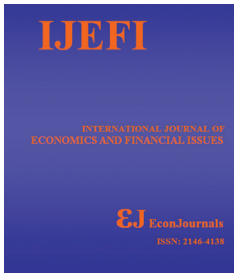

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Influencing Factors of Net Interest Margin in Turkish Banking Sector

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ABSTRACT

The aim of this paper is to define the influencing factors of net interest margin in Turkish banking sector. Within this scope, the effects of 14 explanatory variables on net interest margin were analyzed. Moreover, quarterly data for the period between 2003 and 2014 was used in this study. After that, we created a model by using multivariate adaptive regression splines method so as to illustrate the relationship. The major finding in this study is that net interest margin is negatively related with non-interest income, non-performing loans, total assets and exchange rates. According to these results, it was determined that banks should focus on the quality of the assets in order to increase net interest margin. In addition to this situation, volatility in exchange rates should also be taken into the consideration by the banks for this situation.

Keywords: Banking, Net Interest Margin, Multivariate Adaptive Regression Splines, Turkey
JEL Classifications: E43, G2, G21, O16

1. INTRODUCTION

The importance of the banks for the economies increases especially after globalization. They play such an important role for financial sectors that most of the investments in the countries depend on the loans given by the banks. In addition to this situation, depositors can gain interest income owing to banks. Because of this situation, banking sector is developing almost all around the world.

Similar to this situation, banking sector is also growing in Turkey. Especially, after the banking crisis occurred in 2001, Turkey made a lot of regulations related to banking sector. The subjects of risk management and auditing became more important in the banking sector. Due to these improvements in the banking sector, many foreign banks entered to Turkey.

However, the growing banking system in Turkey brings with questions of bank performance and profitability of the system. New regulations on income limitations of banks and low saving rate increase banks deposit competition. This competition affects deposit interest rate, liquidity and bank profitability. Stability of the banking sector is important task for economic growth.

When taking into the consideration of these factors, in this paper, we tried to understand the determinants of net interest margin in Turkish banking sector. So as to achieve this purpose, we created a model by using multivariate adaptive regression splines (MARS) method. This method was firstly used in this study related to the subject of net interest margin. By making this model, it will be possible to define the ways to increase net interest margin in order for the banks to perform more efficiently.

The paper is organized as follows: After introduction part, the second part describes background of net interest margin in Turkey. After that, the third part provides literature review and fourth part includes research and application, to understand the relationship between determinants MARS method was used. Finally, the analyze results were given at conclusion.

1.1. Net Interest Margin in Turkish Banking Sector

Net interest margin is a measure of the difference between the weighted average of yields on interest revenue and interest expense (Islam and Nishiyama, 2016). The difference amount shows the profitability of banks. Moreover, net interest margin

gives information about the intermediation costs and efficiency of the banks (Türker-Kaya, 2001).

Turkey is a country which suffered from 2 important banking crises occurred in 1994 and 2001. Because of this situation, many improvements were implemented in banking sector of Turkey after 2003. These improvements led to many positive results in this sector, such as low amount of non-performing loans as it can be seen in Graph 1. Because of these positive developments, Turkish banking sector became very attractive for foreign investors.

The Graph 2 also gives information about the changes in loans and deposits after 2003.

As it can be seen from the Graph 2, there was significant increase in both loans and deposits in Turkish banking sector after 2004. Moreover, interest rates were also affected from these improvements. The Graph 3 illustrates interest rates in Turkey after 2003.

It was seen in Graph 3 that there was a radical decrease in both consumer lending interest rates and individual deposit interest rates after 2003. As a result of these improvements, net interest margin of Turkish banking sector was also affected. The Graph 4 gives information about net interest margin after 2003.

As it can be seen from the Graph 4, net interest margin of Turkey has a decreasing path after 2004. This ratio was 5.77 in 2004 whereas it declined to 3.44 in 2014. Another interesting result that can be understood form this graph is that this ratio increased in 2009 due to the global economic crisis occurred in 2008. In addition to this situation, the Graph 5 gives information about the net interest margin of Turkish banks with respect to their types.

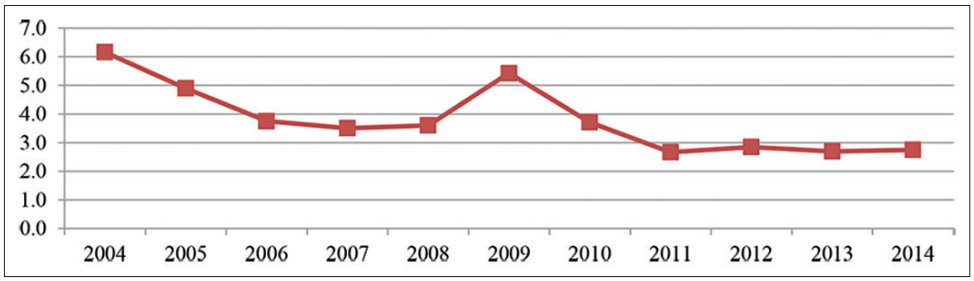
It can be understood from Graph 5 that there was a decrease in net interest margin in all types of the banks. It can also be seen that net interest margin of foreign banks was higher than the state banks and private banks in all years. Additionally, it was identified that net interest margin in private banks is almost similar to the net interest margin of state banks.

2. LITERATURE REVIEW

There are lots of studies related to the determinants of net interest margin in the literature. Some of these studies were depicted on Table 1.

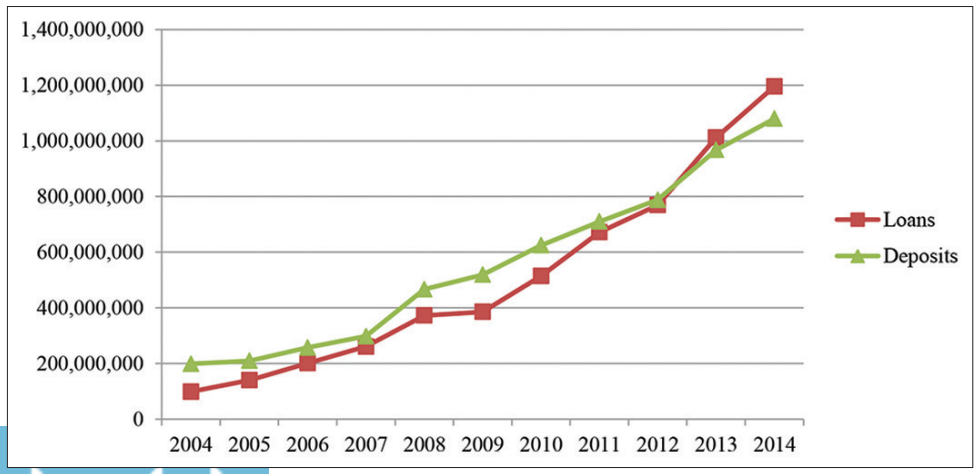
Abreu and Mendes tried to explain the determinants of net interest margin for some European countries. Within this context, 4 European countries were analyzed in this study. Moreover, the data for the period between 1986 and 1999 was tested by using regression method. As a result, it was concluded that, loan-to-asset ratio has a positive impact on interest margins (Abreu and Mendes, 2001). López-Espinosa et al. (2011) also reached the same conclusion for 15 developed and emerging economies by using the same method.

Graph 1: Non-performing Loans of Turkish Banks (2004-2014)



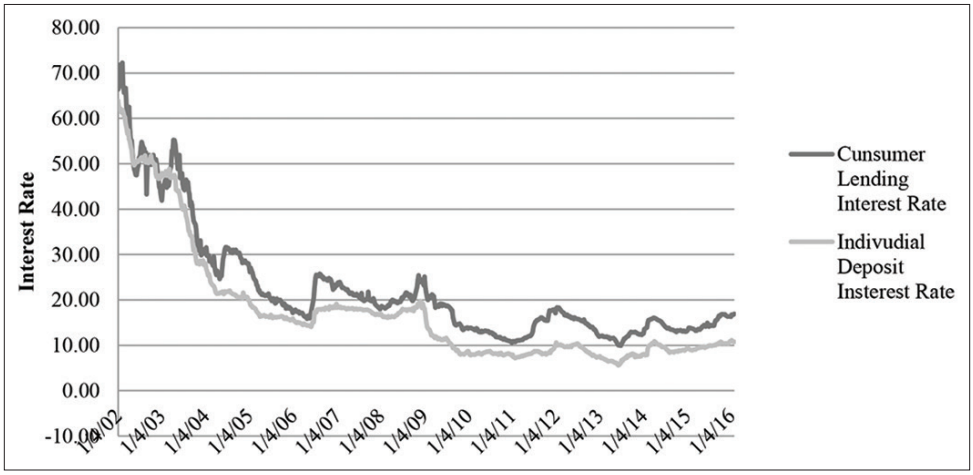
Source: Turkish Banking Association

Graph 2: Total Loans and Deposits of Turkish Banks (1,000 TL) (2004-2014)



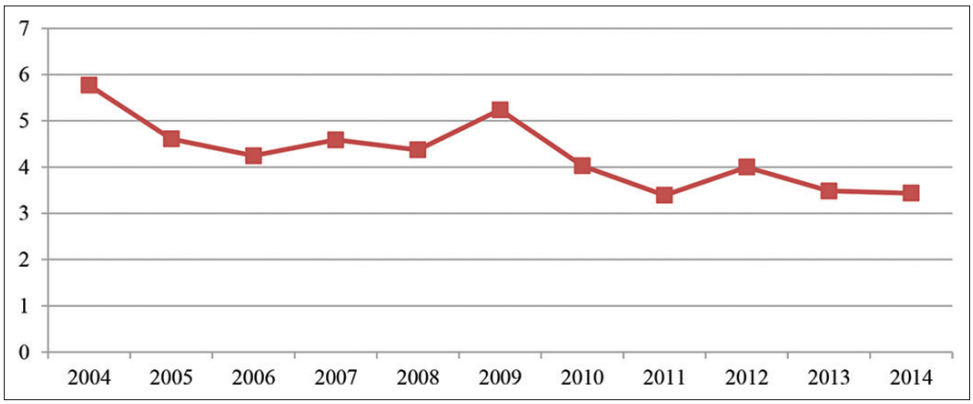
Source: Turkish Banking Association

Graph 3: Banks Average Lending and Borrowing Interest Rate in Turkey



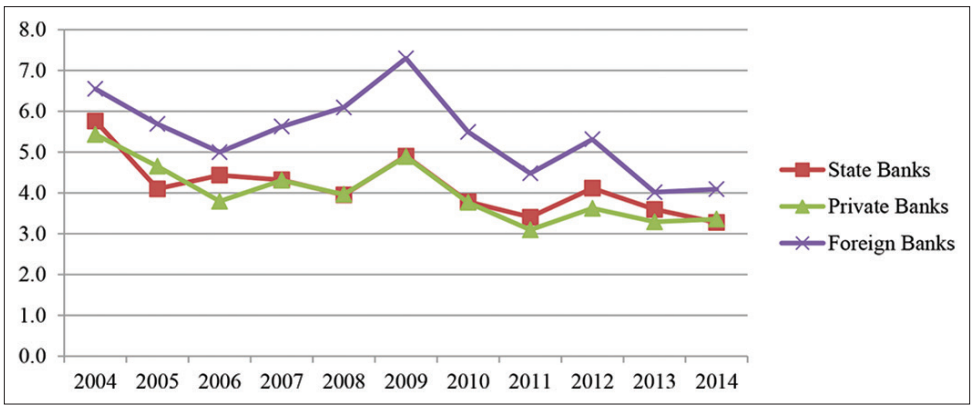
Source: BRSA

Graph 4: Net Interest Margin of Turkish Banks (2004-2014)



Source: Turkish Banking Association

Graph 5: Net Interest Margin of Turkish Banks Regarding Ownership (2004-2014)



Source: Turkish Banking Association

Almorzoqi and Naceur made a study to investigate determinants of bank interest margins in the Caucasus and Central Asia. In order to achieve this purpose, the data of 6 different countries for the years between 1998 and 2013 was used in this study. They concluded that the size of the banks is positively related with net interest margin (Almarzoqi and Naceur, 2015). Gerlach et al. (2005), Valverde and Fernandez (2007) and Beck and Hesse (2006) found the similar results by using different methods.

Angbazo tested the determinants of net interest margin of the banks located in United States. Within this context, the data for the period between 1989 and 1983 was analyzed in this study. As a result of this analysis, it was determined that net interest margin of the banks decreases when there is an increase in NPL (Angbazo, 1997). Kannan et al. (2001), Dumičić and Rizdak (2013), Rahman et al. (2015) also made the same conclusion by using regression method.

Table 1: Studies related to net interest margin

Author	Method	Determinants	Results
Ho and Sounders (1981)	Regression	Interest rate, required reserve ratio, NPL	It was defined that there is a relationship between interest rate and net interest margin
McShane and Sharpe (1985)	Regression	Total deposits, total loans, net income before tax, interest rate, required reserve ratio, total assets, capital amount	It was determined that there is a relationship among interest rate uncertainty and net interest margin
Angbazo (1997)	GLS	NPL, loan provision amount, liquid assets/total assets, short term assets, total assets, total deposit amount, derivatives amount	It was concluded that there is a negative relationship between NPL amount and net interest margin
Demirgüç-Kunt and Huizinga (1999)	Regression	Loans/total assets, equity/lagged total assets, non-interest earning assets/total assets, customer and short-term funding/total assets, overhead/total assets, Foreign ownership dummy, GDP per capita, growth rate, inflation rate, real interest rate, tax rate, reserves interacted with GDP, deposit insurance, bank assets/GDP, stock market capitalization/GDP, number of banks, law and order index	It was determined that foreign banks have higher net interest margin than domestic banks
Saunders and Schumacher (2000)	Regression	Interest expense, required reserves, NPL, interest rate, capital to asset ratio	It was determined that there is a negative relationship between capital amount and net interest margin
Abreu and Mendes (2001)	Regression	Total employment costs/total assets, equity/total assets, loans/assets, bank market share, unemployment rate, inflation rate, exchange rate, time trend, dummy variable for crisis period	It was concluded that there is a positive relationship between loan-to-asset ratio and interest margin
Kannan et al. (2001)	Pooled data model	Log of total assets, non-interest income to total assets, total deposits, off balance sheet items, per capita number of commercial bank offices, fixed assets, NPL	It was concluded that non-performing loans affect net interest margin of the banks in India
Brock and Franken (2003)	Panel data analysis	Interest rate, capital, total loans, total loans/number of personnel, total assets, Number of Branches, Herfindahl Index in terms of total loans, dummy variable for Asian crisis	It was concluded that bank capital is positively correlated with net interest margin
Sensarma and Ghosh (2004)	Panel data analysis	Operational expense, non-interest income, total assets, mortgages, consumer loans, GDP growth rate, inflation	They concluded that bank ownership is a very important determinant of net interest margin
Drakos (2003)	GLS	Liquid assets/total assets, loan provision/total loans, short term assets/capital, capital amount, dummy for the ownership of the bank	It was defined that entry of foreign banks causes net interest margin to decrease
Naceur (2003)	Regression	Equity, the overhead to assets ratio, bank loans, non-interest bearing assets, total assets, inflation, economic growth	It was determined that there is a positive relationship between the amount of the capital and net interest margin
Gerlach et al. (2005)	Panel data analysis	Liquid assets, NPL, capital, Herfindahl index, inflation, GDP growth rate, real interest rate, dummy variable for ownership of the bank	It was defined that there is a negative relationship between the size of the banks and net interest margin
Maudos and De Guevara (2004)	Panel data analysis	Market structure, operating expenses/total assets, equity/total assets, volatility of market interest rates, NPL, Interaction between credit risk and market risk, average size of operations/volume of loans, implicit interest payments, the cost to income ratio	It was defined that there is a relationship between interest rate risk and net interest margin
Peria and Mody (2004)	Panel data analysis	Liquid assets, NPL, capital, Herfindahl-Hirschman Index, inflation rate, GDP growth rate, interest rate, dummy variable for the ownership of the bank	It was defined that there is indirect relationship between foreign participation in banking sector and net interest margin

(Contd...)

Table 1: ***(Continued)***

Author	Method	Determinants	Results
Aliaga-Diaz and Olivero (2005)	Regression	GDP per person, total loans, consumer loans, commercial loans, interest rate, loan provision, total deposit, inflation rate, liquidity ratio, capital adequacy ratio	It was concluded that bank liquidity level affects net interest margin
Doliente (2005)	Regression	Operational costs/total assets, loan provisions/total loans, liquid assets/total assets, capital/total assets, interest rates	It was concluded that net interest margin decreased after crisis period
Valverde and Fernandez (2007)	GMM	NPL/total loans, liquid assets/short term liabilities, interbank interest rate, capital and reserves, consumer loans/total loans, total deposit/total liabilities, non-interest income/total assets, GDP	They concluded that there is a relationship between market power and net interest margin
Hanweck and Ryu (2005)	Panel data analysis	Short term interest rate, short term assets, deposits, total loans/total assets, NPL, total assets	It was concluded that volatility of interest rates affects net interest margin
Burgstaller (2006)	VAR	GDP growth rate, overnight interest rate, concentration ratio in banking sector, non-interest income/operating income, capital adequacy ratio, cash ratio, total loans/total assets, mortgages/total assets, commercial loans/total assets	It was determined that GDP growth rate affects net interest margin
Beck and Hesse (2006)	Regression	Loan provision amount, liquidity ratio, total deposits, dummy variable for the ownership of the bank, Herfindahl index, GDP growth rate, inflation rate, interest rate, exchange rate, number of branches, number of ATMs	It was defined that there is a relationship between the size of the bank and net interest margin
Bennaceur and Goaied (2008)	Regression	Equity, overhead to assets ratio, total bank loans, economic growth, market concentration ratio, total assets, state ownership of the banks, interest rate liberalization, stock markets size	It was defined that high amount of capital provides high interest margin
Garza-García (2010)	GMM	Other operating expenses/total assets, equity/total assets, Interest rate volatility (money market rate), loan loss provisions/total assets, logarithm of assets, (non-interest expenses - other operating income)/total assets, liquid reserves/total assets, cost to income ratio, inflation, GDP growth, tax/total assets, dummy variable on foreign ownership	It was determined that capital amount and interest rate are the main determinants of net interest margin in developed countries whereas inflation rates and economic growth also affect the margin in developing countries
Marinkovic and Radovic (2010)	Regression	Total savings/total assets, the difference between market interest rate and riskless rate, foreign bank saving/total saving	It was defined that there is positive correlation between interest rate risk and net interest margin
Memmel and Schertler (2011)	Regression	Interest rates, derivatives, total loans, total deposits, issued bonds	It was concluded that change in interest rates affects net interest margin of German banks
López-Espinosa et al. (2011)	Regression	Loan loss provision, equity to total assets ratio, natural logarithm of total assets of bank, liquid assets to total debt, cost to income ratio, loans to total assets ratio	It was determined that the loans to total assets ratio as well as loan loss provisions are the predictors of net interest margin
Hamadi and Awdeh (2012)	Regression	Natural log of assets, customer deposit growth, equity-to-asset ratio, liquid assets divided by total assets, cost-to-income ratio, total loans divided by total assets, provisions for doubtful loans divided by gross loans, the assets of top 5 banks divided by total sector assets, GDP growth, Inflation rate, 1 year TBills discount rate, interbank rate, gross national saving as percentage of GDP, total investment as percentage of GDP, loans in foreign currencies divided by total loans, deposits in foreign currencies divided by total deposits	They concluded that the determinants of net interest margin are different between domestic and foreign banks

(Contd...)

Table 1: ***(Continued)***

Author	Method	Determinants	Results
Dumičić and Rizdak (2013)	Regression	Cost to income ratio, total capital ratio, ratio of noninterest revenue to gross revenue, ratio of loans to customer deposits, ratio of reserves for impaired loans to impaired loans, 3 month money market interest rate, GDP growth, inflation, current account, government debt, concentration, NPL, total capital ratio, crisis, country spread, regulatory cost	It was concluded that net interest margin of the banks decreases when there is an increase in NPL
Nassar et al. (2014)	Panel data analysis	Liquid assets-to-total assets, operating costs-to-total earning assets, lagged ratio of loan loss provisions to total loans and advances, Herfindahl-Hirschman index, credit-to-deposit ratio, real GDP growth, inflation	It was defined that operating costs are the most important drivers of banks' net interest margins
Khediri and Ben-Khedhiri (2011)	Regression	Bank's personnel, administrative and other operating expenses to total assets, the ratio of liquid reserves to total assets, the ratio of noninterest revenues to the total assets, the ratio of loans to the total assets, the ratio of equity to total assets	It was concluded that the amount of the capital is positively related to net interest margin
Demirguc-Kunt et al. (2014)	Panel data analysis	Total assets, liquid assets, capital, non-interest income, required reserves, inflation, GDP growth rate, dummy variable for state banks	It was determined that inflation has positive impact on net interest margin
Rahman et al. (2015)	Regression	Shareholders' equity divided by total assets, capital to risk weighted assets, ratio of non-performing loans to total loans, Ratio of loan-loss provisions to total loans, natural logarithm of total assets, ownership dummy is equal 1 if the bank is private-owned, non-interest income to total assets, ratio of cost to income, total of off-balance sheet activities divided by total assets, ratio of total loans to total assets, growth in annual GDP, annual inflation rate	It was defined that non-interest income, GDP growth and NPL amount are main determinants of net interest margin
Almarzoqi and Naceur (2015)	Regression	Overheads to total assets, equity to total assets, loan loss reserves to gross loans, log of total assets, non-interest income to gross revenues, cash to total assets, the difference between total revenue and total cost divided by the total revenue, inflation rate, monetary policy-related interest rate, strength of legal rights index	They concluded that the size of the banks is important determinant of net interest margin whereas capital adequacy is not

GDP: Gross domestic product

Garza-Garcia compared the determinants of net interest margin in developed and developing countries. In order to achieve this purpose, 6 developed and 8 developing countries were analyzed for the period between 2001 and 2008. As a result, it was defined that capital amount and interest rate affect net interest margin in developed countries (Garza-Garcia, 2010). Saunders and Schumacher (2000), Brock and Franken (2003), Naceur (2003), Ben Naceur and Goaied (2008) and Khediri and Ben-Khedhiri (2011) also reached the same results by using regression method.

Demirgüç-Kunt and Huizinga made a study to identify the determinants of net interest margin in commercial banks. Within this scope, the data of 80 different countries for the years between 1988 and 1995 was used. As a result of regression analysis, it was determined that foreign banks have higher net interest margin than domestic banks (Demirgüç-Kunt and Huizinga, 1999). Sensarma and Ghosh (2004), Drakos (2003), Peria and Mody (2004) and Hamadi and Awdeh (2012) made the similar conclusion by using different econometric technique. However, Aliaga-Diaz and Olivero (2005) and Doliente (2005) reached the different conclusion by using the same technique.

Maudos and De Guevera tried to analyze the determinants of net interest margin in European banking sector. Within this context, the data of 5 different countries for the period between 1993 and 2000 was used. As a result of the regression analysis, it was determined that interest rate risk affect net interest margin (Maudos and De Guevera, 2004). This conclusion was also reached in many different studies (Ho and Saunders, 1981), (McShane and Sharpe, 1985), (Hanweck and Ryu, 2005), (Marinkovic and Radovic, 2010), (Memmel and Schertler, 2011). Nonetheless, Nassar et al. (2014) and Demirguc-Kunt et al. (2003) made the different conclusion by using the same method. Moreover, Burgstaller concluded that there is a relationship between gross domestic product (GDP) growth rate and net interest margin (Burgstaller, 2006).

In addition to these studies, there are also some studies related to this subject in Turkey. Erol made a study related to the determinants

of net interest margin in Turkish banks. In this study, the data for the period between 2003 and 2006 was used. As a result of panel data analysis, it was determined that there is a positive relationship between capital amount and net interest margin in Turkish banks (Erol, 2007). Göçmen tried to analyze the determinants of net interest margin in Turkish banking sector. Within this context, the data for the years between 1990 and 2000 was tested. As a result of the analysis it was determined that there is inverse relationship between net interest margin and high inflation rates. Furthermore, it was also defined that net interest margin decreases during the crisis period (Göçmen, 2005).

Furthermore, Tunay and Silpar made a study to examine the influencing factors of profitability of the banks. With respect to the profitability, return on equity, return on asset and net interest margin was used in this study. Furthermore, the data for the period between 1960 and 2004 was used in order to achieve the objective. As a result of regression analysis, it was defined that total assets and total loans are the main determinants of net interest margin (Tunay and Silpar, 2006). Türkey Kaya tried to create a model related to the determinants of net interest margin for Turkish banking sector. So as to achieve this objective, monthly data for the period between 1986 and 2000 was used in this study. It was concluded that any deficit in current account balance causes net interest margin to increase (Türker-Kaya, 2001).

3. RESEARCH AND APPLICATION: TURKISH BANKING SECTOR

3.1. Data

The aim of the study is to define the determinants of net interest margin of the banks located in Turkey. Because of this situation, we used quarterly data for the years between 2003 and 2015. The data was provided from Turkish Banking Association, OECD, Central Bank of Turkey and Turkish Statistical Institute. Moreover, all banks of Turkey were included in the study.

3.2. Analysis Method: MARS

MARS method was produced by Jerome Friedman in 1991. "Multivariate" refers that a lot of explanatory variables can be used by using this method. Moreover, the term of "adaptive" means that MARS method presents us the best model by choosing this model among many alternatives. In addition to them, the word of "regression" demonstrates that this method is used in order analyze the relationship between dependent variable and a series of independent variables. Furthermore, instead of creating a simple regression line, MARS method uses "smoothing splines" so as to define this relationship more accurately (Friedman, 1991). The equation of MARS method is shown below.

$$Y=B_0+\sum_{n=1}^{K} a_n B_n\left(X_t\right)+\mu \quad (1)$$

In this equation, "Y" refers to independent variable whereas "X" shows dependent variable. In addition to them, "B0" is the constant term and "an" shows the coefficient of the basis function. Moreover, "ε" refers to error term of the equation and "K" demonstrates the number of basis functions.

MARS method has many advantageous in comparison with other regression methods. First of all, explanatory variables can take part more than once in equation with different coefficients. This situation provides to achieve more meaningful results. In addition to this issue, in MARS method, there is no multicollinearity problem that demonstrates the relationship among explanatory variables. Therefore, it can be possible to use a lot of independent variables in the analysis. Furthermore, different than other methods, the combinations of independent variables are used in MARS method in order to reach more meaningful results (Friedman, 1991).

The process of creating model by using MARS method included 2 different stages. First of all, system produces all basis functions which mean all potential functions created by independent variables. The model that has maximum basis functions is also called as "the most complex model." The second stage is obtaining the best model from the most complex model. In this stage, system eliminates some basis functions that have highest error value generalized cross validation (GCV). In other words, the best model has the highest R^2 and lowest GCV values (Friedman, 1991).

By creating model, some data should be embedded to MARS system. The space of "the maximum amount of basis functions" should be completed with numbers that are between 0 and 250. Moreover, the number between 1 and 5 should be entered to "volume factor" that is negatively correlated with the meaningful of the model. Furthermore, the space of "maximum interaction among variables" should be completed. This space gives information about the maximum number of explanatory variables that can be interacted each other at the same time (Friedman, 1991). Because MARS is a very new model, there are not many studies about economics and finance by using this method. Some studies related to these majors are depicted on Table 2.

Bolder and Rubin made a study in order to define the best lending strategy for America. In order to achieve this purpose, they used 4 different methods, which are least square method, Kernel regression, projection pursuit regression and MARS method. As a result of the analysis, it was determined that MARS method gives the best result among these methods as for the lending strategy (Bolder and Rubin, 2007).

Muzır tried to create a model regarding credit risk of Turkish banks. Within this scope, quarterly data of 38 banks for the period between 2002 and 2009 was used in this study. He used 3 different methods, which are logit, artificial neural networks and MARS so as to achieve this objective. As a result of the analysis, it was defined that short term loans are the most important determinant of the credit risk (Muzir, 2011).

Oktar and Yüksel made a study in order to determine the early warning signals of banking crisis in Turkey. Within this context, quarterly data for the years between 1988 and 2014 was tested by using MARS method. According to the results of this analysis, it was determined that derivatives with speculative purposes are the most important early warning signal of banking crises occurred in Turkey (Oktar and Yüksel, 2015). Tunay used MARS method in

Table 2: Studies with MARS method in economies and finance

Author	Subject	Scope	Results
Tunay (2001)	Identifying the velocity of circulation of money	Turkey	It was determined that the velocity of money is not stable for Turkey
Sephton (2001)	Finding leading indicators of recession	America	MARS method gives better results than probit method
Bolder and Rubin (2007)	Determining the best lending strategy of America	America	MARS method is the most efficient method with respect to determining the best lending strategy
Muzır (2011)	Measuring credit risk of the banks	Turkey	MARS method measures credit risk better than logit and artificial neural networks
Tunay (2011)	Defining the reasons of recession	Turkey	MARS method is very successful in order to predict recession.
Oktar and Yuksel (2015)	Determining early warning system of banking crisis	Turkey	It was defined that derivatives with speculative purposes are the main indicator of banking crisis

Source: Authors, MARS: Multivariate adaptive regression splines

order to identify the reasons of the recession in Turkey. So as to achieve this objective, quarterly data for the periods between 1986 and 2010 was used in this study. As a result, it was determined that oil prices and industry production index are main reasons of recession occurred in Turkey (Tunay, 2011).

Tunay made also another study in order to identify the velocity of money in Turkey by using MARS method. So as to achieve this objective, quarterly data for the periods between 1978 and 2000 was used in this study. As a result of the analysis by using MARS method, it was determined that the velocity of money is not stable for Turkey. Another result of this study is that inflation is the main reason of this problem (Tunay, 2001). Sephton tried to find the leading indicators of the recession for America. He used both MARS and probit methods in order to achieve this objective. Moreover, monthly data for the years between 1960 and 1999 was used in this study. As a result, it was defined that MARS method gives better results than probit method (Sephton, 2001).

3.3. Variables

3.3.1. Dependent variable: Net interest margin of the banks

So as to analyze the determinants of net interest margin in Turkish banking sector, the ratio of net interest income to total assets is used as dependent variable.

3.3.2. Independent variables

In order to define the factor that affect net interest margin, we used 14 independent variables. The list of the dependent variables is depicted on Table 3.

As it can be seen from Table 3, we used 14 different independent variables. Out of these variables, 9 of them are related to the internal process of the banks whereas 5 of them are external variables.

3.3.3. Internal variables

3.3.3.1. Equity

If the equity amount is high for a bank, this situation represents us that this bank has higher amount of sources to give credit. In other words, this banks needs to lower amount of external funding. Because of this situation, the bank will pay less interest for its sources. Therefore, the relationship between the equity amount of the bank and net interest margin is expected to be positive.

3.3.3.2. Loans

If the ratio of loans to assets increases, this means that the interest income from the loans will also go up. Because net interest margin is the difference between interest income and interest expense, it is expected to have direct relationship between loans amount and net interest margin.

3.3.3.3. Loan loss provisions

The loan loss provision amount demonstrates the expense of the banks for the loans that are expected to be non-performing. Therefore, there should be negative relationship between this amount and net interest margin.

3.3.3.4. Liquidity ratio

If the banks has high amount of liquidity ratio, this means that the bank does not use this amount as a loan. That is to say, this bank does not get interest income from these liquid assets. Due to this situation, there should be negative relationship between liquidity ratio and net interest margin.

3.3.3.5. Non-performing loans

Because non-performing loans are defined as the loans that cannot be paid back buy the customers, interest incomes of the banks will be lower when NPL amount is high. Hence, it is expected to have negative relationship between net interest margin and NPL amount.

3.3.3.6. Total assets

Because net interest margin is directly related to the quality of total assets, there are different results in the literature with respect to the relationship between net interest margin and total assets. In other words, this relationship differs by depending on the quality of total assets.

3.3.3.7. Total deposits

If the deposit amount of the bank is high, this issue demonstrates that this bank pays high interest to these deposits. Because the interest expenses go up, net interest margin will decrease.

3.3.3.8. Net profit

The profits of the banks mostly come from interest income. Therefore, there should be positive relationship between net profit and net interest margin.

Table 3: Lists of independent variables used in this study

Independent variables	Definition	Expected relationship with net interest margin	References
Total equity	Total equity/total assets	+	Abreu and Mendes (2001), Aliaga-Diaz and Olivero (2005), Almarzoqi and Naceur (2015), Ben Naceur and Goaied (2008), Brock and Franken (2003), Burgstaller (2006), Demirgüç-Kunt and Huizinga (1999), Demirguc-Kunt et al. (2014), Doliente (2005), Drakos (2003), Dumičić and Rizdak (2013), Erol (2007), Garza-García (2010), Gerlach et al. (2005), Göçmen (2005), Hamadi and Awdeh (2012), Khediri and Ben-Khedhiri (2011), López-Espinosa et al. (2011), McShane and Sharpe (1985), Naceur (2003), Peria and Mody (2004), Rahman et al. (2015), Saunders and Schumacher (2000), Tunay and Silpar (2006), Valverde and Fernandez (2007)
Total loans	Total loans/total assets	+	Abreu and Mendes (2001), Aliaga-Diaz and Olivero (2005), Ben Naceur and Goaied (2008), Brock and Franken (2003), Burgstaller (2006), Demirgüç-Kunt and Huizinga (1999), Dumičić and Rizdak (2013), Göçmen (2005), Hamadi and Awdeh (2012), Hanweck and Ryu (2005), Khediri and Ben-Khedhiri (2011), McShane and Sharpe (1985), Memmel and Schertler (2011), Naceur (2003), Rahman et al. (2015), Tunay and Silpar (2006)
Loan loss provision amount	Total loan loss provision/ total loans	-	Aliaga-Diaz and Olivero (2005), Angbazo (1997), Beck and Hesse (2006), Doliente (2005), Drakos (2003), Garza-García (2010), Hamadi and Awdeh (2012), López-Espinosa et al. (2011), Nassar et al. (2014), Rahman et al. (2015)
Liquidity ratio	Total cash and central bank amount/total assets	-	Aliaga-Diaz and Olivero (2005), Beck and Hesse (2006), Göçmen (2005)
Non-performing loans	Total NPL amount/total loans	-	Angbazo (1997), Dumičić and Rizdak (2013), Erol (2007), Gerlach et al. (2005), Hanweck and Ryu (2005), Ho and Saunders (1981), Kannan et al. (2001), Maudos and De Guevara (2004), Peria and Mody (2004), Rahman et al. (2015), Saunders and Schumacher (2000), Valverde and Fernandez (2007)
Total assets	The logarithm of total assets amount	+/-	Almarzoqi and Naceur (2015), Angbazo (1997), Ben Naceur and Goaied (2008), Brock and Franken (2003), Demirgüç-Kunt and Huizinga (1999), Demirguc-Kunt et al. (2014), Erol (2007), Hamadi and Awdeh (2012), Hanweck and Ryu (2005), Kannan et al. (2001), McShane and Sharpe (1985), Naceur (2003), Rahman et al. (2015), Sensarma and Ghosh (2004), Tunay and Silpar (2006), Türker-Kaya (2001)
Total deposits	The logarithm of total deposits amount	-	Aliaga-Diaz and Olivero (2005), Angbazo (1997), Beck and Hesse (2006), Erol (2007), Hamadi and Awdeh (2012), Hanweck and Ryu (2005), Kannan et al. (2001), McShane and Sharpe (1985), Memmel and Schertler (2011), Valverde and Fernandez (2007)
Net profit	Net profit/total assets	+	Göçmen (2005), McShane and Sharpe (1985)
Non-interest income	Non-interest income/total assets	-	Almarzoqi and Naceur (2015), Burgstaller (2006), Demirgüç-Kunt and Huizinga (1999), Demirguc-Kunt et al. (2014), Dumičić and Rizdak (2013), Erol (2007), Göçmen (2005), Kannan et al. (2001), Khediri and Ben-Khedhiri (2011), Rahman et al. (2015), Sensarma and Ghosh (2004), Valverde and Fernandez (2007)
Unemployment Rate	The percentage of people who are jobless and look for a job	-	Abreu and Mendes (2001)

(Contd...)

Table 3: ***(Continued)***

Independent variables	Definition	Expected relationship with net interest margin	References
Inflation rate	The percentage change of CPI from the previous term	+	Abreu and Mendes (2001), Aliaga-Diaz and Olivero (2005), Almarzoqi and Naceur (2015), Beck and Hesse (2006), Demirgüç-Kunt and Huizinga (1999), Dumičić and Rizdak (2013), Erol (2007), Garza-García (2010), Gerlach et al. (2005), Göçmen (2005), Hamadi and Awdeh (2012), Naceur (2003), Nassar et al. (2014) Peria and Mody (2004), Rahman et al. (2015), Sensarma and Ghosh (2004), Tunay and Silpar (2006)
Exchange rate	The buying rate of exchange of Central Bank of Turkey for USD	-	Abreu and Mendes (2001), Beck and Hesse (2006)
GDP growth rate	$(GDP_t - GDP_{t-1})/GDP_{t-1}$	+	Aliaga-Diaz and Olivero (2005), Beck and Hesse (2006), Burgstaller (2006), Demirgüç-Kunt and Huizinga (1999), Demirguc-Kunt et al. (2014), Dumičić and Rizdak (2013), Garza-García (2010), Gerlach et al. (2005), Hamadi and Awdeh (2012), Nassar et al. (2014), Peria and Mody (2004), Sensarma and Ghosh (2004), Tunay and Silpar (2006), Valverde and Fernandez (2007)
Interest rate	TL moving average interest rate of deposit for 3 months	+	Aliaga-Diaz and Olivero (2005), Almarzoqi and Naceur (2015), Beck and Hesse (2006), Ben Naceur and Goaied (2008), Brock and Franken (2003), Burgstaller (2006), Demirgüç-Kunt and Huizinga (1999), Doliente (2005), Dumičić and Rizdak (2013), Erol (2007), Garza-García (2010), Gerlach et al. (2005), Hanweck and Ryu (2005), Ho and Saunders (1981), Marinkovic and Radovic (2010), Maudos and De Guevara (2004), Memmel and Schertler (2011), Peria and Mody (2004), Saunders and Schumacher (2000), Valverde and Fernandez (2007)

Source: Authors, GDP: Gross domestic product

3.3.3.9. Non-interest income

Banks can generate income both from interest and non-interest sources. The main source of non-interest income for banks is foreign exchange income. In case of decrease in the margin of net interest, volatility in the market also goes down. Therefore, it is believed that when net interest margin is small, banks try to have incomes from non-interest sources. In other words, it is expected to have negative relationship between net interest margin and non-interest income.

3.4. Internal Variables

3.4.1. Unemployment rate

When unemployment rate in the country is high, this means that there are many people in the country that do not get any revenue. If these people cannot pay the loans back to the banks, non-performing loans of the banks will rise. Thus, it is expected to have negative relationship between unemployment rate and net interest margin.

3.4.2. Inflation rate

When inflation rate is high in a country, it will lead to increase in interest rates as well. Therefore, positive relationship expected between inflation rate and net interest margin.

3.4.3. Exchange rate

The volatility of exchange rates is a significant indicator of market risk for a country. If this rate increases very high, banks that have open position will get losses. Because of this situation, there should be inverse relationship between exchange rate and net interest margin.

3.4.4. GDP growth

GDP growth rate is an essential indicator of economic condition of the country. If economy is in the recession, unemployment rates will go up and investments in this country decline. This situation causes to decrease the profit of the banks. Therefore, we expect positive relationship between net interest margin and GDP growth rate.

Interest Rate: Interest rate in the market also affects net interest margin. In case of high market interest rates, margin between interest income and interest expense is expected to increase.

4. RESULTS

First of all, with respect to the stationary analysis, 14 explanatory variables were tested by using Augmented Dickey Fuller (ADF) unit root test. For this analysis, Eviews7 program was used. The results of this analysis were depicted on Table 4.

In order for the variables to be stationary, ADF unit root test results should be <0.05. If this condition is not satisfied, the first differences of these variables are created and the same test

is performed again. As it can be seen from Table 4, out of 14 independent variables, 5 of them are stationary with their original levels. On the other hand, because the test results of other 9 variables are >0.05, the first difference of these variables were created and used in the model.

After this analysis, a model was created for the net interest margin of Turkish banks. For this process, MARS 2.0 program of Salford Company was used. The maximum number of basis functions was selected as 30 in this analysis in order to have more meaningful results. In addition to this situation, the number of minimum interactions among independent variables was defined as 3 so as for the model not to be more complex.

Furthermore, penalty on added variables was not selected as emphasized by the owner of the program. Moreover, the number of minimum observations between knots was selected as 2. In other words, there should be at least 2 observations in order for a point to be accepted as knot. As a result of the analysis, 11 different models were created by MARS program. The details of these models were shown on Table 5.

The model at the bottom of Table 5 is called as "starting model." It has one basic function and 1 variable. All meaningful combinations of independent variables were added to this starting model by MARS. According to the criteria given to the system, 11 different models were created. The model, which is at the top of the table, is called "the most complicated model." This model has the most basis functions and variables.

Furthermore, some basis functions were eliminated from the most complicated model according to their GCV and GCV R-Square values. In other words, if GCV value decreases and GCV R^2 value increases when a basis function is not included, this basis function will be eliminated. By making this elimination, the system determined "the best model." As it can be seen from Table 5, the model, which has 5 basis functions and 4 different variables, is the best model in our study. The details of the best model were illustrated on the Appendix. This model has the lowest GCV value and highest GCV R^2 value among all models. The results of the best model are explained in Table 6.

As a result of the analysis, it was defined that p values of all variables are less than 0.05. This situation shows us that all of the variables are statistically significant at 5% level. The result of F test also demonstrates that the model is also statistically significant. Moreover, the value of adjusted R^2 is 0.730. This value refers that independent variables can explain 73% of the dependent variable. The details of the basis functions stated in the best model are explained in Table 7.

There are 5 different basis functions in our model. In addition to this situation, it was determined that 4 independent variables affect net interest margin of Turkish banks. Non-interest income is the first determinant of net interest margin in our model. This explanatory variable takes place in 4 different basis functions. Although the coefficient of basis function 1 is positive, the coefficients of other 3 basis functions (BF2, BF3, BF10) are negative. Moreover, the absolute values of negative coefficients (−156.966, −23.667, −29.459) is much higher than the coefficient of BF1. Because of this situation, it was defined that there is a negative relationship between non-interest income and net interest margin.

Table 4: Results of ADF unit root tests

Independent variables	Unit root test results	
	Original data	First difference
Equity/total assets	0.1007	0.0000
Loans/total assets	0.7499	0.0000
Loan loss provision/total loans	0.4574	0.0001
Liquidity ratio	0.0612	0.0000
NPL/total loans	0.0402	-
Total assets	0.0404	-
Total deposits	0.0400	-
Net profit	0.6562	0.0000
Non-interest income	0.3207	0.0018
Unemployment rate	0.3997	0.0064
Inflation rate	0.0003	-
Exchange rate	0.9893	0.0000
GDP growth	0.0002	-
Interest rate	0.0710	0.0003

Sources: Authors, ADF: Augmented Dickey Fuller, GDP: Gross domestic product

Table 5: Results of all models

Basis functions	Total variables	GCV	GCV R^2
11	7	0.000151	0.067
10	7	0.000132	0.187
9	7	0.000113	0.307
8	6	0.000098	0.391
7	6	0.000089	0.449
6	5	0.000084	0.478
5**	4	0.000081	0.496
4	3	0.000084	0.482
3	2	0.000096	0.403
2	2	0.000106	0.346
1	1	0.000098	0.395

Sources: Authors, GCV: Generalized cross validation

Table 6: Results of the best model

Variables	Coefficient	Standard error	t-test	P
Constant term	0.013	0.003	4.109	0.000
Basis function 1	4.536	0.578	7.846	0.000
Basis function 2	−156.966	28.604	−5.487	0.000
Basis function 3	−23.667	6.909	−3.425	0.001
Basis function 5	−0.014	0.004	−3.132	0.001
Basis function 10	−29.459	5.616	−5.246	0.000
Observation	51	F Test	28.101 [0.000]	
R^2	0.757	P	0.000	
Adj R^2	0.730	Total variables	4	
GCV	0.015	GCV R^2	0.496	

Sources: Authors, GCV: Generalized cross validation

Table 7: Explanation of basis functions

Basis functions (BF)	Explanation	Coefficient
Basis function 1	Max (0, non-interest income+0.011)	+4.536
Basis function 2	Max (0, NPL-0.114)* BF1	−156.966
Basis function 3	Max (0, 0.114-NPL)* BF1	−23.667
Basis function 5	Max (0, total assets–5.263)	−0.014
Basis function 10	Max (0, exchange rate+0.286)* Max (0, non-interest income-0.001)	−29.459

Sources: Authors

Non-performing loan is another independent variable that affects net interest margin. This explanatory variable takes place in BF2 and BF3. Both of these functions have negative coefficients. Therefore, it was identified that when the ratio of NPL to total loans increases, net interest margin of the banks decreases. Another result related to this variable is that the effect of the coefficient of BF2 (−156.966) is higher than the coefficient of BF3 (−23.667). In other words, it was defined that when the ratio of NPL to total loans is >0.114, net interest margin goes down more.

According to the results of the analysis, net interest margin decreases when the logarithm of total asset is >5.263. This inverse relationship shows that when total assets of the banks exceed a level, the quality of these assets decreases. The last independent variable that affects net interest margin is exchange rate. The negative coefficient (−29.459) demonstrates that when the exchange rate of USD increases net interest margin goes down. That is to say when the volatility of the exchange rate rises, there will be also increase in the losses and this situation causes net interest margin to decrease. The importance levels of these 4 independent variables are depicted in Table 8.

As it can be seen from Table 8, non-interest income is the most important variable that affects net interest margin of Turkish banks. The importance of this variable is 100% and the cost of omission is the highest. In addition to this issue, exchange rate is the second most significant variable with the 56.69% importance level. Moreover, non-performing loan has 44.88% and total asset has 15.90% importance levels. As a result of this analysis, the equation created from this model is the following.

$$Y = 0.013+4.536* BF1-156.966* BF2-23.667* BF3-0.014* BF5-29.459* BF10 \quad (2)$$

5. CONCLUSIONS

In this study, we tried to identify the influencing factors of net interest margin in Turkish banking sectors. Within this context, quarterly data for the period between 2003 and 2014 was used in this study. In addition to this situation, the effects of 14 independent variables on net interest margin were tested by using MARS model in order to achieve this objective.

First of all, with respect to the stationary analysis, we made ADF unit root test to all independent variables so as to use their stationary forms. As a result of this analysis, it was determined that 5 of these variables are stationary whereas 9 independent variables were not. Therefore, the first differences of these variables were used in the study.

Table 8: Importance levels of independent variables

Independent variables	Cost of omission	Importance (%)
Non-interest income	0.000174	100
Exchange rate	0.000111	56.69
Non-performing loans	0.000100	44.88
Total assets	0.000084	15.90

Sources: Authors

After stationary analysis, we created a model by using MARS program. During this process, totally 11 different models were created and 1 model was chosen as the best model by MARS program. According to the best model, 4 independent variables affect net interest margin of Turkish banks. Firstly, it was defined that there is a negative relationship between non-interest income and net interest margin. That is to say, when the margin in net interest increases, the volatility in the market also goes up. In such a risky situation, there is a decrease in foreign exchange income which is the main component of non-interest income.

Furthermore, non-performing loan is another independent variable that affects net interest margin negatively. Because the banks have lower interest income in case of high NPL, net interest income will go down. Moreover, it was determined that net interest margin decreases when the logarithm of total asset is higher. This result shows that when total assets of the banks exceed a level, the quality of them decreases. Additionally, exchange rate is also another variable that affects net interest margin for Turkish banks negatively. This situation demonstrates that increase in the volatility of the exchange rate leads to unfavorable results in banking sector.

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APPENDIX

Appendix Figures