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# What Determines Return Risks for Bank Equities in Turkey? \*

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October 3, 2011

## Abstract

By using data from thirteen publicly traded commercial and deposit banks this paper estimates the determinants of market risk for bank equities in the case of an emerging market setting, Turkey. The analysis reveals that maturity composition of a bank's loans, the share of trading income in a banks' overall revenue stream and foreign-ownership structure are important indicators of the volatility of its equity returns. Banks with shorter loan maturity positions are regarded by investors as safer companies to invest in while increases in trading income as a source of bank's overall revenue increases the volatility of its equity returns. Foreign ownership of a bank also lowers its equity return risk.

JEL Classification codes: G10, G21, G28

Keywords: Commercial banks, risk, Turkish Banks

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# 1 Introduction

Banking and financial sector performance is crucial to economic growth as evidenced by literature (such as Levine (1997)) and other studies have shown that this causality runs from financial sector to growth (i.e. Rousseau and Wachtel (1998)). Therefore performance of the financial intermediaries is also important for economic growth. As the 2008 Global Financial Crisis has shown banks' balance sheet problems may lead to a contraction of credit to the real sector eventually triggering a recession with serious consequences. Moving from this premise, in this paper I evaluate the drivers of equity returns for financial intermediaries in an emerging market setting such as Turkey. Turkey has demonstrated a phenomenal average growth rate of 5.72% mostly fueled by extension of credit by the banking system between 2002 and 2009.<sup>1</sup> Understanding what influences banks' share prices in Turkey is also important in understanding the *Turkish economic miracle*.

Another aim of this paper is to check whether in an emerging market setting such as Turkey foreign ownership leads to lower risk for the banking system. The previous literature on this topic leads us to believe so: Micco, Panizza, and Yanez (2004) have shown that in developing countries foreign banks usually have higher profitability and lower overhead costs compared to local ones. Figueira, Nellis, and Parker. (2006) find some support for the argument that domestically-owned banks perform less efficiently than foreign-owned banks in Africa. <sup>2</sup>If this is the case in Turkey, we can also expect to see lower equity volatility for banks held in foreign ownership compared to domestic ones.<sup>3</sup> Isik and Hassan (2003) have shown that private foreign banks perform better than private domestic and government banks in Turkey. They indicate that "foreign ownership as well as being traded on the stock exchanges had the most significant effects on bank performances [and that] higher market share of foreign banks in the local banking markets was associated with higher performance of all sample banks in that market."

By utilizing data from the financial statements and about the ownership structure of thirteen publicly traded commercial and investment banks, this paper aims to evaluate the determinants of risk in equity returns for Turkish banking system. In the next section I review previous research on this issue; in Section 3 the dataset is presented; Section 4 provides the empirical estimation; Section 5 provides my findings and Section 6 concludes.

## 2 Literature Review

One of the earliest papers in literature that examines the relationship between volatility of equity returns and diversification of market value is by Templeton and Severiens

(1992) who find that increases in diversification result in diminishing marginal decreases in risk and that diversification does not appear to have an important effect on measures of systematic risk. Saunders and Walter (1994) simulate mergers between bank holding companies and non-bank firms and show that there are risk-reduction benefits of diversification. Demsetz and Strahan (1997) follow the work of Templeton and Severiens (1992) and show that although large bank holding companies(BHCs) are better diversified than small BHCs, there is not necessarily any significant difference in terms of their risk reduction. They attribute the higher risk potential of the larger BHCs to their lower capital ratios and larger commercial and industrial loan portfolios. In one of the more recent papers on this issue, Stiroh (2006) uses equity data on BHCs to evaluate the effects of BHCs' loan and revenue composition on their risk. His contribution to the literature is unique in the sense that it emphasizes market-based assessment of risk and return rather than accounting data assessment as most of previous literature has done. Market-based assessment provides forward looking perspective in terms of expected returns while accounting data is backward-looking.

All of the above mentioned literature studies the case of the US banking system. The literature that looks at the same relationship between risk in equity returns and diversification of bank activities is limited in an emerging market setting. Sanya and Wolfe (2010) uses a panel dataset of 226 listed banks across 11 emerging economies to show the effect of revenue diversification on bank performance and risk. Their findings highlight the positive impact of diversification in banks' activities on the insolvency risk and profitability. As the measure of risk in their research they use bank performance measures such as return on assets(ROA) and return on equity (ROE) adjusted for risk as opposed to a stock price measure. In terms of evaluating bank risk in Turkey however, there is no prior study that I am aware of. In that regard, this paper aims to contribute to the existing literature by providing an equity return aspect of risk in an emerging market setting such as Turkey.

### **3 Data**

I use data on the average monthly returns of thirteen publicly traded commercial and investment banks in Turkey to measure the risk factor. This data comes from The Istanbul Stock Exchange(ISE) and is only available on a monthly average return basis. My analysis excludes the Turkish Banking Crisis (2001-2002) and starts with the last quarter of 2002.

For the thirteen banks in the sample, a full data sample in terms of equity returns is only available for third quarter of 2007 onwards. Table 1 provides the summary statistics

of equity returns for the variables in the sample. Figure 2 shows the median of monthly average returns for the 13 publicly traded banks on a quarterly basis versus the medians of the standard deviation of these monthly average returns per bank on a quarterly basis for the period under study. The figure and the data reported in the table suggest a relatively non-volatile risk for the banking industry except for the 2008-2009 period which corresponds to the Global Financial Crisis. We see average monthly returns falling continuously between first quarter of 2008 till the second quarter of 2009 at a rate of over 14%, 6% and around 9% in the first, second and fourth quarter of this year respectively. The standard deviation of the average monthly returns during this period jumps to a high of 29.33%. Although this is not an all time high in the sample, the duration of the high volatility is a record for the given period<sup>4</sup>.

Table 1: Return Summary Statistics

quarter	Obs	Std of Average Monthly returns	Average monthly returns
2002q4	10	32.58	8.72
2003q1	10	18.72	-0.26
2003q2	10	15.02	5.31
2003q3	10	11.42	2.59
2003q4	10	17.88	18.47
2004q1	10	14.60	4.68
2004q2	10	10.36	-2.14
2004q3	10	9.83	8.63
2004q4	11	17.18	10.65
2005q1	11	19.02	11.17
2005q2	11	10.77	5.57
2005q3	11	12.47	9.54
2005q4	11	18.38	7.23
2006q1	12	17.76	2.50
2006q2	12	13.87	-4.95
2006q3	12	6.89	2.75
2006q4	12	13.46	1.37
2007q1	12	9.70	2.30
2007q2	12	8.36	1.64
2007q3	13	10.94	5.24
2007q4	13	7.36	0.40
2008q1	13	14.15	-14.60
2008q2	13	22.59	-6.36
2008q3	13	29.33	8.74
2008q4	13	16.46	-8.92
2009q1	13	14.54	-2.36
2009q2	13	19.36	21.84
2009q3	13	11.84	11.01
2009q4	13	15.83	4.96
2010q1	13	11.49	1.92

The table shows the median standard deviation of monthly returns and the median of average monthly returns per each quarter studied in the paper. Monthly return data is obtained from Istanbul Stock Exchange (ISE)

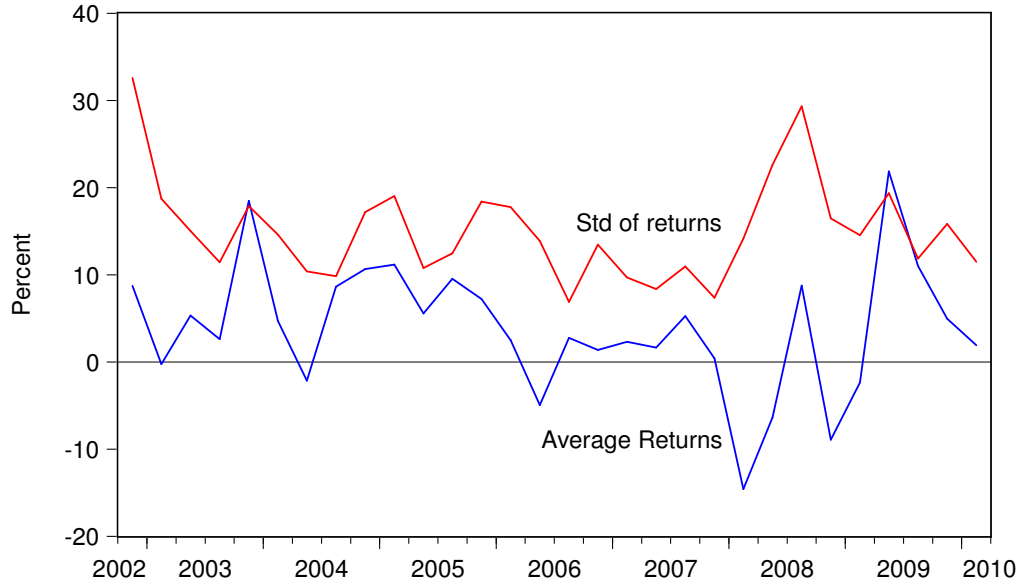


Figure 1: Bank Risk and Returns.

Source: Istanbul Stock Exchange(ISE) and Turkish Banks Association(TBB). The figure shows the median of the average monthly returns(return variable) in a quarter as well as the standard deviation of the average monthly returns in the same quarter(risk variable).

Balance Sheet and Income Statement data are obtained from the Banks Association of Turkey (TBB). This dataset covers a period of 30 quarters (2002q4-2010q1) and is unbalanced due to the unavailability of data for some of the banks in the sample. Some of the balance sheet variables pertaining to maturity composition of bank loans can only be obtained until the third quarter of 2006 limiting my ability for analysis in terms of banks' term composition of loans. Table 2 provides the summary statistics of balance sheet and income statement variables for the banks in the sample. The mean of total assets for the banks in the sample is 28.5 bil TL which corresponds to around 20 bil USD (based on an exchange rate of 1.5 TL per USD). In terms of size, the sample includes a good range of small and big banks in Turkey with assets ranging from 134 bil TL to 428 mil TL as the table shows. The wide range allows us to better reflect the effects of diversification since I are not only concentrating on big or small banks.

## 4 Empirical Estimation

I follow an empirical model on evaluating risk of Bank Holding Companies by Stiroh (2006) using balance sheet and income statement variables. In the first part of my estimation, I evaluate the effect of banks' diversification on their loan portfolios in terms of maturity

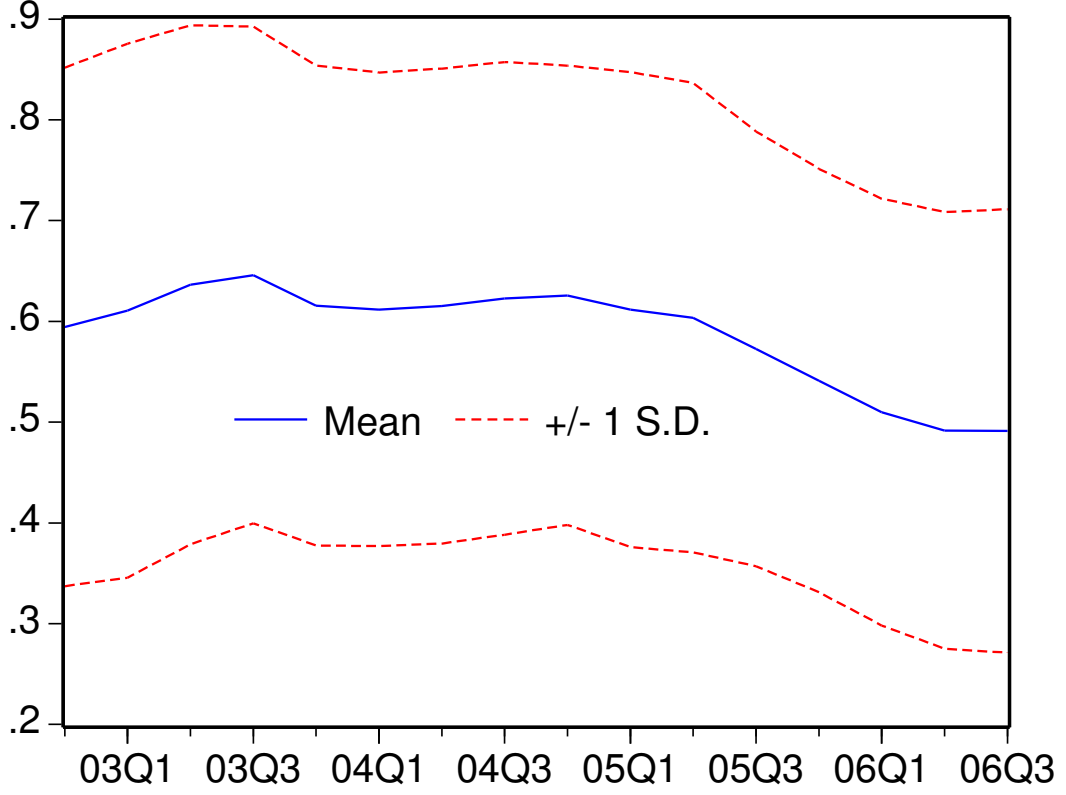


Figure 2: Short Term Loan Ratio

Source: Turkish Banks Association(TBB). The figure shows the median and 1 std deviation bounds of the short term loan to total loan portfolio in the sample.

by using the following specification<sup>5</sup>:

$$\begin{aligned}
 risk_{i,t} = & \alpha + \beta_1 \ln(ta_{i,t-1}) + \beta_2 \ln(ta_{i,t-1})^2 + \gamma shloans_{i,t-1} + \delta hhi(mat)_{i,t-1} \\
 & + \epsilon_{bank_{i,t-1}} + \zeta foreign_t + \varepsilon_{i,t}
 \end{aligned} \tag{4.1}$$

where  $risk_{i,t}$  is the risk for bank  $i$  in quarter  $t$  measured by the standard deviation of monthly returns on the Istanbul Stock Exchange during that month.  $ta_{i,t-1}$  is total assets for bank  $i$  in period  $t - 1$ . I use one period lagged variables in the estimation since investors make their portfolio decisions regarding each bank stock based on last period's financial information available.  $shloans_{i,t-1}$  represents the ratio of the bank's short term loan portfolio to its overall loans,  $hhi(mat)_{i,t-1}$  is the calculated Herfindahl Hirschmann Index (HHI) value for the bank's loan composition in terms of maturity(the higher this value, the more concentrated the bank's loan portfolio is in terms of maturity- see below for

Table 2: Descriptive Statistics For Bank Specific Variables

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Assets(ta)	28,528.75	18,981.19	134,018.20	428.40	29,597.33	1.34	4.14
Loans(loans)	13,333.29	8,026.68	57,978.95	155.23	14,336.26	1.33	3.78
FX Loans(fxloans)	4,946.19	2,874.67	26,793.77	45.50	5,632.23	1.69	5.54
Short Term Loans(stloans)	3,450.79	2,656.84	12,868.65	8.94	2,962.39	1.07	3.62
Nonint Income(nonii)	695.43	266.16	6,392.15	-1.28	1,030.27	2.65	10.89
Operating Inc(oprinc)	1,526.04	780.43	11,122.20	8.30	1,870.36	2.06	7.70
Trading Inc(trainc)	68.67	16.07	1,726.01	-378.33	203.37	3.17	19.68
Dividend Inc(divinc)	8.74	1.22	408.46	0.00	32.07	8.36	91.17
Net Fee Inc(feeinc)	259.04	125.31	1,725.07	0.69	329.06	1.99	6.89
Other Nonint Inc(othnonii)	361.08	94.86	5,054.30	-372.67	736.12	3.42	15.43
Deposits(deposits)	18,999.51	13,692.45	75,362.54	625.10	17,553.44	1.11	3.40
Equity(equity)	3,330.79	1,829.47	15,597.51	0.00	3,573.20	1.43	4.37
Nonperforming Loans(npl)	661.72	390.36	3,010.83	1.77	657.33	1.17	3.89
Offbalance Sheet Rev(offbal)	44,812.24	23,820.03	297,938.88	340.42	53,791.18	1.79	6.25
Operating Profit(profit)	389.48	164.53	3,099.60	-2,603.75	551.94	1.40	8.72

The table shows the descriptive statistics of variables for 13 publicly traded banks used in estimations. Data is obtained from the Turkish Banks Association. The number of observations is 381. All data is in terms of 1 million Turkish Liras(TL).

the calculation of this ratio)  $bank_{i,t-1}$  is a vector of other bank specific variables obtained from the balance sheets and income statements of the banks in the sample and  $foreign_t$  is a dummy variable based on bank's ownership structure<sup>6</sup>. I do not use a lagged value for  $foreign$  dummy since ownership change in banks is a more readily available information than bank specific variables and investors will make their decisions regarding buying or selling a bank stock based on ownership information at time  $t$  as opposed to a quarter ago.

In the panel estimation I use a joint cross-section and period effects model. While each bank is different, each quarter also is different in the sense that there are changes within each bank's loan portfolio and financial statement variables<sup>7</sup>. Even though period fixed effect methodology is favored by some of the existing literature such as Stiroh (2006) for the Turkish bank sample I find that using only a period-effects model, the residual error terms are serially correlated.

The bank specific vector of  $bank_{i,t-1}$  includes the following variables in from the bank's balance sheet and income statement in period  $t - 1$ :

- liability composition, measured by the ratio of deposits to total assets.
- loan quality measured by the ratio of bank's non-performing loans to overall loan portfolio
- off balance sheet activities measured by the ratio of bank's offbalance sheet income to its overall operating profit.
- bank's liquidity measured by loan to total assets ratio

To capture the impact of banks' diversification in loan maturity I compute the Herfind-



ahl Hirschmann Index (HHI) as follows:

$$HHI(mat) = \left(\frac{stloans}{loans}\right)^2 + \left(\frac{ltloans}{loans}\right)^2 \quad (4.2)$$

where,

$$loans = stloans + ltloans \quad (4.3)$$

*stloans* represents short-term loans, similarly *ltloans* stands for long term loans in the bank's loan portfolio(*loans*). HHI(mat) ranges between 0.50 and 1. An increase in this variable indicates an increase in the concentration of a particular type of loan in terms of maturity. The median value for this ratio in the sample is .57 indicating that the loan portfolios of the banks in the sample are fairly balanced. The availability of loan data in terms of its maturity composition is limited to 2002-2006 as indicated in the Data Section(Section 3).

In the second part of my estimation, I evaluate the effect of banks' revenue composition on their overall risk. For this analysis, I break down the total revenue of banks in the sample into two and five categories respectively. In the two category breakdown I evaluate banks' revenues in terms of:

1. Interest Income
2. Non-interest Income

and in the five-category breakdown, I breakdown the noninterest income further into its components as:

1. Interest Income
2. Net Fee Income
3. Trading Income
4. Dividend Income
5. Other Non-Interest Income

The estimation takes the following form for the two-component breakdown:

$$risk_{i,t} = \alpha + \beta \ln(ta_{i,t-1}) + \beta_2 \ln(ta_{i,t-1})^2 + \gamma nonii_{i,t-1} + \delta hhi(rev2)_{i,t-1} + ebank_{i,t-1} + \zeta foreign_t + \varepsilon_{i,t} \quad (4.4)$$

and the following form for the five-component breakdown:

$$\begin{aligned} risk_{i,t} = & \alpha + \beta \ln(ta_{i,t-1}) + \beta_2 \ln(ta_{i,t-1})^2 + \gamma feeinc_{i,t-1} + \theta trainc_{i,t-1} + \iota divinc_{i,t-1} \\ & + \xi othnonii_{i,t-1} + \delta hhi(rev5)_{i,t-1} + \epsilon bank_{i,t-1} + \zeta foreign_t + \varepsilon_{i,t} \end{aligned} \quad (4.5)$$

where  $nonii_{i,t-1}$  is the non-interest income for bank  $i$  at time  $t - 1$  as a ratio of operating revenue,  $feeinc_{i,t-1}$  is the ratio of the bank's total net fee income to operating revenue;  $trainc$  is the trading income as a ratio of operating revenue and similarly  $divinc$ ,  $othnonii$  are the bank's dividend and other non-interest income calculated as a ratio of its operating revenue.  $hhi(rev2)$  is the calculated Herfindahl Hirschmann Index (HHI) value for the bank's revenue composition based on two-component categorization (interest and non-interest income). The higher this value is, the more concentrated the bank's revenue becomes in terms of its source (see below for the calculation of this ratio.) Similarly,  $hhi(rev5)$  is the same ratio calculated as five-component breakdown of the bank's revenue sources.

The HHI ratios are calculated as follows:

$$HHI(rev2) = \left(\frac{intinc}{oprinc}\right)^2 + \left(\frac{nonii}{oprinc}\right)^2 \quad (4.6)$$

where,

$$oprinc = intinc + nonii \quad (4.7)$$

for the two-component breakdown and

$$HHI(rev5) = \left(\frac{intinc}{oprinc}\right)^2 + \left(\frac{feeinc}{oprinc}\right)^2 + \left(\frac{trainc}{oprinc}\right)^2 + \left(\frac{divinc}{oprinc}\right)^2 + \left(\frac{othnonii}{oprinc}\right)^2 \quad (4.8)$$

where,

$$oprinc = intinc + feeinc + trainc + divinc + othnonii \quad (4.9)$$

for the five component breakdown.

$oprinc$  represents bank's operating income,  $intinc$  is the bank's interest income and  $nonii$  is the bank's non-interest income.

## 5 Findings

Table 3 shows the results of my estimations for both maturity and revenue composition breakdowns. The estimation results suggest the following relationships for the Turkish banking system:

- An increase in the banks' short term loan composition as a function of its overall loan portfolio is inversely related with risk. A one-percentage point increase in this ratio leads to an increase in the standard deviation of monthly returns in a quarter by 28-30%. Although the significance of this relationship is not very strong, this coefficient is very high.
- Foreign ownership dummy seems to have a significant and robust effect in all of the estimations suggesting that investors foresee foreign owned banks as relatively safer than locally owned banks in Turkey. Alternatively, this suggests that locally owned banks have higher risk associated with them as opposed to foreign owned ones. This finding is in line with existing literature.
- An increase in the banks' deposits to total asset ratio is considered comforting by investors; we observe this variable to take on the negative sign in all of my estimations<sup>8</sup>.
- As highly expected, an increase in the ratio of non-performing loans in the banks' overall loan portfolio increases the risk factor; this relationship is robust in all my estimations.
- Of all the revenue components evaluated, the only one that is significance in the estimations is the trading income. A highly significant source of risk for banks in Turkey, the higher the ratio of this variable in the bank's overall revenue composition, the riskier is the bank.

The estimations however fail to find any significant relationship regarding the HHI concentration ratios I have utilized in the study. This finding suggests concentration in terms of maturity of loans or revenue breakdown is not necessarily considered by investors a significant risk factor in the equity pricing of Turkish banks.

Table 3: Determinants of Bank Risk in Turkey - Revenue and Maturity Breakdown

Dependent Variable:	Bank Risk Maturity Composition of Loans 2003q1 – 2006q4	Two-Part Revenue Breakdown 2003q1 – 2010q1	Five-Part Revenue Breakdown 2003q1 – 2010q1
Time Period	2003q1 – 2006q4	2003q1 – 2010q1	2003q1 – 2010q1
ln(Assets)	4.304839 (9.067921)	1.108201 (2.153070)	0.263136 (2.803798)
ln(Assets) <sup>2</sup>	55.97738* (36.40459)	-15.80612 (19.94260)	-63.15580* (34.92708)
Loans/Assets	-1.592572 (1.090171)	0.497277 (0.582877)	1.812313* (0.994921)
Short Term Loans/Loans	17.73643 (15.58321)	3.004876 (10.70218)	11.99092 (13.89223)
Loan Maturity HHI	-28.29606* (16.91434)		
Nonint inc/Opr. Rev	11.03216 (17.53045)		
Revenue HHI	-2.328004 (5.176921)	41.02713 (34.20813)	
(Two component)		41.66317 (34.23319)	
Net Fee Inc/Operating Rev	19.36395 (18.35402)	-2.720802 (5.420350)	
Trading Inc/Operating Rev			-11.56263 (10.78006)
Dividend Inc/Operating Rev			17.51308*** (7.161)
Other Nonint Inc/Operating Rev			-20.17104 (123.759)
Revenue HHI			3.900 (7.093)
(Five Component)			2.602 (8.397)
Deposits/Assets	-30.29008 (24.92882)		-47.88493** (18.10846)
ln(Equity/Assets)	-0.829532 (5.281086)		(18.196) (10.737)
Nonperforming Loan Ratio	71.70462* (44.18891)		18.436*** (7.161)
Foreign Bank Dummy	-9.640383** (5.051183)		-30.398 (123.759)
Offbalance Sheet Rev/Opr. Profit	-0.000971 (0.000719)		3.900 (7.093)
Adj. R <sup>2</sup>	0.480265		2.602 (8.397)
Number of banks	11		-52.680*** (18.196)
Number of observations	152		(18.10846) (10.737)
	11		-7.210289** (3.659084)
	152		2.935398 (3.853)
	295		62.45526** (29.12586)
	295		(29.12586) (14.179)
	295		-6.435* (4.004)
	295		(4.026696) (4.004)
	295		-0.001326 (0.001)
	295		(-0.001326) (0.001)
	295		0.413 (10)
	295		0.420 (10)
	295		223 (223)

This table presents the results of estimations on bank risk by using Equation (4.1, 4.4 and 4.5). Bank risk is measured by the standard deviation of average monthly returns in a quarter. All variables except Foreign Bank Dummy are lagged one period. Robust standard errors are reported in parenthesis. \* significant at 10 percent; \*\* significant at 5 percent; \*\*\* significant at 1 percent.

## 6 Conclusions

By using data from thirteen publicly traded commercial and deposit banks in Turkey, in this paper I have estimated the determinants of bank equity market risk in the case of an emerging market setting, Turkey. The analysis reveals three important conclusions regarding bank risk in Turkey from an equity return perspective: Firstly, maturity composition of a bank's loans is an important indicator of the volatility of its equity returns. The rationale here is banks with shorter loan maturity positions carry less maturity mismatch risk and are regarded by investors as safer companies to invest in. A second conclusion we can arrive from the analysis presented is that source of revenue for a bank also serves as a good predictor of bank's equity volatility. In that regard, we see that increases in trading income as a source of bank's overall revenue increases the volatility of its equity returns. This finding suggests for equity investors a bank's income statement is as important as its balance sheet and the volatile nature of a bank's trading revenue is regarded as a source of risk for bank's profitability. This finding has important implications for bank managers and regulators; bank managers who rely on trading revenue as a significant contributor of their bank's overall revenue inadvertently cause their bank stock to become more volatile; from regulators' perspective it suggests banks' trading activity is a source of risk to bank's overall health and thus needs to be more closely watched. And a final attribution of this paper to the literature on banking in Turkey is the importance it stresses on the foreign versus domestic ownership of the bank. The results of this study show there is a robust and significant link between a bank's ownership status and its equity return volatility. During the course of our study, it is observed that investors consider foreign owned banks as less risky equity investments. This finding is not unique; for Turkey and many emerging market banking systems similar results have been observed.<sup>9</sup> In that regard, this paper contributes to the literature by providing more evidence to the finding. The reasons behind investors' perception of foreign owned banks as less risky investments as opposed to domestic ones however is a topic to be investigated in further research.

## Notes

<sup>1</sup>For a survey of developments in the Turkish economy and the 2001-2002 banking crisis see Payaslioglu (2009).

<sup>2</sup>Although the authors add that they cannot safely conclude that the larger the percentage of assets owned domestically, the worse the relative performance will be.

<sup>3</sup>There are also more recent studies that argue this relationship may not hold. For instance, by using stochastic frontier analysis for a sample of 2095 commercial banks in 105 countries Lensink, Meesters, and Naaborg (2008) show that foreign ownership negatively affects bank efficiency.

<sup>4</sup>The highest volatility in my sample is recorded for the first observation (the fourth quarter of 2002) where the standard deviation of the average monthly volatility reaches 32.58%. The high volatility in this period could be considered a residual of the Turkish Banking Crisis of 2000-2001 during which Savings Deposit Insurance Fund (TMSF) closed down eleven banks and the Turkish Lira was devalued by 40% against the USD. (Tanyeri 2010)

<sup>5</sup>Stiroh (2006) uses revenue composition as a measure of his analysis, yet in the case of Turkey preliminary estimations regarding revenue composition does not necessarily yield any significant results. The same could be said for the currency composition of the banks' loan portfolio. Preliminary results regarding this variable also suggested no statistical significance and redundant variable testing proved this measure not to be a significant explanatory variable in the case of Turkish banks

<sup>6</sup>I define a bank "foreign" if the share of the foreign owner exceeds 50.01% following IFRS standards. A redundancy test shows that  $foreign_t$  is an important variable in the estimations that cannot be considered redundant.

<sup>7</sup>Results of redundant fixed effects tests for the equation reveal the joint significance of all of the effects, respectively. The cross-section/period f test has a t-stat value of 4.58 with 25 and 116 degrees of freedom and a chi-square value of 104.48 with 25 degrees of freedom. Both these tests have 0% probability which reject the restricted model in which there is only a single intercept. In addition, in estimations of the above equation using only a period effects model, I find that the residual error terms are serially correlated and the Durbin-Watson Statistic is 1.37.

<sup>8</sup>Although in the maturity composition estimations, I do not observe any significance

<sup>9</sup>Such as Isik and Hassan (2003), Figueira, Nellis, and Parker. (2006), Micco, Panizza, and Yanez (2004)

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