Economic Modelling 28 (2011) 1328–1334

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

The impact of interest rate and exchange rate volatility on banks' stock returns and volatility: Evidence from Turkey

Saadet Kasman [a,*], Gülin Vardar [b], Gökçe Tunç [b]

[a] Department of Economics, Faculty of Business, Dokuz Eylul University, 35160 Buca/Izmir, Turkey
[b] Department of International Trade and Finance, Izmir University of Economics, 35330 Balçova/Izmir, Turkey

ARTICLE INFO

Article history:
Accepted 31 January 2011

JEL classification:
C32
G21

Keywords:
Market risk
Interest rate risk
Foreign exchange risk
Bank stock returns
GARCH

ABSTRACT

This paper investigates 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. Also, bank stock return sensitivities are found to be stronger for market return than interest rates and exchange rates, implying that market return plays an important role in determining the dynamics of conditional return of bank stocks. The results further indicate that interest rate and exchange rate volatility are the major determinants of the conditional bank stock return volatility.

1. Introduction

In recent years, the liberalization of financial markets has caused exposure to many sources of risk. The impact of interest rate and exchange rate changes on banks' stock returns has been of major interest to bank managers, regulatory authorities, academic communities and investors, since the failure of numerous banks has been especially attributed to the adverse impacts of fluctuations in interest rates and exchange rates.

The sensitivity of bank stock returns to interest rate and exchange rate changes can be theoretically explained with several models and hypothesis. Initially, with reference to the intertemporal capital asset pricing model (ICAPM) of Merton (1973), the interest rate risk may be included in the model (ICAPM) as one-possible extra market factor, since a change in the interest rate may represent a shift in the investment opportunity set. Therefore, investors require additional compensation for bearing the risk of such changes. Also, the implications of Arbitrage Pricing Theory (APT) can provide evidence of whether interest rate (Sweeney and Warga, 1986) or exchange rate risk are priced factors in the equilibrium price of bank stocks. In equilibrium, interest rate (Yourougou, 1990) and exchange rate sensitivities exert a significant impact on the common stocks of financial institutions,[1] including banks.

The nominal contracting hypothesis (Kessel, 1956; Bach and Ando, 1957; French et al., 1983) has also been used to explain the interest rate sensitivity of banks, given the composition of their balance sheets (Flannery and James, 1984). This hypothesis suggests that the interest rate sensitivity of a bank's common stock return depends on the amount of net nominal assets held by the bank. A bank's holdings of nominal assets and nominal liabilities affect its common stock returns through wealth distribution effects caused by unexpected inflation.[2] Since the internationalization process of most financial institutions have not been completed, it is more likely that both interest and exchange rate sensitivity would vary among banks. Therefore, the nationality and financial operations of the banks will affect the extent to that variation. Maturity mismatch between the assets and liabilities of banks and unexpected change in interest and exchange rates are

[1] Theoretical justification of stock returns sensitivity to different types of risks can be explained in terms of risk aversion. A risk averse investor relates decision process on portfolio holdings to the covariance of the portfolio's return with market factors and other types of risks (i.e. interest rate and exchange rate changes). An investor will always choose the portfolio that provides a better hedge against unfavorable shifts in risk factors. As a result, in equilibrium asset prices (and expected returns) will differ due to changes in risk factors.

[2] Since unexpected inflation will redistribute wealth from creditors to debtors which results in a benefit to stockholders in firms with more nominal liabilities than nominal assets, the equity of firms with positive net nominal assets should decline.

* Corresponding author.
E-mail addresses: saadetkasman@deu.edu.tr (S. Kasman), gulin.karasulu@ieu.edu.tr (G. Vardar), gokce.aksoy@ieu.edu.tr (G. Tunç).

0264-9993/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.econmod.2011.01.015

considered as the key factors that lead to increase the risk exposure of the banks. Additionally, most financial analysts and economists agree that the revenues, costs and profitability of banks are directly influenced by the unexpected changes in interest rates and exchange rates (Saunders and Yourougou, 1990). With the financial market liberalization process, most of the banks generally carry out their operations in foreign countries and are exposed to the interest rate risk because of volatile financial market conditions in recent years. Therefore, interest rate and exchange rate changes could have an adverse effect on the viability of banks because their impacts cannot be eliminated through risk management techniques (Gilkenson and Smith, 1992).

Banking institutions can reduce their interest rate and exchange rate risk exposures by engaging in various off-balance sheet activities and implementing effective risk management techniques. However, financial institutions in emerging countries are more vulnerable due to their inadequacy in such instruments and techniques. It is not surprising that these countries are more often faced with serious financial crises. Hence it is worthwhile to investigate the interest rate and exchange rate exposures of banks in emerging market countries as the results can have important implications on financial stability and policy formulation for banking and regulatory communities.

Despite the clear importance of an understanding of the impact of interest and exchange rates on the bank stock returns, surprisingly, only a few papers have investigated explicitly the joint interaction of the interest and exchange rates on bank stock returns and volatility in the context of emerging markets. However, the majority of studies on this issue have been concentrated in developed markets. Hence, the objective of this study is to contribute to the related literature by studying the sensitivity of bank stock returns to interest and exchange rates changes using data from a major emerging market. Turkey, which is considered an emerging market, has witnessed significant developments in its banking system since financial crisis of 2001. As is the case in most emerging markets, the high interest rates and exchange rate fluctuations have been characteristics of the Turkish economy for a long time. The large maturity gaps and short positions in foreign exchange on the balance sheets and duration gaps during the crisis resulted in a significant amount of erosion of their capital. Hence, the main objective of this study is to investigate the sensitivity of a sample of Turkish banks' stock returns to interest rate and exchange rate changes over the period 1999–2009, using both standard OLS method and GARCH model. The contribution of this paper to the related literature is three-fold: first, to the authors' best knowledge, this is the first study that has conducted an in-depth investigation regarding joint interest rate and exchange rate risks on the Turkish banks' stock returns. The study is based on daily data rather than monthly data, since daily data provide stronger evidence of the sensitivity of bank stock returns to both interest rate and exchange rate changes. Second, it utilizes two different econometric approaches, the standard OLS and GARCH model, to enhance the analysis. In this way, the comparison of the empirical results dictates the extent to which the empirical results are reliable and also the usefulness of the estimated parameters. Third, the time period examined covers a unique large and recent data set, which is characterized by the inclusion of financial and economic crises in Turkey.

The remainder of paper is organized as follows. Section 2 presents the literature review. Section 3 discusses the data. Methodology is presented in Section 4. Section 5 discusses the empirical results. Finally, Section 6 provide conclusions.

2. Literature review

Most of the existing studies concentrate on the interest rate and exchange rate sensitivity of bank stock returns separately by employing different methodologies. This variation in turn gives rise to different empirical results. By using cash flow approach with US bank stocks, Flannery (1981) found that they were not affected by interest rate fluctuations since these changes did not have a significant impact on the costs and profits. Prior empirical studies of banks' interest rate sensitivity include the works of Stone (1974), Lloyd and Shick (1977), Lynge and Zumwalt (1980), Chance and Lane (1980), Flannery and James (1984), Booth and Officer (1985), Scott and Peterson (1986), and Bae (1990). By employing a two-index factor model (including both market and interest rate factors) on the bank stock returns under the assumption of constant variance error terms, the empirical findings were dissimilar regarding the direction and magnitude of the effect. The empirical findings of Lloyd and Shick (1977) and Chance and Lane (1980), which provided a weak evidence of interest rate impact on the return generating process of the stocks of financial institutions, were challenged by the results of Lynge and Zumwalt (1980), Flannery and James (1984), Booth and Officer (1985), Scott and Peterson (1986), and Bae (1990). The latter authors reported that stock returns of financial institutions were negatively affected by interest rate changes.

Despite a vast amount of literature on interest rate sensitivity, few empirical studies have dealt with foreign exchange rate sensitivity of bank stock returns. Since unexpected movements in exchange rates can affect the banks directly by generating translation gains or losses based on the net foreign position, the exchange risk could be another important determinant of bank stock returns. The first empirical studies that attracted particular attention to foreign exchange exposure on banks' return generating process were Grammatikos et al. (1986) and Chamberlain et al. (1997). The results of these studies showed that US banks were exposed to the exchange rate risk. By using both daily and monthly data, Chamberlain et al. (1997) compared the exchange rate sensitivities of US banks with those of Japanese banks. They found that stock returns of a significant portion of the US banking companies appeared to be sensitive to exchange rate changes, whereas only a few of the Japanese bank stock returns moved with the exchange rate.

While most of the research has generally analyzed the impacts of either interest rates or exchange rates on bank stock returns, Choi et al. (1992) and Wetmore and Brick (1994) applied a three index model to the US bank stock returns which jointly estimated the impact of market, exchange rate and interest rate factors under the assumption of constant variance error terms. Even though the results of Choi et al. (1992) provided much stronger evidence of interest rate sensitivity than exchange rate sensitivity, Wetmore and Brick (1994) found a controversial result for US banks. In addition, by employing the same three-factor model to the return generating process of Korean banks, Hahm (2004) concluded that Korean bank stock returns were sensitive to those factors.

As aforementioned, these studies have mainly employed linear estimation methods, such as OLS and GLS, and do not consider that bank sensitivities to market, interest rate, and exchange rate factors are time-varying. Due to the volatility clustering, the leverage and ARCH effects of the high frequency data, the linear (OLS) estimation methods produce biased and inconsistent results and therefore, it would be unwise to assume constant volatility in any analysis. Based on the assumption of a time-dependent conditional variance, few empirical studies have used ARCH-type models to capture time-varying risk properties in these data. Song (1994), who employs ARCH estimation models, suggests that ARCH-type modeling is the most appropriate framework in determining bank stock returns. The empirical findings of Mansur and Elyasiani (1995), who investigated the effect of changes in both level and volatility of interest rates on the bank stock returns applying ARCH estimation models, revealed that both level interest rate and their respective volatilities were likely to influence bank stock returns. Flannery et al. (1997), by employing a two-factor GARCH model originally developed by Engle et al. (1990), showed that though both the market and interest rate risks

Table 1
Sample and data specification.

Variables	Sample period
Akbank	27.07.1999–09. 4.2009
Alternatif	27.07.1999–09.04.2009
Finans Bank	27.07.1999–09.04.2009
Fortis	27.07.1999–09.04.2009
Garanti	27.07.1999–09. 04.2009
Is Bank	27.07.1999–09. 04.2009
Seker Bank	27.07.1999–09.04.2009
Tekstil	27.07.1999–09.04.2009
Tkbnk	27.07.1999–09.04.2009
Tskb	27.07.1999–09.04.2009
Tebnk	28.02.2000–09.04.2009
Denizbank	01.10.2004–09.04.2009
Vakıfbank	18.11.2005–09.04.2009

constituted a significant priced factor in non-bank stock portfolios, the effect of interest rate risk was found to be less strong in the bank stock portfolio. Likewise, by using the GARCH-M model, the findings of Elyasiani and Mansur (1998) indicated that change in interest rates had a negative impact on the first moment whereas the associated volatility exercised a negative impact on the second moment of the bank stock return distributions. However, these studies do not take into account the exchange rate risk. Given the lack of study of exchange rate risk pricing in the bank stock returns and prior inconsistent results of interest rate pricing, it is the purpose of this paper to provide evidence concerning joint interaction of market, interest rate and exchange rate on bank stock returns by using both OLS and GARCH models.

Despite the vast literature on the banks of the developed countries, little research has been carried out in emerging countries. In one of these few studies, Hooy et al. (2004), who investigated the interest rate and exchange rate risk sensitivity of bank stocks in Malaysia during the recent financial crisis by using GARCH-M model, found that prior to and during the crisis, bank stock pricing became less sensitive to those risks, although, the risk exposure of Malaysian banks increased after the capital control policy and forced banking consolidation program. In this context, we try to fill the gap in the studies of emerging markets by investigating the effects of interest rate and foreign exchange rate changes on banks' stock returns in Turkey. Turkey is considered as an emerging market due to the existence of macroeconomic instability as characterized by the high volatility in the growth and real interest rates, high exchange rate depreciations, the lack of well-developed money and capital markets. Therefore, it is worthwhile to examine how some of these characteristics threatened the viability of the Turkish banking system.

3. Data

The sample consists of thirteen Turkish commercial bank stocks listed on the Istanbul Stock Exchange (ISE). The daily closing individual bank stock price, the closing price of the bank index, exchange rates and interest rates are used for the period beginning on 27 July 1999 and ending on 9 April 2009. However, the sample period varies for daily closing stock prices of Tebnk, Denizbank and Vakıfbank due to data availability. The sample period for each bank is reported in Table 1.

The data were obtained from Matriks Data Delivery System. The foreign exchange (FX) rate is based on a simple basket of equally weighted two major currencies, the US dollar and the Euro, and the interest rate is measured as the 2-year Turkish Government Bond yield. The Istanbul Stock Price Index 100 is used for the market index. The continuously compounded daily returns for the data are computed as $r_t = 100\ \ln(p_t/p_{t-1})$. p_t is the stock price at time t, and p_{t-1} is the stock price at time $t-1$. Table 2 reports the descriptive statistics for the continuously compounded returns of the individual banks, bank portfolio, market, interest rate and foreign exchange rate. The return distribution is positively skewed for all data except for Garanti bank. The relatively large value of kurtosis statistics suggests that the underlying data are leptokurtic, or fat-tailed and sharply peaked about the mean when compared with the normal distribution. The Jarque–Bera statistic also shows that we have to reject normality at one percent level. Verification that the unit root has been removed from each series by the calculation of continuously compounded returns is indicated by the significant Augmented Dickey–Fuller (ADF) statistics in the last column.

4. Methodology

Most empirical studies employ OLS method to estimate the effect of interest rate and FX rate changes on bank stock returns. Thus, following model is estimated with OLS:

$$r_t = \beta_0 + \beta_1 MRK_t + \beta_2 INT_t + \beta_3 FX_t + \mu_t \quad (1)$$

where r_t is the return of the ith stock at time t; MRK_t is the return of the market index which is considered to reflect economy-wide factors;

Table 2
Descriptive statistics.

	Mean	Max	Min	SD	Skewness	Kurtosis	Jarque–Berra	ADF
Akbank	0.0010	0.1916	−0.2425	0.0352	0.1671	7.2381	1768.1*	−48.883
Alternatif	0.0006	2.2231	−0.2326	0.0408	0.3768	6.7115	1400.1*	−49.090
Finans Bank	0.0017	0.2281	−0.2006	0.0415	0.1904	6.4898	1205.7*	−51.274
Fortis	0.0009	0.2135	−0.2231	0.0387	0.1856	7.2510	1786.0*	−52.912
Garanti	0.0001	0.1918	−0.4054	0.0389	−0.4182	10.8290	6058.4*	−47.179
Is Bank	0.0007	0.2065	−0.2080	0.0359	0.2901	6.5307	1255.7*	−49.069
Seker Bank	0.0005	0.2411	−0.2260	0.0425	0.4442	6.9754	1623.3*	−46.580
Tekstil	0.0003	0.2316	−0.2337	0.0420	0.0427	8.4516	1316.4*	−51.145
Tkbnk	0.0003	0.2316	−0.2337	0.4021	0.4278	8.4516	2979.2*	−44.488
Tskb	0.0011	0.2513	−0.2231	0.0406	0.2598	7.2695	1809.7*	−52.146
Tebnk	0.0005	0.2231	−0.1941	0.0388	0.1877	6.1831	951.5*	−50.685
Denizbank	0.0014	0.2011	−0.2147	0.0366	0.9701	10.9399	3134.4*	−28.270
Vakıfbank	−0.0005	0.1676	−0.1348	0.0322	0.1330	5.4152	209.3*	−26.970
Bankindex	0.0007	0.1726	−0.2116	0.0319	0.1357	7.3144	1828.3*	−47.422
MRK	0.0006	0.1777	−0.1997	0.0273	0.0939	8.8409	3341.1*	−48.097
INT	−0.0008	0.9682	−0.6507	0.0473	5.1861	169.58	2725*	−12.911
FX	0.0006	0.3299	−0.1242	0.0128	7.5007	195.60	3651*	−39.048

Note: Max, Min, SD, MRK, INT, and FX stand for maximum, minimum, standard deviation, market index return, interest rate and foreign exchange rate, respectively.
* Indicates the significance level at 1%.

Table 3
Estimates of OLS regression of individual banks and portfolio.

	β_0	β_1	β_2	β_3	Adjusted R^2	ARCH (1)
Akbank	0.0003	1.1066*	−0.0064	−0.0837**	0.7352	56.782*
	(0.0003)	(0.0140)	(0.0081)	(0.0291)		
Alternatif	0.0001	0.9318*	0.0013	−0.1266**	0.3864	98.388*
	(0.0006)	(0.0248)	(0.0143)	(0.0513)		
Finans	0.0011	0.8873*	−0.0400*	−0.0867	0.3521	210.61*
	(0.0006)	(0.0259)	(0.0149)	(0.0537)		
Fortis	0.0003	0.9371*	0.0234***	−0.0399	0.4281	60.865*
	(0.0006)	(0.0227)	(0.0130)	(0.0470)		
Garanti	0.0002	1.1960*	0.0078	−0.1069*	0.6970	22.591*
	(0.0004)	(0.0166)	(0.0095)	(0.0344)		
Is Bank	−0.0000	1.1446*	0.0047	−0.0483***	0.7520	5.9848**
	(0.0115)	(0.0138)	(0.0080)	(0.0287)		
Seker Bank	0.0004	0.2817*	−0.0150	−0.0821	0.0344	225.79*
	(0.0008)	(0.0323)	(0.0186)	(0.0670)		
Tekstil	−0.0000	0.8711*	−0.0098	−0.2506*	0.3227	93.917*
	(0.0007)	(0.0268)	(0.0154)	(0.0555)		
Tkbnk	−0.0001	0.8024*	−0.0262***	−0.0320	0.3036	344.11*
	(0.0006)	(0.0259)	(0.0149)	(0.0538)		
Tskb	0.0006	0.7899*	−0.0232	−0.0936***	0.2873	121.86*
	(0.0007)	(0.0265)	(0.0153)	(0.0549)		
Tebnk	0.0003	0.8643*	−0.0033	−0.0745	0.3417	44.18*
	(0.0006)	(0.0260)	(0.0142)	(0.0506)		
Denizbank	0.0013	0.7931*	0.1612***	−0.0689	0.1712	179.40*
	(0.0009)	(0.0583)	(0.0869)	(0.1016)		
Vakıfbank	−0.0002	1.1796*	−0.1648*	−0.0302	0.7112	7.088*
	(0.0005)	(0.0329)	(0.0511)	(0.0555)		
Bankindex	0.0000	1.1271*	0.0003	−0.0575*	0.9274	69.360*
	(0.0001)	(0.0066)	(0.0038)	(0.0137)		
No of significant cases	0/14	14/14	5/14	7/14		14/14

Note: Numbers in parentheses indicate the standard errors.
* Indicates the significance level at 1.
** Indicates the significance level at 5%.
*** Indicates the significance level at 10%.

INT_t is the return of a risk-free interest rate or bond index; and, FX_t is the return of the foreign exchange rate (FX). β_0 is the intercept term and μ_t, is an error term with the assumption of an *iid* condition. The suitability of the OLS estimation is tested with the ARCH test.

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) process, first introduced by Bollerslev (1986), is estimated next. The GARCH (1, 1) process is specified as follows[3]:

$$r_t = \gamma_0 + \gamma_1 MRK_t + \gamma_2 INT_t + \gamma_3 FX_t + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (2)$$

where other parameters are defined as before, the variance equation includes the long-term average volatility α_0, news about volatility from the previous period which is defined as an ARCH term and the previous period's forecast variance which is defined as the GARCH term. The GARCH specification requires that in the conditional variance equation, parameters α_0, α_1 and βshould be positive for a non-negativity condition and the sum of α_1 and β should be less than one to secure the covariance stationarity of the conditional variance. Moreover, the sum of the coefficients α_1 and β must be less than or equal to unity for stability to hold.

The following GARCH (1, 1) model is used next, to analyze whether interest return and *FX* rate return volatility have any impact on the stock return volatility of individual banks and bank portfolio. INT_t^2 and FX_t^2 are used to measure the interest rate and *FX* rate return volatility.

$$r_t = \gamma_0 + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \theta_1 INT_t^2 + \theta_2 FX_t^2. \quad (3)$$

5. Empirical results

5.1. OLS estimation

Table 3 reports the results of the OLS estimation. The variables of market risk are positive and statistically significant for all individual bank stock and portfolio returns. Moreover, the results show that the market return explains a greater proportion of bank returns, compared to interest rate and FX rate returns. Evidence of interest rate sensitivity is not strong since the coefficients of interest rate return are significant in only 5 out of 14 cases. Evidence of FX rate sensitivity is stronger compared to interest rate sensitivity, except for Denizbank and Vakıfbank. The coefficient of FX rate return is significant and negative in 7 out of the 14 cases. Overall, most of the impact on the individual bank and portfolio returns is associated with the overall market returns and the FX rate returns.

The suitability of the regression estimates is examined with the ARCH test. If the squared residuals in Eq. (1) contain autocorrelation or heteroscedasticity, it is likely that the null hypothesis will be rejected. The last column of Table 3 reports the results of the ARCH test. Unsurprisingly, a residual serial correlation is present for all the banks and the portfolio level analysis. The presence of residual autocorrelation is a very serious failure of the OLS classical assumption because its presence implies that the OLS coefficients are not

[3] Several GARCH models including EGARCH, GARCH-M, as well as various GARCH models with different lag orders (p,q) were estimated for all series and likelihood ratio test indicated that GARCH(1, 1) is the appropriate parameterization for all return series.

Table 4
Estimation of return.

	γ_0	γ_1	γ_2	γ_3	α_0	α_1	β
Akbank	0.0000	1.1242*	−0.0119	−0.0750*	0.0000*	0.0678*	0.9054*
	(0.0003)	(0.0107)	(0.0076)	(0.0183)	(0.0000)	(0.0089)	(0.0126)
Alternatif	0.0000	0.9148*	0.0032	−0.0661***	0.0000*	0.1261*	0.8147*
	(0.0005)	(0.0162)	(0.0107)	(0.0350)	(0.0000)	(0.0121)	(0.0150)
Finans	0.0011**	0.7854*	−0.0492**	0.0195	0.0000*	0.0726*	0.9123*
	(0.0005)	(0.0177)	(0.0149)	(0.0411)	(0.0000)	(0.0066)	(0.0068)
Fortis	−0.0002	0.9110*	−0.0029	−0.0204	0.0000*	0.0982*	0.8911*
	(0.0005)	(0.0165)	(0.0117)	(0.0434)	(0.0000)	(0.0067)	(0.0065)
Garanti	0.0003	1.2616*	0.0085	−0.0719**	0.0000*	0.0091*	0.9895*
	(0.0003)	(0.0126)	(0.0083)	(0.0248)	(0.0000)	(0.0011)	(0.0012)
Is Bank	0.0000	1.2065*	0.0092	−0.0226	0.0000*	0.0514*	0.9412*
	(0.0310)	(0.0104)	(0.0066)	(0.0310)	(0.0000)	(0.0514)	(0.0045)
Seker Bank	0.0003	0.2696*	−0.0243	−0.0572	0.0002*	0.2889*	0.5584*
	(0.0006)	(0.0209)	(0.0115)	(0.0560)	(0.0000)	(0.0217)	(0.0284)
Tekstil	−0.0010***	0.8796*	−0.0117	−0.0928**	0.0000*	0.1425*	0.8351*
	(0.0005)	(0.0186)	(0.0135)	(0.0460)	(0.0000)	(0.0118)	(0.0117)
Tkbnk	−0.0002	0.7773*	−0.0577*	−0.0259	0.0001*	0.2594*	0.5944*
	(0.0005)	(0.0152)	(0.0064)	(0.0454)	(0.0000)	(0.0183)	(0.0200)
Tskb	0.0000	0.9412*	−0.0469**	−0.0543	0.0000*	0.0616*	0.9376*
	(0.0005)	(0.0165)	(0.0186)	(0.0471)	(0.0000)	(0.0039)	(0.0035)
Tebnk	0.0005	0.9229*	−0.0312**	−0.0747	0.0000*	0.0521*	0.9397*
	(0.0006)	(0.0200)	(0.0158)	(0.0490)	(0.0000)	(0.0059)	(0.0063)
Denizbank	0.0002	0.5504*	0.0828***	0.0404	0.0000*	0.2624*	0.7099*
	(0.0006)	(0.0253)	(0.0444)	(0.0655)	(0.0000)	(0.0218)	(0.0144)
Vakıfbank	−0.0001	1.1592*	−0.1665**	−0.0032	0.0000**	0.0668*	0.8959*
	(0.0005)	(0.0274)	(0.0517)	(0.0544)	(0.0000)	(0.0167)	(0.0263)
Bankindex	0.0000	1.1525*	0.0030	−0.0182*	0.0000*	0.1016*	0.8734*
	(0.0001)	(0.0004)	(0.0019)	(0.0130)	(0.0000)	(0.0111)	(0.0124)
No of significant cases	2/14	14/14	6/14	5/14	14/14	14/14	14/14

Note: Numbers in parentheses indicate the standard errors.
* Indicates the significance level at 1%.
** Indicates the significance level at 5%.
*** Indicates the significance level at 10%.

efficiently estimated and statistical inferences based on standard *t* and *F*-tests would not be reliable. Therefore, GARCH type models would appear to be more appropriate for estimating such data.

5.2. Estimation of return with GARCH (1, 1) model

The estimated GARCH (1, 1) parameters of the conditional return model are shown in Table 4.[4] The coefficient γ_1, which measures the effect of market return on each of the bank stock returns traded in the ISE, is positive and statistically significant in all cases. The results indicate that the conditional return has a negative and significant relation with exchange rate risk exposure in 5 out of 14 cases, which is consistent with the results reported by Ferson (1989) and Shanken (1990), while the same relationship with interest rate changes in 6 cases.

The impact of market returns on the conditional mean equation is found to be larger in magnitude and strongly significant in all cases. Given the fact that the majority of the banks are included in ISE-100 Index, as expected, the market return is found to explain a greater proportion of conditional bank stock returns. The main rationale for the negative relationship with the exchange rate can be explained by the size of foreign currency denominated assets and liabilities in a bank balance sheet. The unexpected movements in exchange rates can affect a bank balance sheet directly by generating translation gains or losses based on the net foreign positions. When foreign currency denominated liabilities exceed foreign currency denominated assets, the depreciation of the local currency may lead to damage in the bank balance sheet and the deterioration of bank equity may result in a decline in the bank stock return.

A number of potential explanations for the negative relationship with interest rate changes exist. Changes in interest rates have an impact on the value of a bank's common stock by influencing its net interest income and the level of other interest-sensitive income. When the average duration period of assets in a bank is longer than that of liabilities, an unexpected increase in interest rates will negatively influence a bank's balance sheet. An indirect impact of an increase in market interest rates on the bank balance sheet may be due to the worsening of non-financial borrowers' cash flows. The resulting increase in borrower credit risk will damage the asset quality of the banks, thereby leading to a decrease in the bank capital.

In a conditional variance equation, the intercept term (α_0) is positive and statistically significant in all cases, indicating that there is a significant time-invariant component in the return generating process. Both the ARCH parameter α_1 and the GARCH parameter β satisfy the non-negativity condition. The GARCH parameter is significantly greater than the ARCH parameter, which implies that the volatility of each stock return is more sensitive to its own lagged values than it is to new surprises. To put it in another way, the effects of a previous period's forecast variance are more persistent. The sum of α_1 and β parameters are close to unity for 12 out of 14 cases, stating that shocks to the bank stock and index returns have highly persistent effects and the response of volatility decays at a slower rate. In particular, bank stock return sensitivities are found to be stronger for market return than interest rates and exchange rates, implying that market return plays an important role in determining the dynamics of the conditional return of bank stocks.[5]

[4] The Turkish economy witnessed a major financial crisis in 2001. Thus, we introduce a dummy variable into the conditional variance equation to accurately estimate volatility in stock market returns and capture the effects of crisis on the stock market. Since the estimation results do not change, it is not reported in here to save the space.

[5] We also include interaction between interest rate and foreign exchange rate in regression equations to investigate interaction effect in addition to the pure effect. The regression results show that the interaction variables have no explanatory power on the bank returns. To save space, the results were not reported but available from the authors upon request.

Table 5
Volatility estimates.

	γ	α_0	α_1	β	θ_1	θ_2
Akbank	0.0013**	0.0001*	0.1550*	0.5758*	0.2148*	0.2911*
	(0.0006)	(0.0000)	(0.0000)	(0.0321)	(0.0224)	(0.1035)
Alternatif	0.0007	0.0000*	0.1666*	0.7989*	0.0725*	0.1586*
	(0.0006)	(0.0000)	(0.0122)	(0.0110)	(0.0095)	(0.0480)
Finans	0.0014*	0.0000*	0.0712*	0.9285*	0.0029**	−0.0206*
	(0.0005)	(0.0000)	(0.0003)	(0.0027)	(0.0013)	(0.0077)
Fortis	0.0007	0.0000*	0.0873*	0.8972*	0.0079**	0.0174
	(0.0006)	(0.0000)	(0.0062)	(0.0051)	(0.0038)	(0.0257)
Garanti	0.0010	0.0002*	0.1374*	0.4970*	0.3850*	0.5483*
	(0.0006)	(0.0000)	(0.0212)	(0.0303)	(0.0245)	(0.1594)
Is Bank	0.0007	0.0002*	0.1494*	0.5480*	0.1910*	0.2282*
	(0.0006)	(0.0000)	(0.0205)	(0.0354)	(0.0247)	(0.0828)
Seker Bank	0.0005	0.0003*	0.2554*	0.5087*	0.0290**	0.7288*
	(0.0007)	(0.0000)	(0.0210)	(0.0295)	(0.0111)	(0.1300)
Tekstil	0.0001	0.0001*	0.1589*	0.7684*	0.0093***	0.0136
	(0.0007)	(0.0000)	(0.0130)	(0.0162)	(0.0049)	(0.0365)
Tkbnk	0.0007	0.0003*	0.2803*	0.3532*	0.3871*	0.0725
	(0.0006)	(0.0272)	(0.0272)	(0.0351)	(0.0381)	(0.0840)
Tskb	0.0008	0.0001*	0.0906*	0.7300*	0.1910*	0.1921*
	(0.0007)	(0.0000)	(0.0082)	(0.0154)	(0.0191)	(0.0662)
Tebnk	0.0010	0.0005*	0.1286*	0.2743*	0.3718*	0.8726*
	(0.0007)	(0.0000)	(0.0220)	(0.0478)	(0.0607)	(0.2095)
Denizbank	0.0006	0.0000*	0.2291*	0.7854*	0.1147*	−0.1113*
	(0.0006)	(0.0000)	(0.0206)	(0.0121)	(0.0176)	(0.0325)
Vakıfbank	−0.0003	0.0002*	0.0868*	0.2904*	1.5915*	0.7612**
	(0.0009)	(0.0000)	(0.0337)	(0.0874)	(0.3282)	(0.3242)
Bankindex	0.0012**	0.0000*	0.1614*	0.6444*	0.1517*	0.1735*
	(0.0005)	(0.0000)	(0.0214)	(0.0273)	(0.0171)	(0.0656)
No of significant cases	3/14	14/14	14/14	14/14	14/14	11/14

Note: Numbers in parentheses indicate the standard errors.
** Indicates the significance level at 5%.
* Indicates the significance level at 1%.

5.3. Estimation of volatility with GARCH (1, 1) model

Table 5 presents the results of the bank stock and index return volatility model with the inclusion of variables reflecting interest rate volatility and exchange rate volatility. The small and statistically significant ARCH parameter α_1 provides a weak support for the presence of the last period's shock on bank volatility, whereas the larger and statistically significant GARCH parameter β indicates strong evidence of previous surprises. The sum of ARCH and GARCH parameters as a measure of volatility persistence is relatively low with the inclusion of interest rate and exchange rate volatility. The empirical findings show that the estimated coefficient θ_1, which measures the effect of the interest rate volatility on bank stock and index volatility, is positive and statistically significant for all cases. This manifests that, when the interest rate becomes more volatile, this will lead to an increase in bank stock volatility. A possible explanation for the increase in the bank stock return volatility in response to an increase in interest rate volatility is that banks are unable to refrain from interest rate risk since they are not capable of holding derivative securities and matching duration's of assets and liabilities. Given the lack of derivative instruments in the Turkish financial market and inability to implement effective risk management techniques, it is indispensible to encounter with this result, which is in accordance with findings of Elyasiani and Mansur (2003).

Concerning the exchange rate volatility on the bank stock return volatility, the coefficient θ_2 is found to be positively significant in 9 out of the 14 cases. Finding significant exchange rate coefficients necessarily implies that the fluctuations in exchange rates lead to an increase in the bank stock return volatility. In line with the globalization of the banking sector, Turkish banks have been exposed to significant foreign exchange rate risk over the sample period. However, Turkish banks may not adequately hedge their exchange rate exposure using such instruments as cross-currency swaps and foreign exchange forwards. Therefore, this may be one possible explanation for the positive relationship between the exchange rate and bank stock return volatility. The findings are in accordance with the studies of Choi et al. (1992) and Wetmore and Brick (1994) but inconsistent with the results of Ryan and Worthington (2002).

6. Conclusion

An investigation of the impact of interest rates and exchange rates on bank stock returns and volatility has been of special importance in recent years as a consequence of shifts in monetary policy regimes, free capital flows, financial and technological developments in communications, and trading systems. Therefore, this study examines the simultaneous interest rate, exchange rate and market risk on bank stock return by employing both OLS and GARCH estimation models. However, due to the existence of residual autocorrelation in the data, the GARCH model produces more efficient coefficients than OLS. Application of time-varying risk models also enables us to introduce volatility of interest and exchange rates into the bank stock return volatility generating process.

The results of this paper indicate that interest rate and exchange rate changes have a negative and significant impact on the conditional bank stock return. Also, bank stock return sensitivities are found to be stronger for market return than interest rates and exchange rates, implying that market return plays an important role in determining the dynamics of conditional return of bank stocks. The results further indicate that interest rate and exchange rate volatility are found to be a major determinant in the conditional bank stock return volatility. Hence, our evidence suggests that variation in interest and exchange rate risk can explain the observable bank characteristics that are relevant for interested parties who want to manage their risk exposure and oversee changes in exposure. Overall, these findings seem to be robust for an emerging financial market, like in Turkey, which does not provide hedging opportunities in its derivative market for interest and exchange rates risks.

The findings of this paper provide important information particularly for investors in revaluing banks' stocks, for bank managers in building risk management strategies and finally for policy makers in constructing monetary policies. Hence, the findings of this paper have some policy implications. Knowing the nature of the impact of the interest and exchange rates on bank stock returns could provide valuable information for portfolio management purposes both domestically and internationally. The results suggest that investors should follow more closely the monetary policies to take decisions on their investments since interest and exchange rates have predictive powers on bank stock return and volatility. When there are changes in interest and exchange rates, investors should change the composition of their portfolios due to the sudden change in the risk-return trade off. As for the bank managers, they should also follow monetary policies when they build risk management strategies. Finally, policy makers should take the condition of banking system into account when they form monetary policies. This is crucial since the role of banking system in economic growth is significant and monetary policies can help to develop a stable and sound banking system.

References

Bach, B., Ando, A., 1957. The redistribution of effects of inflation. The Review of Economics and Statistics 3, 1–13.
Bae, S.C., 1990. Interest rate changes and common stock returns of financial institutions: revisited. Journal of Financial Research 13, 71–79.
Bollerslev, T., 1986. Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics 31, 307–327.
Booth, J., Officer, D.T., 1985. Expectations, interest rates, and commercial bank stocks. Journal of Financial Research 8, 51–58.
Chamberlain, S., Howe, J., Popper, H., 1997. The exchange rate exposure of US and Japanese banking institutions. Journal of Banking & Finance 21, 871–892.

Chance, D.M., Lane, W.R., 1980. A re-examination of interest rate sensitivity in the common stocks of financial institutions. Journal of Financial Research 3, 49–55.
Choi, J.J., Elyasiani, E., Kopecky, K., 1992. The sensitivity of bank stock returns to market, interest, and exchange rate risks. Journal of Banking & Finance 16, 983–1004.
Engle, R.F., Ng, V., Rothschild, M., 1990. Asset pricing with a factor-ARCH covariance structure: empirical estimates for treasury bills. Journal of Econometrics 45, 213–238.
Elyasiani, E., Mansur, I., 1998. Sensitivity of bank stock returns distribution to changes in the level of volatility of interest rate: a GARCH-M model. Journal of Banking & Finance 22, 535–563.
Elyasiani, E., Mansur, I., 2003. International spillover of risk and return among major banking institutions: a bivariate GARCH model. Journal of Accounting, Auditing, and Finance 23, 303–330.
Ferson, W.E., 1989. Changes in expected security returns, risk, and the level of interest rates. The Journal of Finance 44, 1191–1217.
Flannery, M., 1981. Market interest rates and commercial bank profitability: an empirical investigation. The Journal of Finance 34, 1085–1101.
Flannery, M., James, C., 1984. The effect of interest rate changes on the common stock returns of financial institutions. The Journal of Finance 39, 1141–1153.
Flannery, M.J., Hameed, A.S., Harjes, R.H., 1997. Asset pricing, time-varying risk premia and interest rate risk. Journal of Banking & Finance 21, 315–335.
French, K., Ruback, R., Schwart, G., 1983. Effects of nominal contracting on stock returns. Journal of Political Economy 70–96.
Gilkenson, J., Smith, S., 1992. The convexity trap: pitfalls in financing mortgage portfolios and related securities. Economic Review. Federal Reserve Bank of Atlanta, pp. 14–27.
Grammatikos, T., Saunders, A., Swary, I., 1986. Returns and risks of US bank foreign currency activities. The Journal of Finance 41, 671–683.
Hahm, J.H., 2004. Interest rate and exchange rate exposures of banking institutions in pre-crisis Korea. Applied Economics 36, 1409–1419.
Hooy, C.W., Tan, H.B., Md Nassir, A., 2004. Risk sensitivity of bank stocks in Malaysia: empirical evidence across the Asian financial crisis. Asian Economic Journal 18, 261–276.
Kessel, R., 1956. Inflation-caused wealth redistribution: a test of a hypothesis. The American Economic Review 3, 128–141.
Lynge, M.J., Zumwalt, J.K., 1980. An empirical study of the interest rate sensitivity of commercial bank returns: a multi-index approach. Journal of Financial and Quantitative Analysis 15, 731–742.
Lloyd, W.P., Shick, R.A., 1977. A test of stone's two-index model of returns. Journal of Financial and Quantitative Analysis 12, 363–376.
Mansur, I., Elyasiani, E., 1995. Sensitivity of bank equity returns to the level and volatility of interest rates. Managerial Finance 21, 58–77.
Merton, R.C., 1973. An intertemporal capital asset pricing model. Econometrica 41, 867–887.
Ryan, S., Worthington, A.C., 2002. Time-varying market, interest rate and exchange rate risk in Australian bank portfolio stock returns: a GARCH-M approach. School of Economics and Finance Discussion Papers and Working Paper Series. Queensland University of Technology. 112.
Saunders, A., Yourougou, P., 1990. Are banks special? The separation of banking from commerce and interest rate risk. Journal of Economics and Business 42, 171–182.
Scott, W.L., Peterson, R.L., 1986. Interest rate risk and equity values of hedged and unhedged financial intermediaries. Journal of Financial Research 9, 325–329.
Shanken, J., 1990. Intertemporal asset pricing. Journal of Econometrics 42, 99–120.
Song, F., 1994. A two factor ARCH model for deposit-institution stock returns. Journal of Money Credit and Banking 26, 323–340.
Stone, B., 1974. Systematic interest rate risk in a two index model of returns. Journal of Financial and Quantitative Analysis 9, 709–721.
Sweeney, R., Warga, A., 1986. The pricing of interest rate risk: evidence from the stock market. The Journal of Finance 41, 393–410.
Yourougou, P., 1990. Interest rate and the pricing of depository financial intermediary common stock: empirical evidence. Journal of Banking & Finance 14, 803–820.
Wetmore, J.L., Brick, J.R., 1994. Commercial bank risk: market interest rate, foreign exchange. Journal of Financial Research 17, 585–596.