The Effect Of Maturity Structures Of Bank Assets And Liabilities On Performance: An Empirical Implementation On Deposit Banks In Turkey[1]

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Abstract

Asset-liability management is among the most important tasks of financial intermediaries. Credits and deposits are generally the instruments with the highest proportionally share in bank balance sheets. Therefore, when it comes to bank profitability, the management of these instruments comes to the fore. In this study, the effect of the maturity structure of the deposits in bank liabilities on the bank performance has been analysed with the censored Tobit model method.

Keywords: Banking Performance Analysis, Maturity Structures of Assets and Liabilities, Dynamic Censored Tobit Model

JEL Classification: G21, G00.

Banka Varlık Ve Yükümlülüklerinin Vade Yapılarının Performansa Etkisi: Türkiye'de Bankalardaki Kredi Ve Mevduat Üzerine Ampirik Bir Uygulama

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Öz

Aktif pasif yönetimi, finansal aracıların en önemli görevleri arasında yer almaktadır. Banka bilançolarında oransal olarak en yüksek paya sahip araçlar genellikle kredi ve mevduattır. Dolayısıyla banka karlılığı denilince bu enstrümanların yönetimi ön plana çıkmaktadır. Bu çalışmada, banka pasiflerindeki mevduatın vade yapısının banka performansına etkisi sansürlü Tobit modeli yöntemi ile analiz edilmiştir.

Anahtar Kelimeler: Bankacılık Performans Analizi, Aktif ve Pasif Vade Yapıları, Dinamik Sansürlü Tobit Modeli

JEL Classification: G21, G00.

1. Introduction

Banks are primary financial institutions that takes an important place in the economy. The main duties of the banks are to mediate the meeting of fund suppliers and fund demanders and to earn profit from the intermediary service. Deposits and loans are the two most important products in this mediate service. Loans are among the instruments that have the highest share in the assets of the bank's balance sheets and deposits in their liabilities compared to other components. Therefore, one of the main duties of bank management is asset and liability management. Bank management's ability to identify, measure, monitor and control credit risk is effective in making interest rate decisions. Management quality indicates whether it has the capacity to identify financial stress and take necessary measures.

It comes to the fore the management of this structure that affects and is affected by each other when considering all the components in the asset and liability management. There are several risks arising from this interaction. The most important ones are interest rate risk, credit risk and liquidity risk. According to the Best Practice Guide published by the Banking Regulation and Supervision Agency of Turkey (2016), this task can be fulfilled through the ALCO (Asset and Liability Committee) or another unit/committee, although the board of directors is primarily responsible for liquidity risk. Banks finance highly liquid short-term liabilities and less liquid long-term assets; due to the nature of this intermediation, it is exposed to maturity mismatch. Therefore, liquidity risk is at the centre of traditional banking transactions due to maturity mismatch. The maturity mismatch of asset and liability items in the balance sheet of banks can also cause interest rate risk (Yalcinkaya and Ekinci, 2017). Another definition of interest rate risk is the risk a financial instrument

is exposed to when the maturities of its assets and liabilities do not match (Saunders and Cornet, 2017). Changes in interest rates also affect the current values of banks' assets and liabilities (Uzunoglu, 2005). This also affects the net interest margin.

Banks are organizations that do business by providing financial intermediary services and whose main task is to make a profit, like other traders. The most commonly used ratios in bank profitability analysis studies are return on assets, return on equity and net interest margin. When the profitability of banks is mentioned, two main income items stand out: interest income and non-interest income. When the income statements of banks are analysed, it is seen that the difference between interest income and interest expenses is net interest income. Net Interest Margin (NIM) is obtained by dividing the net interest income by the total assets of the bank. The level of the net interest margin is affected by the bank managers' decisions in asset and liability management. The committees responsible for asset and liability management determine the deposit and loan interest rates according to the interest rates in the financial market, and sometimes they can direct the market's interest rate. It is not necessary for banks to assume the risk of high interest rates for profitability. Some economists argue that banks can increase their profitability with high interest rate risk; On the other hand, economic analyses and experiences do not confirm this claim. While many banks made profits with modest interest rates; others suffered serious losses due to excessive risks. The bank does not need to take the risk of high interest rates to earn more profits (Matz 2010).

Banks manage the risks of interest rates according to their maturity structures. Changes in interest rates affect the decisions of banks' asset and liability committees. In this study, the effect of the maturity structures of the loans given by the banks and the deposits collected by the banks on the net interest margin during the periods of increasing and decreasing interest rates is examined.

In studies on the profitability of banks in Turkey, ratios such as return on assets and return on equity are commonly used. In financial markets, banks' asset sizes, contributions to the economy and profits are discussed. This study examines the change in the maturity structure of banks' loans and deposits and whether the asset/liability management, which is the source of this change, has an effect on the profitability of the bank.

In studies on asset/liability management, liquidity mismatch and maturity mismatch, the risks arising from these mismatches are generally

examined in periods when interest rates increase or decrease. In studies on bank profitability, the effects of internal and external factors on profitability are generally examined. In this study, the effects of changes in loans and deposits' maturities according to the term structures of interest rates, and the changes in loans and deposits' maturity structures in bank assets and liabilities in periods when interest rates increase or decrease, on the net interest margin are studied. When the studies in this field related to the Turkish banking sector are examined, it is seen that panel data regression analysis and CAMELS analysis are generally used. This study was analysed with Tobit model. While the net interest margin is taken with its real value in the periods when the interest rates increase, the net interest margin in the decreasing periods is censored; In periods when the net interest margin is decreased, the net interest margin is taken with its real value, the net interest margin in the increase periods is censored. Net interest margin is used in the model simultaneously in both the increase and decrease periods. This study is an original study using the censored Tobit model.

2. Literature Review

There are various studies in the academic literature on asset-liability management, maturity mismatch and performance analysis of banks.

Samuelson (1945), in his study examining the effects of the rise in interest rates on the banking system, wrote that increasing interest rates in the USA would be beneficial to any organization whose average maturity of debt is longer than the average maturity of its assets. Stated that an increase in interest rates would be beneficial to banks rather than hindering them immeasurably.

In research on profitability analysis, there is Ho and Saunders' (1981) research that models the net interest margin. In this study, it is stated that interest margins depend on the volume of transactions carried out by the bank, the degree of risk aversion, the change in interest rates and the market structure of the bank.

Flannery (1983) stated in his study that in order to measure interest rate risk, the average maturity difference between assets and liabilities should be calculated. Chosen 12 banks are divided into 5 categories according to their asset sizes (between 1960-1978) in 1978: below 25 million USD, 25-49.9 million USD, 50-99.9 million USD, 100-299.9 million USD, over 300 million USD. Large banks (with assets exceeding US$ 2 billion in 1978) take good precautions against changes in interest rates. When market interest rates change, banks change their costs and incomes, ensuring that their net operating income is not affected by this situation. Thrift institutions have

balance sheet mismatches that cause their incomes to fluctuate in interest rate changes. Small banks, on the other hand, are generally concerned with retail savings and have access to a wider range of assets and liabilities. Therefore, the similarity of small banks to large commercial banks in exposure to interest rate risk is not clear.

Angbazo (1997) made a study on commercial banks of different sizes in the USA by examining the bank balance sheet data for the years 1989-1993 by adding the non-payment risk and the relationship of the non-payment risk with the interest rate to the model of Ho and Saunders (1981). He built his hypothesis on the approach that banks with higher risk and higher interest rate loans would have higher net interest margins and tested this hypothesis. It has been concluded that the research results are consistent with the hypothesis, that the interest margin reflects the default and interest rate risk premium.

Claessens, Demirgüç-Kunt and Huizinga (2001) examined the effect of foreign banks on local banking markets in their study with data from 7.900 banks in 80 countries between 1988-1995. They concluded that foreign banks in developing countries earn higher returns than local banks, while the situation in developed countries is the opposite. They stated that foreign banks in developing countries have higher interest margins, profits and tax payments. They stated that the entry of foreign banks transformed the market, made the national banking market more competitive, and therefore local banks were compelled to start more efficient management.

Aysun (2012) shows that maturity mismatch, capital flow and profitability in developing countries at the level of banks are positively related to capital flows. In particular, the analysis with bank-level data reveals that maturity mismatches increase significantly during periods of high cash inflows, and although it is more profitable, when there is no sudden change in capital in more stagnant periods, banks with high maturity mismatches experience greater losses. Used the short-term debts / total liabilities ratio for the maturity mismatch measure, and the return on assets and return on equity for the general profitability measure.

Ghosh (2012) states in his book Managing Risks in Commercial and Retail Banking that interest rate risk mainly arises from mismatch or difference in assets, liabilities and off-balance sheet items. Elements of interest rate risk are yield curve risk, basis risk, mismatch risk, reinvestment risk, embedded options risk, and net interest position risk. Mismatch risk represents the risk arising from maturity mismatches of assets, liabilities and off-balance sheet positions and differences due to the timing of repricing of these items. For

example, if a three-year fixed rate loan is financed with a six-month maturity deposit, the bank will have to renew its time deposits at higher rates every six months in line with the market trend, and the interest margin will narrow. Similarly, if a bank is financing a one-year loan with a three-year fixed-rate time deposit, the bank may not be able to maintain the interest margin if loan interest rates fall in the second year. When the inflation rate rises in an economy or the local currency depreciates rapidly against foreign currencies, the central bank intervenes in the market with monetary policies including liquidity tightening in the financial system. When banks experience liquidity constraints, they increase interest rates on time deposits to take in new deposits and not miss out on due deposits, which raises the average cost of funds. When loan interest rates follow market interest rates, customers taking loans demand a reduction in interest rates. Banks cannot increase their loan interest rates unilaterally in accordance with the agreements they have signed with their customers. In cases where credit agreements allow banks to increase interest rates, banks may not take quick action to avoid losing their good customers. Therefore, differences in the timing of repricing of assets and liabilities pose interest rate risk even when flexible interest rate policy is applied and reduce net interest income until interest rate revision is made. Therefore, the risk of non-compliance is one of the risks that cannot be avoided in banking. Ghosh stated in his study that banks' assets and liabilities should be evaluated in terms of interest rate sensitivity in terms of earnings approach and economic value approach. He stated that the earnings approach is used to measure the effect of interest rate change on a bank's profit in the short run and the economic value approach shows the effect on equity.

Young, Wiseman, and Hogan (2014) investigated the maturity mismatches in the commercial banking system in the USA that led to the crisis between 1990 and 2009. According to the data analysed during this period, there is weak evidence that market participants to determine banks provide short-term funds. It was stated that this situation resulted from a break in 1996. Analyses made by separating the time series data as 1990-1996 and 1997-2009 show that banks provide short-term funds in the early period. However, there is no such evidence for the 1997-2009 period. After 1996, consumer loans and real estate loans for market participants are short-term; commercial and industrial loans and cash assets have been long-term. During maturity mismatch periods, banks tend to increase their real estate loans within their total assets.

English, Heuvel, and Zakrajšek (2018) stated in their study on interest rate risk and bank equity valuation that bank managers were closely involved

in the management of interest rate risk after their experiences in the deposit and loan crisis of the 1980s. In the literature, on the one hand, there is evidence that bank net interest margins and profits increase when interest rates rise and there is an increasing yield curve, and on the other hand, there is evidence that the value of bank stocks decrease. They described their contribution in three stages. In the first, they defined the problem with the activity study approach. In the second, they used core deposit dependency and interest rate derivatives in their analysis as a new measure of maturity mismatch. Finally, in order to better understand the mechanisms that determine the effects of interest rates on equity values, they refer to the balance sheet and income statement items in the annual reports of banks. They analysed the quarterly data of 4.827 commercial banks in the USA from 1996 to 2009. The results of their studies show that an unexpected increase in the level or slope of the yield curve during the periods of monetary policy announcements causes a large economic and statistical decrease in the equity values of banks.

Table 1. Similar Studies in Turkey in the Recent Period

Research	Year	Object	Methodology	Results
Agaoğlu	1994	Analysis of the general structure of profitability and banking dilemma in the Turkish banking system	Multiple regression analysis	There is a negative relationship between loan / deposit ratio and profitability in the post-1980 period. An expensive resource will be tied up in assets (dirty assets) as an expensive resource can be placed at high interest rates and borrowers will generally have high credit risks. In this case, bank profitability will be negatively affected as banks will have to move away from loans.
Erol	2007	Analysis of the determinants of net interest margin in the Turkish banking sector	Panel data regression analysis	There is a positive relationship between the ratio of net short-term assets to total assets and the net interest margin. This arises from the fact that banks opened short positions due to the continuation of the expectation of a decrease in interest rates.
Aysan, Dalgic & Demirci	2010	Analysis of the determinants of macroeconomic, sector-based and bank-based net interest margin	Panel data regression analysis	There is a positive relationship between real interest rates and net interest margin. This is due to the uncertainty and therefore the increase in margins in the period when interest rates increase.
Taskin	2011	Analysis of the factors affecting the performance of banks in Turkey	Panel data regression analysis	There is a negative relationship between loans / total assets ratio and net interest margin.
Kucukbay	2017	Analysis of factors affecting bank profitability in Turkey	Panel data regression analysis	Loan ratio and capital ratio positively affect the net interest margin.

Ozturk Karacor, Mangir, Kodaz & Kartal	2017	CAMELS of public and private banks performance analysis	CAMELS rating system	Private banks are more successful in measuring asset quality. Public banks are more successful in measuring sensitivity to market risk.
Erdogan & Karaca	2018	Performance analysis of the Turkish banking sector with the CAMELS rating system	CAMELS rating system	In the market risk sensitivity component, public banks have the highest performance, private banks have the second-best performance, and foreign banks have the lowest performance.
Emir & Cizgici Akyuz	2018	Financial performance evaluation of deposit banks in Turkey	CAMELS rating system	While foreign deposit banks showed the highest performance in capital adequacy, asset quality and liquidity components, private capital deposit banks showed the highest performance in the market risk sensitivity component.
Diko	2019	Analysis of the determinants of net interest margin in the Turkish banking system	Panel data regression analysis	There is a positive relationship between the net interest margin and the fluctuation of the overnight borrowing interest rate in the interbank money markets.
Senol, Oncul & Alici	2019	Analysis of the effect of bank-specific financial risks on bank profitability in Turkey	Panel data regression analysis	While the effect of liquidity risk on bank profitability is positive, credit and capital risk affect profitability negatively.
Goçmen Yagcilar ve Kalayci	2020	Analysis of the micro determinants of net interest margin in the Turkish banking sector	Panel data regression analysis	There is a positive relationship between the share of credits and receivables in total assets and net interest margin.

3. Methodology

The Tobit model or censored regression model was proposed by Tobin in 1958. This model is used to analyse limited dependent variables, in other words, dependent variables with an upper or lower limit. The regression is obtained by matching the previous mean with a basic regression model (Greene, 2002). The general formula of the model is given as an index function;

$$y_i^* = x_i'\beta + \varepsilon_i$$

$$if\ y_i = 0\ \ eğer\ y_i^* \leq 0$$

$$if\ y_i = y_i^*\ eğer\ y_i^* > 0.$$

In here x_i' gives a vector of variation of loans and deposits' maturity structures. β is the vector of parameters. y_i^* gives the NIM, which is the censored dependent variable during periods of increasing and decreasing interest rates. While NIM was included in the model with its real value during the periods of increase, the data was censored by giving a value of zero for the periods of decrease. In the decline periods, the NIM is included in the model with its actual value (NIMD), while the data is censored by giving a zero value for the increase periods. Here, the value zero is arbitrarily chosen and $\varepsilon_i's$ are assumed

to be $\mathrm{IIN}(0,\sigma^2)$. This is known as the Tobit model after work published by Tobin in 1958. Only NIM is censored in order to see the effect of independent variables in the periods of increase and decrease of interest rates. All data of independent variables are known.

4. Empirical Results

In this study, it is examined whether the maturity structures of banks' deposits affect on NIM in periods when interest rates increase. For this purpose, the period from the end of 2003 to the end of 2019 was examined and quarterly data (65 periods) were used. Loans are in three groups as loans with a maturity of up to three months, loans with a maturity of 3-12 months and loans longer than 12 months; deposits are analysed in two groups as demand deposits and time deposits. Since a common interest rate was analysed for all banks, two-year benchmark interest rates were used and changes in these interest rates were examined. In the study, using the data of 10 banks, the relationship between the variables was examined with the Tobit model. Stata 16 package program was used in the analyses in the study.

The results of the analyses made on banks with an asset size of more than TL 100 billion are given in the tables in this section. Since the type of bank is thought to be important, separate models with the dummy variable were created. In these models, where the "BnkT" dummy variable is used, the value of "1" is given to public banks, while the value of "0" is given to private banks.

Table 2. Descriptive Statistics

Variable	Mean	Std.Dev.	Minimum	Maximum
NIM	0.0161572	0.0199866	0	0.0776711
NIMD	0.0253202	0.0230976	-0.0032851	0.0779979
L1	0.2805679	0.1108888	0.0507638	0.6639024
L2	0.2149305	0.0857011	0.0190059	0.4428952
L3	0.5045016	0.1101426	0.2033684	0.8632135
D1	0.1977263	0.0963555	0.0803286	0.8257906
D2	0.8022737	0.0963555	0.1742094	0.9196714
LrD	0.9606903	0.2697778	0.1605678	1.482039
LrA	0.5560697	0.1286471	0.1163878	0.7413498
Number of Observations		650		
Period	2003/12	2019/12		

Note: NIM, net interest margin (in times of rising interest rates); NIMD, net interest margin (in times of decreasing interest rates); L1, loans with three months to mature; L2, loans 3-12 months to mature; L3, loans with more than 12 months to maturity; D1, demand deposits; D2, time deposits; LrD, Loans/Deposits ratio; LrA, Loans/Total Assets ratio.

Table 3. The Effect of Loans on NIM/NIMD in the Periods of Increasing/decreasing Interest Rates According to Maturity Structures

Depdent Variable	NIM				NIMD			
	Model 1		Model 2		Model 3		Model 4	
	Coefficients	Marginal Effects	Coefficients	Marginal Effects	Katsayı	Marjinal Etki	Katsayı	Marjinal Etki
Constant	0.0077**		-0.0099*		0.0276***		0.091***	
L1	-0.0181***	-0.0181			0.0634***	0.0634		
L2			0.0234**	0.0234			-0.0634***	-0.0634
L3			0.0159**	0.0159			-0.0634***	-0.0634
LrD	0.0141***	0.0141	0.0136***	0.0136	-0.0209***	-0.0209	-0.0209***	-0.0209
Wald chi²	32.7900		33.3700		99.9800		99.9800	
Prob > chi²	0.0000		0.0000		0.0000		0.0000	

Note: Figures in parenthesis are standard errors. ***,** and * indicates significance at 1 %, 5 % and 10 % statistical levels respectively.

Table 4. The Effect of Loans on NIM/NIMD in the Periods of Increasing/ Decreasing Interest Rates According to Maturity Structures by Type of Bank

Depdent Variable	NIM				NIMD			
	Model 5		Model 6		Model 7		Model 8	
	Coef	Marginal Effects	Coef.	Marginal Effects	Coef.	Marginal Effects	Coef.	Marginal Effects
Constant	0.013**		-0.016**		0.021***		0.097***	
L1	-0.030***	-0.0301			0.076***	0.0760		
L2			0.038***	0.0384			-0.078***	-0.0780
L3			0.028***	0.0284			-0.076***	-0.0758
LrA	0.0224***	0.0224	0.020***	0.0200	-0.034***	-0.0340	-0.033***	-0.0333
BnkT	-0.0047**	-0.0047	-0.005**	-0.0052	0.0074**	0.0074	0.008**	0.0075
Wald chi²	33.06		34.03		98.20		98.32	
Prob > chi²	0.000		0.000		0.000		0.000	

Note: Figures in parenthesis are standard errors. ***,** and * indicates significance at 1 %, 5 % and 10 % statistical levels respectively.

* In the analyses examined on the maturity structures of the deposit, no meaningful conclusion could be reached.

5. Conclusion

In the study, the effect of the change in the maturity structure of loans and deposits on the net interest margin in periods when interest rates rise and fall has been examined. While significant results were obtained in the models created for the maturity structures of loans in the study, significant results could not be obtained in the models related to the maturity structures of deposits. The reason for this is that 98% of the total deposits in the Turkish banking sector consist of demand deposits and maturity deposits of up to 3 months. In other words, the fact that the maturity structure of deposits is not

dispersed in the banking system and concentrated on a single point is also reflected in the findings. For this reason, the study focused on the effects of loans on the net interest margin according to their maturity structure.

Due to the fact that the maturity distribution of deposits in the banking sector in Turkey is predominantly deposits with a maturity of up to 3 months, short-term interest rates are effective in determining interest rates. Due to the low share of long-term deposits, the management of loan interest rates is more prominent.

In times of increased interest rates, banks are expected to increase their loan interest margins and as a result, the net interest margin will increase. In this period, competition in short-term loans is increasing in order to maintain the market share. Long-term loans given with the expectation that interest rates will decrease in the future, during periods of decreasing yield curve situation, ensure that banks' interest margins are higher in the period after the interest rates decrease. For this reason, relatively longer-term loans given when interest rates increase are expected to positively affect the profits of banks. In periods where there is a humped yield curve situation, short-term loans are preferred more until the interest rate increase slows down.

In periods when interest rates decrease, the increase in the share of short-term loans provided by banks ensures an increase in the net interest margin. On the other hand, this situation reduces the risk of banks to stay in reverse position in case of an increase in interest rates. In this period, the margin between the interest rates of long-term loans provided and deposit rates is decreasing. As the interest rates increase again, a negative margin occurs, so the increase in the long-term loan share affects the profitability negatively.

As a result of the study, it has been observed that the increase in the share of loans with 3 months to maturity in periods when interest rates increase has a negative effect on the net interest margin. It was observed that the increase in the share of loans with more than 3 months to maturity had a positive effect on the net interest margin. The results are in line with the study of Aysan, Dalgıç, Demirci (2010), which showed that the net interest margin increased in the period when interest rates increased. This is due to the fact that short-term loan interest margins are more competitive in times of increased interest rates, and the increase in long-term loan interest rates and interest margins. In periods when interest rates increase, the net interest margin in public banks is lower. This is due to the fact that public banks reduce their interest margins in order to balance competition.

It has been observed that the increase in the share of loans with 3 months remaining due in periods of falling interest rates positively affects the net interest margin. It was observed that the increase in the share of loans with more than 3 months to maturity had a negative impact on the net interest margin. The results are consistent with Erol's (2007) study. This is due to the more effective management of short-term loan interest margins (such as floating interest rates) during periods of decreasing interest rates, the increase in the share of short-term loans due to the expectation of a decrease, and the decrease in long-term loan interest rates and interest margins. In periods when interest rates decrease, the net interest margin is higher in public banks. This is due to the lower cost of resources in public banks and the lower cost of resources compared to the sector, as there is access to public resources. The fact that the loans / total assets ratio was negatively related to the net interest margin in the period when the interest rates decreased is similar to the findings of Taskin's (2011) study.

In the main model, the effect of loans according to maturity structures on the net interest margin increased, while in the model in which bank type (dummy) was added, the effect of loans increased according to maturity structures. In terms of net interest margin in the period when interest rates increase, the performance of public banks is lower than that of private banks, while public banks perform higher when interest rates decrease.

When the results are analysed in terms of private banks and public banks, it is seen that private banks adopt a more aggressive asset-liability management in periods when interest rates increase; On the other hand, it is observed that public banks prefer a more balanced management. In the periods when the interest rates decrease, while the public banks are more willing; private banks adopt a more conservative asset-liability management.

It is recommended that banks increase their loan share with a maturity longer than 3 months in periods when interest rates increase, and increase their share of short-term loans in periods when they decrease, while being more conservative in their long-term loan share.

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Appendix

Table 7. Banks by Assets Size Used in The Study

Bank	**Asset Size (K TL)**	**Bank Type**
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	649.756.191	Public
Türkiye İş Bankası A.Ş.	468.059.471	Private
Türkiye Halk Bankası A.Ş.	457.045.401	Public
Türkiye Vakıflar Bankası T.A.O.	419.425.553	Public
Türkiye Garanti Bankası A.Ş.	391.152.270	Private
Yapı ve Kredi Bankası A.Ş.	387.495.827	Private
Akbank T.A.Ş.	360.501.112	Private
QNB Finansbank A.Ş.	181.680.511	Private
Türk Eximbank	162.883.112	Private
Denizbank A.Ş.	156.478.028	Private
Türk Ekonomi Bankası A.Ş.	107.350.168	Private