127*
State Bank of India	0.0031	0.2774	-0.2246	0.0585	0.2383	5.6651	238.5558*	-27.8281*
Union Bank of India	0.0070	0.2158	-0.4370	0.0645	-0.8234	8.4423	596.7717*	-23.4195*
Yes Bank Ltd.	0.0053	0.2864	-0.4981	0.0796	-0.9159	9.5288	569.0173*	-18.5507*
Bankex	0.0053	0.2052	-0.1894	0.0473	-0.4508	5.6373	155.6994*	-13.6401*
MRK	0.0022	0.1317	-0.1738	0.0366	-0.3594	4.8337	126.2349*	-17.6506*
Δ INT	9.45E-06	0.1634	-0.1674	0.0123	-0.5385	139.7220	556927*	-4.8700*
No. of significant cases							21/21	21/21

Note: Max, Min, S.D., MRK and Δ INT stands for Maximum, Minimum, standard Deviation, Market Index Return and Changes in Interest Rate respectively. *indicates significant at 1%.

Table 3: Estimates of Individual Bank Stock Returns and Bankex Returns by Ols Regression

Name	β_0	β_1	β_2	Adjusted R2	ARCH(Lag 1)
Allahabad Bank	0.0031 (0.2341)	0.9954* (0.0000)	-0.5367 (0.3735)	0.2939	0.1300* (0.0066)
Axis Bank Ltd.	0.0040*** (0.0839)	0.9380* (0.0000)	-0.1901 (0.2905)	0.2562	0.1709* (0.0000)
Bank of Baroda	0.0005 (0.8108)	1.0852* (0.0000)	0.0051 (0.9769)	0.3262	0.1377* (0.0002)
Bank of India	0.0003 (0.8744)	1.0983* (0.0000)	-0.4254** (0.0167)	0.3280	0.1104* (0.0031)
Canara Bank	0.0013 (0.5719)	1.1347* (0.0000)	-1.1771** (0.0390)	0.3828	0.1109** (0.0215)
Federal Bank Ltd.	0.0019 (0.4104)	0.8360* (0.0000)	-0.0014 (0.9940)	0.1930	0.2502* (0.0000)
HDFC Bank Ltd.	0.0033** (0.0467)	0.7417* (0.0000)	0.1872 (0.1664)	0.2752	0.1583* (0.0000)
ICICI Bank Ltd.	0.0019 (0.4099)	1.0788* (0.0000)	0.1983 (0.2938)	0.2912	0.2048* (0.0000)
IDBI Bank Ltd.	-0.0011 (0.6179)	1.1037* (0.0000)	0.0087 (0.9634)	0.2976	0.1696* (0.0000)
Indian Overseas Bank	0.0023 (0.3552)	0.9793* (0.0000)	0.0552 (0.7615)	0.2554	0.0618 (0.1532)
Indusind Bank Ltd.	3.14E-05 (0.9903)	1.0432* (0.0000)	-0.0840 (0.6821)	0.2454	0.1727* (0.0000)
Karnataka Bank Ltd.	0.0002 (0.9282)	1.0050* (0.0000)	-0.7702 (0.2414)	0.2493	0.1083** (0.0195)
Kotak Mahindra Bank Ltd.	0.0039 (0.1682)	1.1776* (0.0000)	0.2985 (0.1989)	0.2446	0.3419* (0.0000)
Oriental Bank of Commerce	0.0004 (0.8204)	0.9126* (0.0000)	0.0017 (0.9913)	0.2792	0.1976* (0.0000)
Punjab National Bank	0.0034 (0.1473)	1.0604* (0.0000)	-0.3629 (0.5157)	0.3389	0.1434* (0.0009)
State Bank of India	0.0007 (0.6595)	1.0802* (0.0000)	0.1274 (0.3366)	0.4553	0.1904* (0.0000)
Union Bank of India	0.0024 (0.3288)	1.1204* (0.0000)	-0.8070 (0.1597)	0.3660	0.2283* (0.0000)
Yes Bank Ltd.	0.0004 (0.8840)	1.4853* (0.0000)	0.6569 (0.3165)	0.5185	0.2028* (0.0004)
Bankex	0.0010 (0.3600)	1.1818* (0.0000)	0.0518 (0.8460)	0.7315	0.0327 (0.4743)
No. of significant cases	2/19	19/19	2/19		17/19

Number in Parentheses indicates the p-value. *indicates significant at 1%. **indicates significant at 5%. ***indicates significant at 10%.

Table 4: Estimation of Returns with Garch (1, 1) Model

Name	γ_0	γ_1	γ_2	α_0	α_1	α_2
Allahabad Bank	0.0031 (0.2642)	0.9812* (0.0000)	-0.7897 (0.1486)	0.0014** (0.0220)	0.0774 (0.1443)	0.4333*** (0.0563)
Axis Bank Ltd.	0.0037*** (0.0554)	1.0487* (0.0000)	-0.2465 (0.3256)	6.51E-05** (0.0146)	0.0911* (0.0000)	0.8908* (0.0000)
Bank of Baroda	0.0001 (0.9484)	1.1117* (0.0000)	-0.2795* (0.0076)	0.0003* (0.0005)	0.1286* (0.0000)	0.7794* (0.0000)
Bank of India	-9.32E-05 (0.9645)	1.0687* (0.0000)	-0.6780* (0.0016)	0.0019* (0.0014)	0.1469* (0.0013)	0.2843 (0.1435)
Canara Bank	0.00012 (0.9575)	1.1565* (0.0000)	-1.1302** (0.0178)	0.0001*** (0.0823)	0.0587** (0.0335)	0.8967* (0.0000)
Federal Bank Ltd.	0.0019 (0.3445)	0.8724* (0.0000)	-0.2592 (0.2427)	0.0007* (0.0000)	0.1927* (0.0000)	0.6121* (0.0000)
HDFC Bank Ltd.	0.0025*** (0.0748)	0.7853* (0.0000)	0.2175 (0.3980)	2.66E-05** (0.0121)	0.0553* (0.0000)	0.9317* (0.0000)
ICICI Bank Ltd.	0.0002 (0.9085)	1.2959* (0.0000)	0.3131 (0.2709)	8.46E-06 (0.2279)	0.0695* (0.0000)	0.9308* (0.0000)
IDBI Bank Ltd.	-0.0020 (0.3688)	1.1416* (0.0000)	-0.0411 (0.9219)	0.0005* (0.0000)	0.0990* (0.0000)	0.7602* (0.0000)
Indian Overseas Bank	0.0020 (0.4112)	0.9809* (0.0000)	0.1209 (0.4615)	0.0002** (0.0370)	0.0456* (0.0050)	0.8934* (0.0000)
Indusind Bank Ltd.	0.0020 (0.4011)	1.0158* (0.0000)	-0.1198 (0.5397)	0.0002** (0.0221)	0.1070* (0.0000)	0.8552* (0.0000)
Karnataka Bank Ltd.	-0.0013 (0.6513)	1.0345* (0.0000)	-0.5403 (0.4581)	0.0017* (0.0000)	0.2273* (0.0000)	0.3033** (0.0151)
Kotak Mahindra Bank Ltd.	0.0031 (0.1153)	1.2702* (0.0000)	0.3178** (0.0433)	8.07E-05* (0.0097)	0.1100* (0.0000)	0.8768* (0.0000)
Oriental Bank of Commerce	-0.0003 (0.8903)	0.8515* (0.0000)	-0.0173 (0.9550)	0.0002* (0.0009)	0.0824* (0.0001)	0.8390* (0.0000)
Punjab National Bank	0.0008 (0.6656)	1.0631* (0.0000)	-0.3111 (0.4527)	2.90E-05* (0.0083)	0.0817* (0.0000)	0.9051* (0.0000)
State Bank of India	0.0005 (0.7072)	1.1215* (0.0000)	-0.1691** (0.0145)	0.0002* (0.0019)	0.1191* (0.0000)	0.7826* (0.0000)
Union Bank of India	-0.0011 (0.6401)	1.1423* (0.0000)	-0.9915** (0.0278)	0.0004** (0.0199)	0.1765* (0.0004)	0.6818* (0.0000)
Yes Bank Ltd.	-0.0002 (0.9606)	1.4688* (0.0000)	1.0002 (0.1945)	0.0011 (0.1389)	0.1101 (0.1364)	0.5233*** (0.0801)
Bankex	0.0009 (0.4003)	1.1842* (0.0000)	0.0304 (0.9064)	1.68E-05 (0.1663)	0.0471** (0.0238)	0.9226* (0.0000)
No. of significant cases	2/19	19/19	6/19	16/19	17/19	18/19

Number in Parentheses indicates the p-value. *indicates significant at 1%. **indicates significant at 5%. ***indicates significant at 10%.

banks in our sample as well as for Bankex and Sensex. Table 2 also reports that each of the bank stock returns, Bankex returns, Market returns and changes in interest rate time series is stationary i.e. the mean and variance are

Table 5: Volatility Estimates

Name	γ_0	α_0	α_1	α_2	θ_1
Allahabad Bank	0.0071** (0.0216)	0.0034** (0.0121)	0.1223*** (0.0693)	0.0576 (0.8697)	-0.0786** (0.0169)
Axis Bank Ltd.	0.0068** (0.0113)	7.55E-06 (0.7987)	0.0773* (0.0000)	0.8923* (0.0000)	0.0057* (0.0039)
Bank of Baroda	0.0030 (0.2395)	0.0002** (0.0141)	0.1222* (0.0000)	0.7627* (0.0000)	0.0106** (0.0243)
Bank of India	0.0025 (0.3417)	0.0021* (0.0043)	0.1477* (0.0013)	0.2693 (0.1788)	-0.0059 (0.6067)
Canara Bank	0.0058*** (0.0626)	-2.26E-05* (0.0000)	-0.0102* (0.0000)	0.9972* (0.0000)	0.0036* (0.0000)
Federal Bank Ltd.	0.0023 (0.3719)	0.0005* (0.0000)	0.1733* (0.0000)	0.6326* (0.0000)	0.0103** (0.0348)
HDFC Bank Ltd.	0.0054* (0.0040)	5.50E-06 (0.6467)	0.0462* (0.0055)	0.8759* (0.0000)	0.0076* (0.0017)
ICICI Bank Ltd.	0.0043 (0.1191)	-3.67E-05* (0.0000)	0.0419* (0.0000)	0.9462* (0.0000)	0.0044* (0.0000)
IDBI Bank Ltd.	0.0009 (0.7217)	0.0005* (0.0001)	0.0999* (0.0000)	0.7572* (0.0000)	-0.0007 (0.8355)
Indian Overseas Bank	0.0051*** (0.0818)	0.0002 (0.1218)	0.0449* (0.0061)	0.8967* (0.0000)	0.0004 (0.8999)
Indusind Bank Ltd.	0.0027 (0.3592)	0.0001 (0.1072)	0.1193* (0.0001)	0.8169* (0.0000)	0.0093 (0.1130)
Karnataka Bank Ltd.	0.0039 (0.2222)	0.0024* (0.0001)	0.2092* (0.0000)	0.3068** (0.0231)	-0.0498* (0.0072)
Kotak Mahindra Bank Ltd.	0.0050 (0.1119)	-7.36E-06 (0.8061)	0.0937* (0.0000)	0.8765* (0.0000)	0.0091* (0.0037)
Oriental Bank of Commerce	0.0021 (0.3501)	0.0002* (0.0050)	0.0795* (0.0001)	0.8452* (0.0000)	0.0026 (0.2388)
Punjab National Bank	0.0073** (0.0118)	-4.11E-05** (0.0111)	0.0408* (0.0002)	0.9453* (0.0000)	0.0047* (0.0001)
State Bank of India	0.0031 (0.1409)	-7.08E-06 (0.2482)	0.0128** (0.0363)	0.9640* (0.0000)	0.0029* (0.0000)
Union Bank of India	0.0070** (0.0236)	0.0002*** (0.0925)	0.1758* (0.0003)	0.6868* (0.0000)	0.0101 (0.1892)
Yes Bank Ltd.	0.0053 (0.2517)	-5.76E-05* (0.0000)	-0.0052 (0.1115)	0.9923* (0.0000)	0.0063* (0.0000)
Bankex	0.0053** (0.0152)	-2.88E-06 (0.5746)	0.0175 (0.2168)	0.9548* (0.0000)	0.0014* (0.0024)
No. of significant cases	8/19	12/19	17/19	17/19	13/19

Number in Parentheses indicates the p-value. *indicates significant at 1%. **indicates significant at 5%. ***indicates significant at 10%.

constant over time indicated by the significant Augmented Dicky-Fuller (ADF) statistics.

Table 3 reports the results of the OLS estimation (multivariate) for the sample period 1st April 1996- 31st March 2011. The slope coefficients for market factor are positive and statistically significant for all bank stock returns and Bankex returns, whereas the slope coefficients for the interest rate risk are negative and statistically significant in only 2 out of 19 cases. Therefore, interest rate sensitivity is not strong for Indian banking industry and bank stock returns are found to exhibit strong sensitivity for market risk only. Hence, a major portion of bank stock returns is explained by the market factor in India. This lends support to the standard capital asset pricing model.

The suitability of the OLS coefficients is estimated with the ARCH test. If ARCH effect persists in the data then OLS estimates would not be reliable because OLS model makes the assumption of homoscedasticity. The last column of Table 3 reports the results of the ARCH test. The value of the ARCH coefficient is statistically significant in 17 out of 19 cases, means a residual serial correlation persist in the data and the OLS coefficients estimated are not efficient. Any inferences drawn on the basis of t-value and p-value would not be reliable. Therefore, in such cases it would be appropriate to estimate the parameters by GARCH models.

Table 4 reports the results of the GARCH (1, 1) model, in which the variables of the conditional returns are estimated. γ_1 , the coefficient of the market risk are positive and statistically significant in all cases whereas γ_2 , the coefficient of the interest rate risk is negative and statistically significant in 5 out of 19 cases. There may be several reasons for such relationship. If the rate of interest paid by banks to depositors increases, people will switch their money from equity market to banks. This in turn, will decrease the demand of share and capital investment in an economy. Hence, there is inverse relationship between Stock returns and Interest rate. Also changes in interest rate affect bank's net income which in turn will affect its stock value. The other possible reason may be that their nominal liabilities are more than their nominal assets (nominal contracting hypothesis).

In a conditional variance equation α_0 , intercept term, is statistically significant in all cases except for ICICI Bank Ltd., Yes Bank Ltd. and Bankex. α_1 , the ARCH parameter is statistically significant in all cases except for Allahabad

Bank and Yes Bank Ltd. This implies that overall volatility of bank stock returns is sensitive to the previous period residual variance and it also satisfies non-negativity condition. α_2 , the GARCH parameter is also statistically significant in all cases except for Bank of India, which implies that volatility of each bank stock returns is sensitive to the previous period's forecast variance and it also satisfies the non-negativity condition. α_2 , the GARCH parameter is also greater than the ARCH parameter; α_1 implying that the volatility of each bank stock returns is more sensitive to previous period's forecast variance rather than residual variance. In GARCH model, the sum of the ARCH and GARCH parameter should be less than one to ensure covariance stationarity which also holds true in most of the cases.

Table 5 reports the results of volatility transmission estimates i.e. whether interest rate volatility have any effect on individual bank stock returns volatility. α_1 , the ARCH parameter is statistically significant in 17 out of 19 cases which imply that individual bank stock returns and Bankex returns are sensitive to the previous period's residual variance. α_2 , the GARCH parameter is also statistically significant in 17 out of 19 cases which imply that previous period's forecast variance sensitivity is also there. Again the coefficient of GARCH parameter is greater than the ARCH parameter implying individual bank stock returns volatility exhibiting greater sensitivity with previous period's forecast variance rather than residual variance. θ_1 , which measures the effect of interest rate volatility on individual bank stock returns volatility and Bankex returns volatility is statistically significant in 11 out of 19 cases implying that if interest rate becomes more volatile it will also increase the bank stock returns volatility. The reason for such volatility may be that interest rate is a macroeconomic variable which is a source of systematic risk and banks are unable to refrain from interest rate risk. It is determined by the forces of demand and supply and lack of availability of interest rate derivatives and other hedging securities for banks in India, it leads to increase in bank stock returns volatility. Our findings are in accordance with the study of Kasman et al. (2011) but inconsistent with the findings of Leon (2008).

5. Summary and Conclusion

The issue of interest rate sensitivity of bank common stock returns is of major interest for regulators, banks,

investors and academic and for that reason a voluminous amount of literature has explored the issue. Empirical studies have provided substantial evidence for bank stock returns exhibiting statistically significant inverse relationship with interest rate changes (Alam and Uddin, 2009; Asprem, 1989; Ballester et al., 2011; Benink and Wolff, 2000; Brewer et al., 2007; Choi et al., 1992; Choi and Jen, 1991; Dinesis and Staikouras, 1998; Elyasiani and Mansur, 1998; Flannery and James, 1984; Lyng and Zumwalt, 1980; Singh and Arora, 2010). The recent studies for the US banking sector have concluded that interest rate sensitivity has decreased in the late 1980's and early 1990's due to the availability of interest rate derivatives contracts for hedging purposes (Benink and Wolff, 2000).

We examined the interest rate sensitivity of banking stock returns in India using multivariate OLS and GARCH (1, 1) models. The sample consisted of 18 commercial banks listed on BSE and form part of Bankex. We find negative but weak relationship between interest rate changes and banking stock returns in India. Banking stock returns are explained more by market return rather than by interest rate changes. However, interest rate volatility is found to affect significantly the stock volatility in case of most of the banks in India. Hence, although interest rate movements may not significantly affect banking stock returns in India but stock's volatility is significantly affected by the interest rate volatility.

Overall, there is an off setting effect of interest rate change on bank stock returns because interest rate is cost as well as source of income for the bank. This may be one of the possible reasons for weak relationship between interest rate changes and banking stock returns in India. In our study banking stock returns exhibit significant negative sensitivity to interest rate changes only in case of 5 banks. The reason for such sensitivity in case of these banks only may be that their nominal liabilities are more than their nominal assets (nominal contracting hypothesis). The effect of interest rate volatility on individual bank stock returns volatility and Bankex returns volatility is statistically significant implying that if interest rate becomes more volatile it will also increase the bank stock returns volatility.

According to Arbitrage Pricing Theory (APT), systematic risk is relevant in determining expected returns. According to it there may be several non-diversifiable risk factors

macroeconomic in nature which can affect the returns of all stocks. We have taken only market risk and interest rate risk. Interest rate risk is found to exhibit weak sensitivity with bank stock returns so there may be other factors i.e. unanticipated inflation, exchange rate, foreign exchange reserves and value of trade balance etc. which may be affecting banking stock returns in India. It provides a scope for further study.

These findings have important implications for banking companies, investing community and policy regulators because bank stock returns in India are not found to be significantly related with interest rate changes over the past decade. Hence changes in interest rate may not be a primary tool for affecting banking stock returns in India. The banking sector in India is not found to respond to interest rate changes.

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