

**THE REPUBLIC OF TURKEY  
BAHCESEHIR UNIVERSITY**

**THE IMPACT OF CENTRAL BANK  
INSTRUMENTS ON RETURN OF ASSET RATIO  
FOR BANKS IN TURKEY**

**Master's Thesis**

**AYKUT GUL**

**ISTANBUL, 2019**



**THE REPUBLIC OF TURKEY  
BAHCESEHIR UNIVERSITY**

**GRADUATE SCHOOL OF SOCIAL SCIENCES  
MASTER OF BUSINESS ADMINISTRATION PROGRAM**

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**Thesis Supervisor: Assoc. Prof. Emin Koksal**

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## ABSTRACT

### THE IMPACT OF CENTRAL BANK INSTRUMENTS ON RETURN OF ASSET RATIO FOR BANKS IN TURKEY

Aykut Gül

Master of Business Administration

Thesis Supervisor: Assoc. Prof. Emin Köksal

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Central banks has an important role in the economies of the countries. They have some instruments to effect or change the economic indicators according to the economic policy of the country in terms of price stability. In Turkey, these instruments are reserve requirement ratios, overnight interest rates, one week repo interest rates and late liquidity window interest rates. By changing all of these instruments, the central bank has been affecting the economy. Banks in Turkey have to behave according to these interest rates. The profitability is one of the most essential things for the banks. There are some ratios to measure it, in this study Return on Asset ratio has been used as a profitability indicator. The purpose of this paper is to identify if there is a positive or negative relation between the instruments of the Central Bank of the Republic of Turkey and the banks' profitability.

In order to identify this, a linear regression model has been designed. According to the model, there is a negative relation between reserve requirement ratio for foreign currencies and the banks' profitability. And there is also a negative relation between overnight lending ratio lead 1 (the value from the upcoming quarter) and the banks' profitability.

**Key Words:** Profitability, Central Banks, Monetary Policy Instruments, Linear Regression

## ÖZET

### MERKEZ BANKASI ENSTRÜMANLARININ TÜRKİYE'DEKİ BANKALARIN AKTİF GETİRİ ORANINA ETKİSİ

Aykut Gül

İşletme Yüksek Lisans Programı

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Merkez Bankalarının ülke ekonomilerinde önemli bir rolü vardır. Fiyat istikrarını sağlamak için, ülkenin ekonomik politikasına göre ekonomik göstergeleri etkileyebilecekleri veya değiştirebilecekleri enstrümanları mevcuttur. Türkiye'de bu enstrümanlar zorunlu karşılık oranları, gecelik faiz oranları, 1 haftalık repo faiz oranları ve geç likidite penceresi faiz oranlarıdır. Merkez Bankası bu enstrümanları değiştirmek suretiyle ülke ekonomisini etkiler. Türkiye'de bulunan bankalar da bu faiz oranlarına göre hareket etmek durumundadırlar. Karlılık, bankalar için en önemli noktalardan bir tanesidir. Bunu ölçmek için birden fazla ölçüt vardır, bu çalışmada Aktif Getiri Oranı karlılık göstergesi olarak kullanılmıştır. Bu çalışmanın amacı Merkez Bankası'nın enstrümanları ile bankaların karlılığı arasında olumlu ya da olumsuz bir ilişki olup olmadığını belirlemektir.

Bunu belirleyebilmek için, bir lineer regresyon modeli tasarlanmıştır. Modele göre yabancı para birimleri için kullanılan zorunlu karşılık oranları ile bankaların karlılığı arasında olumsuz bir ilişki vardır. Ve ayrıca bir sonraki çeyreğin gecelik borç verme oranı ile bankaların karlılığı arasında da olumsuz bir ilişki vardır.

**Anahtar Kelimeler:** Karlılık, Merkez Bankaları, Para Politikaları Enstrümanları, Lineer Regresyon

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# 1. INTRODUCTION

This chapter of the thesis is going to review the background of the paper, objectives and structure of the study.

## 1.1 BACKGROUND

In today's world, Central Banks of the countries has crucial role on the economic performance of that country. Actually many countries are re-organizing the structure of the central banks because of the modernization of the financial sector (Downes and Vaez-Zadeh 1991). The central banks can directly affect the economy of the country with various instruments such as changing reserve requirement ratios or overnight borrowing rates.

In this chapter, we must mention the history of Turkish economy. After the crises in 2001, Turkey has decided to use floated exchange rate regime. With this regime, Turkey economy had shown an increasing performance with the help of recovery period after the 2001 crises. And also again in the crises period, Banking Regulation Supervision Agency has been established to regulate banking industry very strictly.<sup>1</sup> Until 2008, the economy was better according to the crises period and after that there is another crises about the mortgage credits in United States of America, and this crises affected the whole world in some way. However Turkish economy was strong enough to get less damage out of this crises as it is expected. Again until 2015/2016, the economy had shown a strong performance, but after that period mostly because of political reasons and macroeconomic reasons, the economy had shown a poor performance relatively to other periods. This behavior also can be seen in data that we are about to discuss in the later chapters.

In Turkey, the importance of the central bank (The Central Bank of the republic of Turkey) has been increasing over the years.<sup>2</sup> The CBRT is using many instruments to

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<sup>1</sup> BDDK [Online], <https://www.bddk.org.tr/Hakimizda/Kurulus/9> [Accessed 8 December 2019].

<sup>2</sup> TCMB [Online], <https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/About+The+Bank> [Accessed 8 December 2019].

keep the price stability , that of course implies to inflation rates.<sup>3</sup> The most important ones are reserve requirement ratios, overnight borrowing rates, overnight lending rate, late liquidity windows interest rates and repo borrowing rates.

The instruments that has been used by the Central Bank of Turkey is more complicated than most of the central banks from other countries. There is no simple approach to the interest rates, instead there is a corridor system. That's why the country has more than one interest rate with different types, different applications and different terms. Apart from the interest rate, the change in the reserve requirement ratios has been a widely used methodology in the past couple of years in Turkey. Because it is an effective way to force banks to lend more or less. With this tool, the Central Bank of the Republic of Turkey can directly affect the money amount in the market.

The direct impact of these instruments can be observed on the banks in the country. Since there are strict regulations in the country, each bank has to be align with these regulations. In the meantime, they need to also keep in mind the profit ratio that they need to improve. It is difficult to balance these both, however we can see from the data that Turkish banks can be benefit from the difficult times with high percentages of profit ratios.

There are some recent decision that the Central Bank of the Republic of Turkey had made and these decisions had made an immediate impact on the currency rates (especially EUR/TRY and USD/TRY) and inflation. Therefore we can expect that these decisions might have an impact on the banks profitability.

For example, there is a significant increase in the inflation rate in the first quarter of 2018. In order to reply this significant increase, the central bank had to decrease the reserve requirement ratios for the foreign currencies in the next quarter, increase the overnight borrowing rate, increase the overnight lending rate and finally increase the repo rate for a week. We can see these behaviors from the data.

This study will be about the relationship between these instruments and the profit ratio of the banks. There are a lot of researches that investigates the profits of the industry from

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<sup>3</sup> TCMB [Online], <https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/About+The+Bank> [Accessed 8 December 2019].

different aspects, however with the recent data which covers pre-crises period, crises period and post-crises period, we can contribute the literature with Turkey case.

## **1.2 OBJECTIVES**

The objective of this thesis is to find out the impact of the CBRT decisions on the banks profitability. In order to do that, all the instruments and the inflation ratios will be the inputs of the regression model and the target variable will be Return on Asset Ratio (RoA). We will try to find an answer for whether the profitability of the banks have been affected by some of these instruments positively or negatively.

## **1.3 STRUCTURE**

There will be 4 different chapters in the study. First one is the introduction which is explaining the basics of the study. In this chapter, the background of the paper has been discussed. And also the question which is “why this topic?” has been answered. Second one will be Literature review which is going to explain in detail the studies about the concept before this paper. Also in this chapter all of the components of this study will be defined by using some sources. Third one will be the methodology which will explain the data and the model itself. This will be a detailed section where the data (all of the variables) will be analyzed and limitations will be discussed. Also the result of the model will be analyzed in terms of validity and the technical point of view. Fourth one will be the discussion chapter that explains the result of the study. In this last chapter, there will be some comments about the interpretation of the paper.

## 2. LITERATURE REVIEW

There are many studies that have investigated the instruments of central banks on economy and also there are many studies that have investigated them separately.

In this paper; reserve requirements ratios, inflation, overnight borrowing rates, late liquidity window rates and repo borrowing rates have been used to research the relationship between these instruments and Return on Asset (RoA) ratio. These terms will be explained in this chapter. All these terms are central bank's monetary tools excluding one: Inflation. It is included as a candidate variable due to the fact that it might be an important indicator that can explain Return on Asset ratio. Then some papers that investigate similar topics will be explained and discussed.

Central banks want each bank to keep a specific amount that needs to be calculated with percentages that Central banks provide (Honohan 2003). This is called reserve requirements ratio and it is compulsory. This tool has a direct impact on banks strategies of lending credit. If central banks increase this ratio for the banks, they need to keep more money for the central bank, this will lead a decrease in the lending of the credit which will lead an economic shrinkage. If central banks decrease the reserve requirement ratios, this means that banks do not have to reserve their money and they can lend more, which will lead an economic expansion. Both cases can be an option depending on the economic situation of the country and economic politic of the country.

Inflation is different from other terms that this paper is going to use, but it might be a mistake not to include this macroeconomic variable since it is expect to be correlated with interest rates and Return on Asset ratio. Inflation can be described as decreasing value of currency (Frisch 1983). The volatility in the inflation rates is affecting the banks strategies and affecting Return on Asset ratios. When the inflation is high, the value of money is decreasing which leads high interest rates both in Central bank and banks credit interest rates. This means that the price of the credit is increasing for the borrower and the risk appetite is low for the banks.

The overnight interest rate can be defined as the interest rate for only one day loan (Moschitz 2004). It is a tool that can be used by central banks to keep financial and price stability. In Turkey, it is stated that this interest rate is going to be set according to repo borrowing rate with a threshold 1.5 bps.<sup>4</sup> The interest rate (all kind of them) decisions that have been made by the Central Bank of the Republic of Turkey are in parallel to each other which means that if one of them has been increased, the other one generally has not been decreased. This behavior can be observed from the data.

The late liquidity window rates are designed to prevent the problems in the payments system for banks or to provide money for the banks in the short time (Kilci 2019). Kilci's paper is explaining the impact of the late liquidity window rates on bank credits and exchange rates.

Glocker and Towbin (2012) had conducted an investigation about reserve requirements and its impact on the economy. This is a really important study in terms of this very topic. The result of the study suggest that reserve requirements can be an additional instruments together with interest rate policy to ensure the financial stability. In general, interest rates are the first tool that one can think of when it comes to sustain the financial stability. Because it has direct impact on the economy and the value of the local currency. So higher volatility in currency leads to higher interest rates (Chen 2006). The reason of this behavior is related with the value of the money or the local currency (Sanchez 2005). Interest rates rise, if the depreciation might happen or already has been happening. Interest rate is an important instrument that Central Banks have. However it is not the only one and Glocker and Towbin suggest that with the help of changes in the reserve requirement ratios, financial stability can be ensured.

That's why reserve requirements have become a widely used instrument in the monetary systems (Baltensperger 1982).

A very important study for this thesis is Butun (2018)'s paper regarding the effect of reserve requirement on bank loans. The study is focusing on Turkey case and a vector auto regression model has been designed to explain the relationship between reserve

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<sup>4</sup> TCMB [Online], <https://www.tcmb.gov.tr/wps/wcm/connect/tr/tcmb+tr/main+menu/temel+faaliyetler/para+politikasi/merk ez+bankasi+faiz+oranlari> [Accessed 8 December 2019].

requirements and loan growth. Their conclusion is that reserve requirements seem to have an impact on the growth of the bank loans; more importantly in the conclusion part there is a suggestion that for the next studies, different reserve requirement ratios for different banks can be analyzed according to asset size. In this paper, there is not going to be different reserve requirement rates but in order to take into account the asset size, the target variable will be Return on Asset ratio which needs to be calculated by profits and asset sizes.

Another important working paper for this study is the one that has been prepared by Alper, Binici, Demiralp, Kara and Ozlu (2014). The working paper is about reserve requirement and banks' lending behavior and it argues that banks' lending behavior has a strong relationship with reserve requirements. The study is focusing on Central Bank of the Republic of Turkey.

Dare, David, Okeya and Olaitan (2017)'s research is another example of the monetary policy research papers. They used the case for Nigeria and the paper was about the impact of this policy regarding the commercial banks in Nigeria. Monetary Policy Rate, Cash Reserve Requirement and Liquidity Ratio are their independent variables, and Return on Assets is their target variable. They found out that there is a positive but insignificant relationship between the independent variables and Return on Asset ratio. The data for this paper is between 2009 and 2014 (panel cross-sectional data).

Another study has been conducted for Ghana by Amidu (2006) This study is about the monetary policy and banks' lending behaviors. The study has found out that this behavior has been affected by the economic activities. The data period is 1998-2004 and the methodology in this study is Ordinary Least Square Regression. And also the study states that size and liquidity increases the ability of the banks' lending capacity.

In Greece, there is a similar study by Spyros (2001) which investigates the impact of inflation on Return on Stock in Greece. The study is using a Vector Auto Regression model and found out that the inflation hedges returns of stock negatively until 1995. After that, relation is not significant.



Gertler and Karadi (2011) states that the credit policies of the central banks are effective only during the crises times, and using unconventional monetary policy is not effective in non-crises normal times. This is an important point for this study, we are going to investigate a non-crises period for Turkey.

Another study for Latin American countries has been conducted by Vera Martin, Tovar Mora and Garcia-Escribano (2012) to show reserve requirement effect and they states that reserve requirements have a modifier role for the monetary policy.

In order to examine the profitability of the banks in Turkey, Acaravci and Calim (2013) has investigated three biggest state/privately owned and foreign banks and they gathered a data for a period between 1998 and 2011. For the profitability concept, they used Return of Asset, Return of Equity and net interest margin. The result of study states that the reel gross domestic product and the reel exchange rate have an impact on the profitability.

Our research topic is a well-known concept in the literature and it has been discussed many times with different perspectives and from different aspects. The papers which investigates the cases for the countries other than Turkey generally has focused on the relation between some profitability ratios ( Return on Equity, Return on Stock or Return on Asset) and monetary policies. The researches that investigates Turkey case are focusing on banks behavior in terms of lending appetite and monetary tools. Therefore our research has been covering both aspects and in our opinion it is going to contribute the literature by creating this connection with the recent data for Turkey case.

### **3. METHODOLOGY**

In this chapter, the data that is required by this study will be explained. The relationship between variables will be investigated and limitations will be discussed. Secondly, the prediction model will be discussed. The reasons behind the modelling process will be explained and the results will be shared and assessed.

#### **3.1 THE PURPOSE OF THE RESEARCH**

The purpose of this research can be summarized as follows: Whether there is a relationship between The Central Bank of The Republic of Turkey's monetary instruments (or inflation) and the profit ratios of banks. If there is, can it be acceptable (or strong enough to conclude ) ? These monetary instruments are reserve requirement ratio for Turkish Lira, reserve requirement ratio for foreign currencies, overnight borrowing rate, overnight lending rate, late liquidity window lending rate, late liquidity window borrowing rate and repo lending rate.

#### **3.2 THE DATA GATHERING**

The data that has been used for this study is available in the official website of The Central Bank of The Republic of Turkey (<https://www.tcmb.gov.tr/>) and the official website of the Banks Association of Turkey (<https://verisistemi.tbb.org.tr/>). For the target variable, the banks official published quarterly reports have been used while for the candidate variables, the database of the Banks Association of Turkey has been used to reach the related data. Every variable table has its own structure, therefore some standardizations that is explained below have been applied for them to get them in one table with one structure.

### 3.2.1 The Target Variable

The target variable of this study is the profit ratios of the banks in Turkey. In order to get this target variable, the official financial results of banks have been used.

There was 3 candidate ratios to assess the profitability of banking industry. Overall profit amount, Return on Equity ratio, and Return on Asset ratio. For this study it was important to use the size of the banking industry. Besides, if we would use the total profit amounts over the years, it would lead us some inconvenient results. Because, the total asset size of a bank can also change over the time and if the size is decreasing for the banking industry, it may not require such a high profit amount.

That's why profit amount cannot be used by itself. However it is an important part of the equation. We also wanted to include the asset size of the banks in our research, that leads us to use Return on Asset ratio for a target variable for the profitability.

The first step is to download the consolidated financial data that has been shared by the banks to the public which include asset sizes of the banks and profit amounts of the banks. These reports have been shared every quarter. This is the first limitation of the study, target variable is available at the end of each quarter. There are 2 different data set with this information (one of them includes asset size of banks, the other one includes profit amounts of the banks). Also, since Turkish Banking sector started to use IFRS9 standards after January 2018, the data that is available after 2018 needed to be downloaded and added to the before 2018 data separately.<sup>5</sup>

The second step is to calculate the profit ratio which needs to reflect asset size and profit amount together. In the sector and the literature, this ratio is known as Return on Asset ratio. In order to calculate it, quarter end results will be divided to each other with following formulation:

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<sup>5</sup> PWC [Online] <https://www.pwc.nl/en/industries/banking/finance-and-regulatory-reporting/ifrs.html> [Accessed 8 December 2019]

$$(PA_{i+1} - PA_i) / AS_{i+1} \quad (3.1)$$

Where  $PA_0=0$  and minimum value of  $i$  is 0 and maximum value of  $i$  is 3.

$PA_i$  stands for the profit amount in  $i$ th period.

$AS_i$  stands for the asset size in  $i$ th period.

Since the profit amounts in a year is reflected in the reports as cumulative, the adjustment above has to be done to calculate the quarter end results. It is available from 2002 Q1.

The information is available for each bank, but in this study sum of the amounts have been used for the whole banking industry which also available in the data set.

### **3.2.2 Independent Variables and the Methodology**

All the independent variables can be downloaded from the same websites. For the modelling purposes, the lag and the lead columns of each variable have been created. The reason of this is that a decision on monetary instruments can be effective on the profit amounts later on or vice versa. In order not to miss a relation, those columns have been created.

The lag of a variable is defined as following: If there is a value for a certain time period (in our case it can be quarter 1), that value needs to be carried to the next period (in our case to quarter 2).

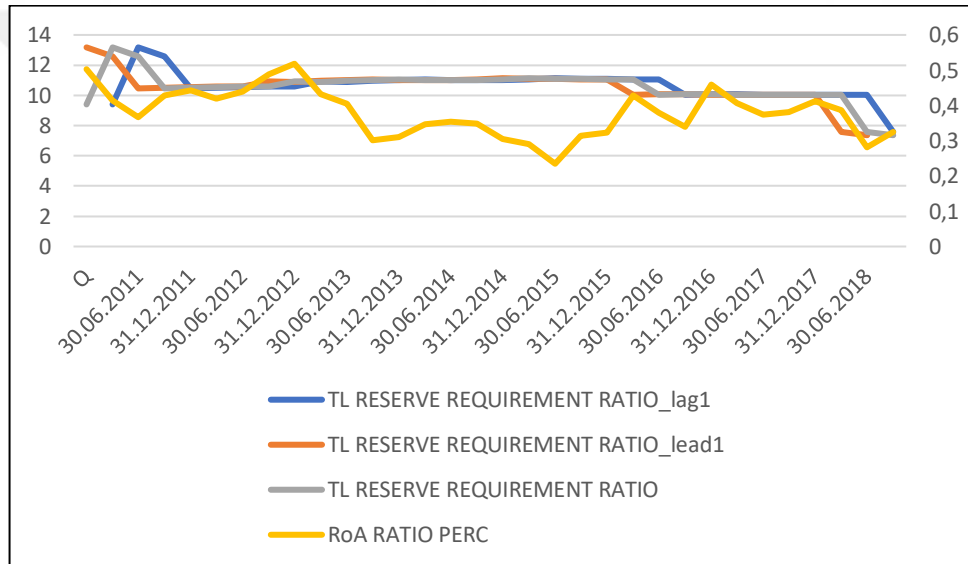
The lead of a variable is defined as following: If there is a value for a certain time period (in our case it can be quarter 2), that value needs to be carried to the previous period (in our case to quarter 1).

### 3.2.3 Reserve Requirement Ratio for Turkish Lira

The variable “TL RESERVE REQUIREMENT RATIO” is Reserve Requirement Ratio for Turkish Lira.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA PERC”) can be shown in the following graph.

**Figure 3.1: ‘TL reserve requirement ratio’ & ‘RoA Ratio’ comparison**



In the figure it can be easily seen that there is no direct relation between the target variable and the candidate variables.

This information is available from 7 January 2011 and it is almost updated every fourteen days in the data. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 9,4 which can be found between 18 February 2011 and 4 March 2011 (see appendix 1) .

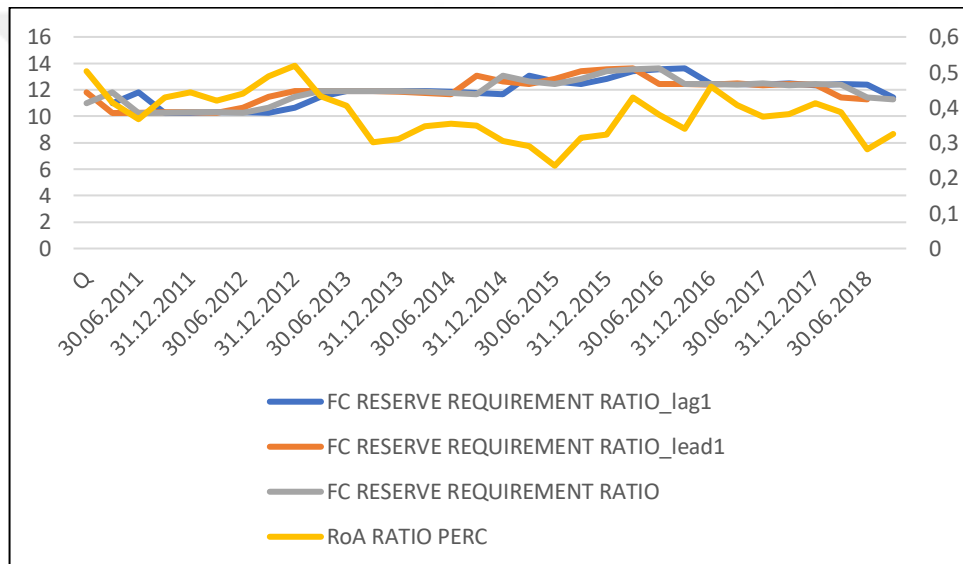
Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### 3.2.4 Reserve Requirement Ratio for Foreign Currencies

The variable “FC RESERVE REQUIREMENT RATIO” is Reserve Requirement Ratio for foreign currencies.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.2: ‘FC reserve requirement ratio’ & ‘RoA Ratio’ comparison**



In the figure it can be seen that there is no direct relation between the target variable and the candidate variables, but also for some certain periods there is a relation which the model can capture.

This information is available from 7 January 2011 and it is almost updated every fourteen days in the data. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 11 which can be found between 18 February 2011 and 4 March 2011 (see appendix 1) .

Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

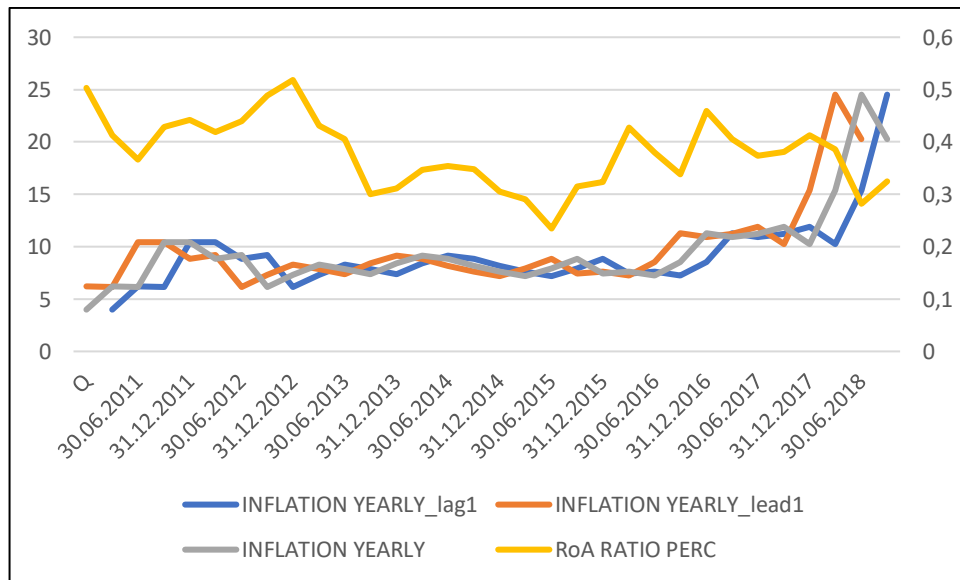
### 3.2.5 Yearly Inflation Ratio

The variable “INFLATION YEARLY” is the yearly inflation rate for Turkey.

Since it is not a monetary tool for the Central Bank of the Republic of Turkey, this variable is different. However it might include a valuable relation for the future model, it is considered as a candidate variable.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.3: ‘Inflation Yearly’ & ‘RoA Ratio’ comparison**



In the figure it can be seen that there is no direct relation between the target variable and the candidate variables, but also for some certain periods there is a relation which the model can capture and asses.

This is an information that is published once in a month. The information is available from January 2005. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 11 which can be found at March 2011 (see appendix 2) .

Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### **3.2.6 Monthly Inflation Ratio**

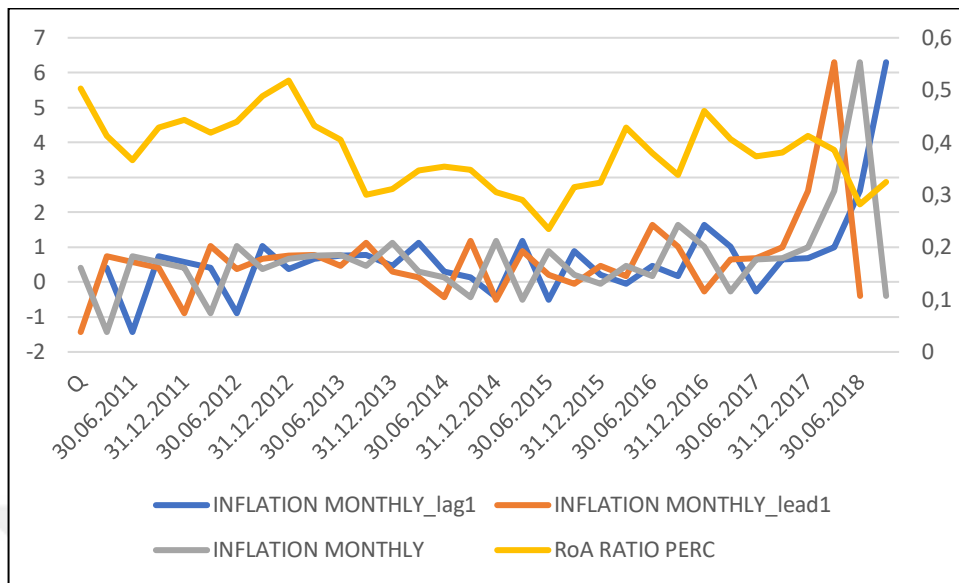
The variable “INFLATION MONTHLY” is the monthly inflation rate for Turkey.

This variable also is not a monetary tool for the Central Bank of the Republic of Turkey, however because of same reason it might include a valuable relation for the future model, it is considered as a candidate variable.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.



**Figure 3.4: ‘Inflation Monthly’ & ‘RoA Ratio’ comparison**



It can be seen that there is no direct relation between the variables and the target variable.

This is an information that is published once in a month. The information is available from January 2005. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 11 which can be found at March 2011 (see appendix 2) .

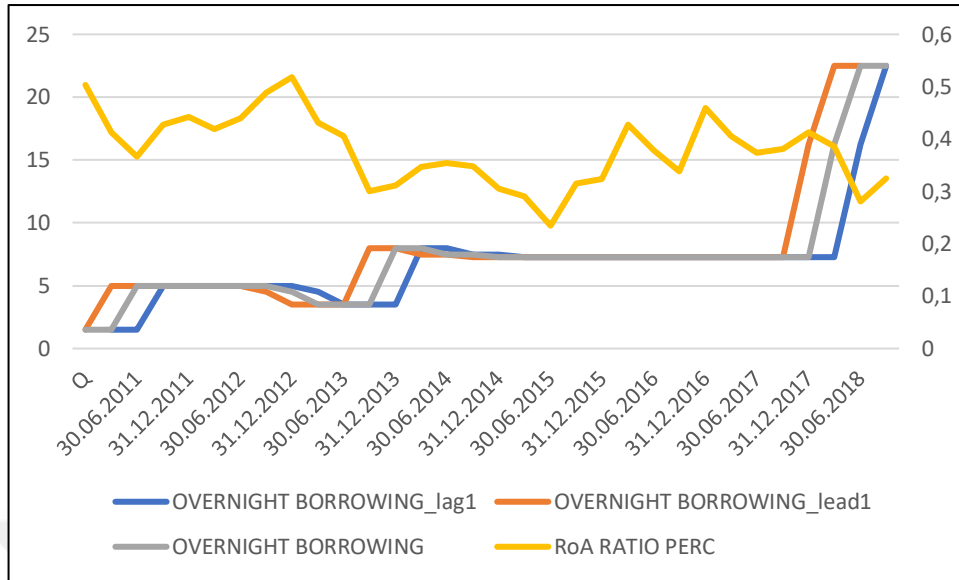
Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### 3.2.7 Overnight Borrowing Rate

The variable “OVERNIGHT BORROWING” is the overnight borrowing rate for Turkey.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.5: ‘Overnight Borrowing’ & ‘RoA Ratio’ comparison**



There might be a negative relation between these variables which the model can capture.

This information is available from 20 February 2002 and it is updated whenever it is necessary. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 1,5 which can be found in 17 December 2010 since the next update date is 5 August 2011 which is later that the end of first quarter (see appendix 3).

It is interesting to see the initial ratios for this variable, for example in 2002 values. Because of the crises, the country interest rates (all kind) are really high. For this one, it is almost 60%. When you think that this is only one night interest rate, it is really abnormally high.

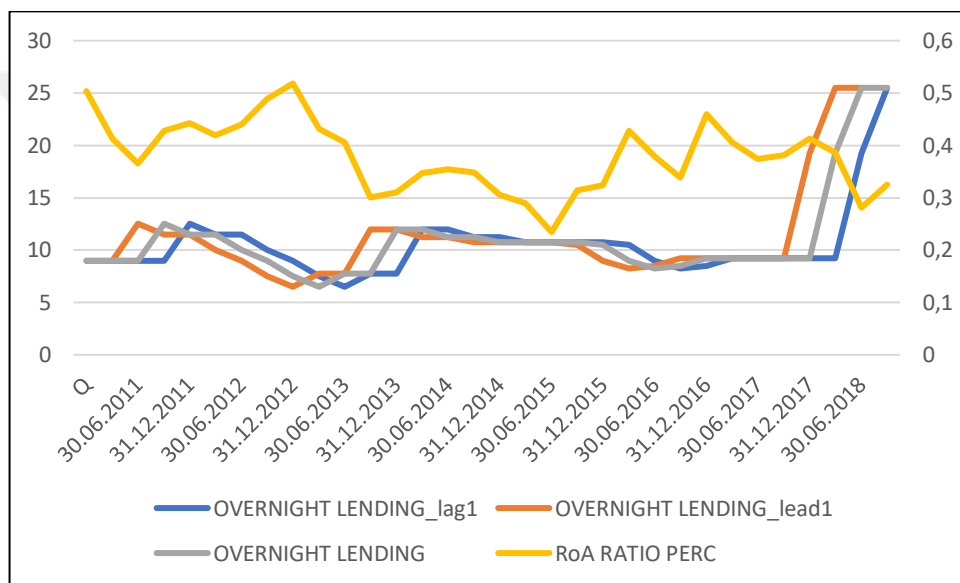
Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### 3.2.8 Overnight Lending Rate

The variable “OVERNIGHT LENDING” is the overnight lending rate for Turkey.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.6: ‘Overnight Lending’ & ‘RoA Ratio’ comparison**



From the figure above, it is difficult to conclude about a relation, however there is no relation that can be easily detected.

This information is available from 20 February 2002 and it is updated whenever it is necessary. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 9 which can be found in 17 December 2010 since the next update date is 5 August 2011 which is later that the end of first quarter (see appendix 3) .

It is interesting to see the initial ratios for this variable, for example in 2002 values. Because of the crises, the country interest rates (all kind) are really high. For this one, it

is almost 65%. When you think that this is only one night interest rate, it is also abnormally high.

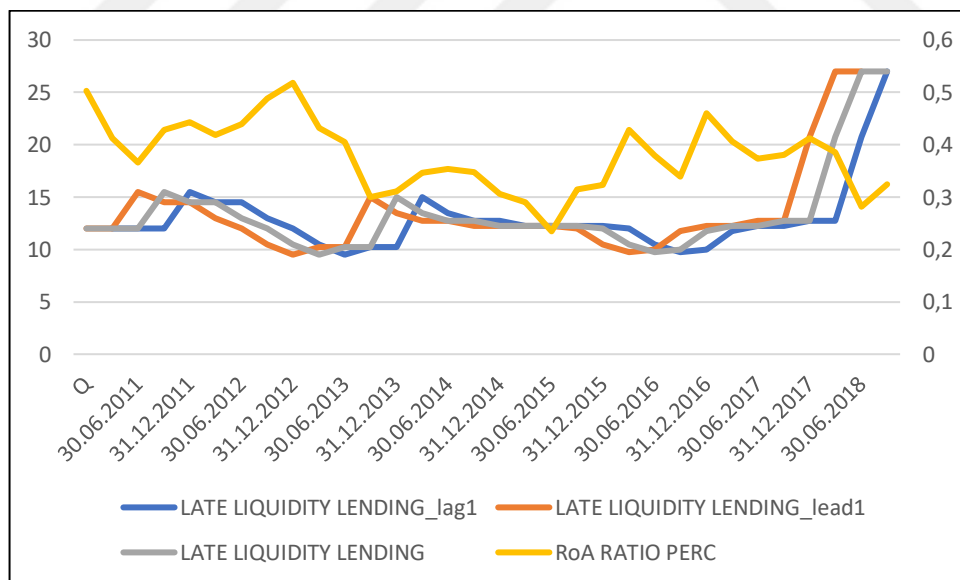
Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### 3.2.9 Late Liquidity Lending Rate

The variable “Late Liquidity Lending” is the late liquidity lending rate for Turkey.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.7: ‘Late Liquidity Lending’ & ‘RoA Ratio’ comparison**



In the figure above, it can be seen that for some periods the variables behave similar and it can be a valuable information for the model.

This information is available from 20 February 2002 and it is updated whenever it is necessary. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 12 which can be found in 17 December 2010 since the next update date is 21 October 2011 which is later that the end of first quarter (see appendix 4) .

It is interesting to see the initial ratios for this variable as well, for example in 2002 values. Because of the crises, the country interest rates (all kind) are really high. For this one, it is almost 65%. When you think that this is only one night interest rate, it is also abnormally high.

There is also another variable called late liquidity borrowing rate which can be seen in the data. However this variable is not included to the research since it is set 0 after 12 October 2010.

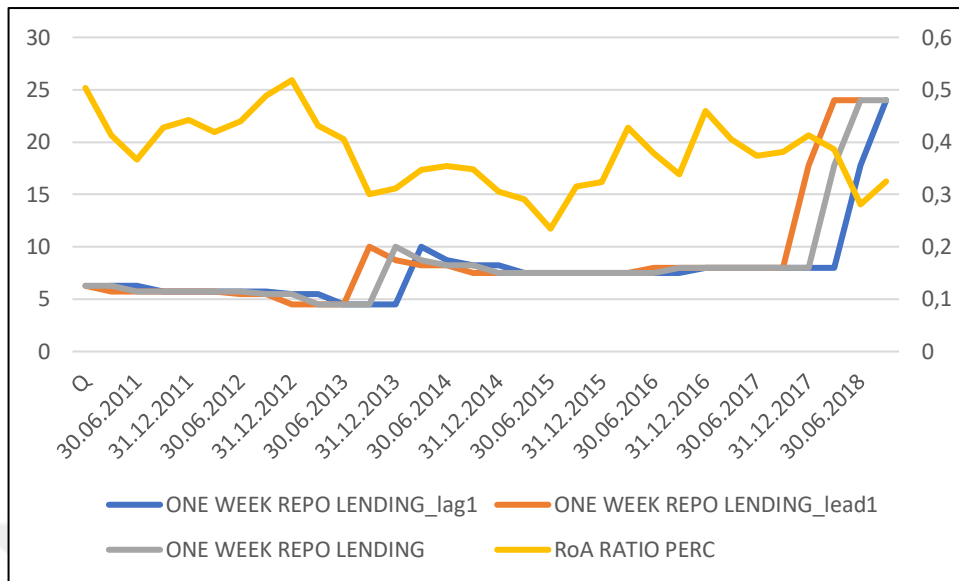
Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### **3.2.10 One Week Repo Lending Rate**

The variable “ONE WEEK REPO LENDING” is the repo lending rate for one week for Turkey.

The variable is available in the same website. The column itself, the lag of it, the lead of it and profit ratio (the name of the variable is “RoA RATIO PERC”) can be shown in the following graph.

**Figure 3.8: ‘One Week Repo Lending’ & ‘RoA Ratio’ comparison**



As it can be seen from the figure, there is no direct relation between variables.

This information is available from 20 May 2010 and it is updated whenever it is necessary. In order to have a align data in terms of period, the value that covers the end date of the specified quarter has been selected. For example, the value for quarter 1 of 2011 is 6,25 which can be found in 21 January 2011 since the next update date is 5 August 2011 which is later that the end of first quarter (see appendix 5) .

Since the data set created with the rule of “starting from the time that everything is available”, there is no missing values for this variable. We can also see that there is no seasonality problem for the variable.

### **3.3 MODEL**

After the data gathering process, all available data has been placed to a csv file. As a modeling tool, SAS Enterprise Guide has been used.

A linear regression model has been fitted for the modeling process with stepwise selection methodology. This methodology is similar to the forward selection methodology however there are some differences between them. In this methodology, if a variable was selected in the previous step, it does not stay in the model necessarily. Variables are added or deleted comparing their p-values with significance level which in this case 0.1 both for entering to the model and staying in the model. This ensures that no impact can be added to the model while some effect currently in the model is not deemed significant. Only after all necessary eliminations have been done may an effect be added to the model. In this case the impact whose addition is the most significant is added to the model and the algorithm goes on to the next step.

4 quarters from 2017 have been excluded from the data set and they are used to assess the prediction power of the model. With this exclusion, the model is built on 24 observation period which start from 2011 to 2016 year end.

#### **3.3.1 Limitations**

One of the limitations when trying to build the model is that there is an inconsistency between the periods that is available for each variable. Since there is not much data to treat the missing values with some methodologies (averages or using minimum values..), it is decided to use the starting point 2011 quarter 1 which each variable available from this date until the end of the period.

Other limitation is that since the banks only publishes the related reports quarterly, only 4 data point for each year can observed for the target variable. This problem will be discussed after getting the model results whether there is enough data point or not. This problem is also related with the model selection which is linear regression.

Apart from this, in the literature there are many researches which had to use limited data points because of the limitations. In the literature review chapter, we mentioned the paper that is written by David, Dare, Okeya and Olaitan (2017). For their research, they used 9 data points starting from 2006 to 2014 for their linear regression model.

Also in Butun's study (2018), there are 9 years available between 2008 and 2016 and he used monthly data for his vector auto regression model.

And another paper has been published by Hyndman which discuss to fit models to short time series.<sup>6</sup> He is strongly argues that "magic number" 30 is not a good approach for the problem. He states that it might be a good approach to use some technical methodologies such as Akaike Information Criterion (AIC) and to see if the model performs well for out-of-sample data.

Fiedler and Kareev (2011) also studied on this very topic. They call it Small Sample Advantages (SSA) which they claim that the decisions are often insensitive to sample size.

There is also a lot of study about this topic, because when you have a relatively big data, it becomes harder to work with but you have more information. Different models can be tried. However with the small data, the options are limited, and it is better to keep it simple.<sup>7</sup>

### **3.3.2 Variable Selection Process in the Model**

For the model, stepwise selection methodology has been chose. In total, there are 5 steps with adding/removing variables.

Before going into the selection process, the original candidate variables had been analyzed. Below the summary statistics for each one can be seen.

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<sup>6</sup> Hyndman, R., 2014. [Online] <https://robjhyndman.com/hyndsight/short-time-series/> [Accessed 8 December 2019]

<sup>7</sup> What to do with small data? [Online] <https://medium.com/rants-on-machine-learning/what-to-do-with-small-data-d253254d1a89> [Accessed 10 December 2019]



**Table 3.1: Descriptive summary statistics of real candidate variables**

<b>Variable</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Minimum</b>	<b>Maximum</b>	<b>N</b>
TL RESERVE REQUIREMENT	109.268.954	0.7393164	93.881.083	131.743.594	24
FC RESERVE REQUIREMENT	118.015.348	10.817.112	102.445.290	136.249.419	24
INFLATION YEARLY	78.920.833	14.094.803	39.900.000	104.500.000	24
INFLATION MONTHLY	0.3775000	0.6834774	-14.300.000	16.400.000	24
OVERNIGHT BORROWING	57.083.333	19.831.720	15.000.000	80.000.000	24
OVERNIGHT LENDING	98.645.833	16.533.549	65.000.000	125.000.000	24
LATE LIQUIDITY LENDING	121.354.167	16.664.515	95.000.000	155.000.000	24
ONE WEEK REPO LENDING	67.291.667	14.501.062	45.000.000	100.000.000	24

There is no missing variable since N is 24. However when we add lag and lead variables, we are going to see one missing value for each of them because of the methodology that we have applied.

For ‘TL RESERVE REQUIREMENT’, the mean value is around 10.9, standard deviation value is around 0.74, minimum value is around 9.4 and maximum value is around 13.2.

For ‘FC RESERVE REQUIREMENT’, the mean value is around 11.8, standard deviation value is around 1.08, minimum value is around 10.3 and maximum value is around 13.6.

For ‘INFLATION YEARLY’, the mean value is around 7.9, standard deviation value is around 1.4, minimum value is around 4 and maximum value is around 10.5.

For ‘INFLATION MONTHLY’, the mean value is around 0.38, standard deviation value is around 0.68, minimum value is around -1.4 and maximum value is around 1.64. This is where we see a negative value for the first time.

For ‘OVERNIGHT BORROWING’, the mean value is around 5.7, standard deviation value is around 1.98, minimum value is around 1.5 and maximum value is around 8.

For ‘OVERNIGHT LENDING’, the mean value is around 9.9, standard deviation value is around 1.65, minimum value is around 6.5 and maximum value is around 12.5.

For ‘LATE LIQUIDITY LENDING’, the mean value is around 12.1, standard deviation value is around 1.67, minimum value is around 9.5 and maximum value is around 15.5.

For ‘ONE WEEK REPO LENDING’, the mean value is around 6.7, standard deviation value is around 1.45, minimum value is around 4.5 and maximum value is around 10.

Before the modelling process, standardization needs to be applied for the variables. However in SAS, the modelling process has already been doing that, that's why when we standardize the data and develop the model, we got the same results. That's why in order to avoid the complications, from now on not-standardized results will be shown.

This is the overall look to the variable selection process:

**Table 3.2: Summary of stepwise selection**

Summary of Stepwise Selection									
Step	Variable Entered	Variable Removed	Label	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	OVERNIGHT BORROWING_lead1			1	0.6199	0.6199	.	34.25	<.0001
2	OVERNIGHT LENDING_lead1			2	0.0497	0.6696	.	3.01	0.0983
3	FC RESERVE REQUIREMENT			3	0.1004	0.7700	.	8.29	0.0096
4		OVERNIGHT BORROWING_lead1		2	0.0016	0.7684	.	0.13	0.7186

The first column is the steps that have been performed. So in the first step a variable (OVERNIGHT BORROWING\_lead1) has been added to the model with 0.6199 R-square. Then in the second another one (OVERNIGHT LENDING\_lead1) has been added with additional 0.0497 R-square. In third step, another variable (FC RESERVE REQUIREMENT) has been added with additional 0.1004 R-square, after that in the fourth step, one variable has been deleted (OVERNIGHT BORROWING\_lead1), by doing this, we lost 0.0016 R-square. Now we need to investigate the steps that have been performed.

In Step 1, the first variable has entered to the model with 0.6199 R-square which is 'OVERNIGHT BORROWING\_LEAD1' (Overnight borrowing rate with lead 1 period). It has negative relation with the target variable (-0.03524 parameter estimate). And p-value of it is smaller than 0.0001. In 'The Data Gathering' chapter, this variable has been discussed and the comment was that this variable can be valuable for the model that is going to be developed.

So for the hypothesis test, if we say;

H0: 'OVERNIGHT BORROWING\_LEAD1' (Overnight borrowing rate with lead 1 period) has no significant impact on 'RoA' which indicates Return on Asset.

We need to reject this hypothesis at this step. Below there are summary tables that explains the Step 1.

**Table 3.3: Variable selection process step 1, analysis of variance**

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.06596	0.06596	34.25	<.0001
Error	21	0.04044	0.00193		
Corrected Total	22	0.10640			

**Table 3.4: Variable selection process step 1, variable statistics**

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	0.59154	0.03810	0.46427	241.08	<.0001
OVERNIGHT BORROWING_lead1	-0.03524	0.00602	0.06596	34.25	<.0001

In Step 2, another variable has been entered to the model by increasing R- square from 0.6199 to 0.6696 which is ‘OVERNIGHT LENDING\_ LEAD1’ (overnight lending rate with lead 1 period). It has again negative relation with the target variable (-0.01093 parameter estimate). It is also effecting the previous variable’s parameter estimate which had been entered to the model from -0.03524 to -0.02899. This addition increase the p-value of the previous variable, as well to 0.0004. And it entered with p-value 0.0983 which is high from a modelling perspective. However overall p-value of the model stays at less than 0.0001.

So for the hypothesis test, if we say;

H0: ‘OVERNIGHT BORROWING\_ LEAD1’ (Overnight borrowing rate with lead 1 period) has no significant impact on ‘RoA’ which indicates Return on Asset.

H0: ‘OVERNIGHT LENDING\_ LEAD1’ (Overnight lending rate with lead 1 period) has no significant impact on ‘RoA’ which indicates Return on Asset.

We still need to reject the first hypothesis at this step. However the second hypothesis cannot be rejected if the value is being compared to 0.05 p-value level. Below there are summary tables that explain the Step 2.

**Table 3.5: Variable selection process step 2, analysis of variance**

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.07124	0.03562	20.27	<.0001
Error	20	0.03516	0.00176		
Corrected Total	22	0.10640			

**Table 3.6: Variable selection process step 2, variable statistics**

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	0.66143	0.05430	0.26079	148.37	<.0001
OVERNIGHT BORROWING_lead1	-0.02899	0.00679	0.03203	18.22	0.0004
OVERNIGHT LENDING_lead1	-0.01093	0.00630	0.00529	3.01	0.0983

In Step 3, another variable has been entered to the model by increasing R-square from 0.6696 to 0.7700 which is ‘FC RESERVE REQUIREMENT’ (reserve requirement for foreign currencies ). This addition is really important for the study. The findings will be discussed in the next chapter. And the increase in the R-square is valuable as well. This has also negative relation with the target variable (-0.03724 parameter estimate). And the previous variables’ parameter estimation are changing as well. Overall p-value for the model is still <0.0001 but individual p-values are 0.0096, 0.7168, 0.0024 respectively for ‘FC RESERVE REQUIREMENT’, ‘OVERNIGHT BORROWING\_LEAD1’, ‘OVERNIGHT LENDING\_LEAD 1’.

H0: ‘OVERNIGHT BORROWING\_LEAD1’ (Overnight borrowing rate with lead 1 period) has no significant impact on ‘RoA’ which indicates Return on Asset.

H0: ‘OVERNIGHT LENDING\_LEAD1’ (Overnight lending rate with lead 1 period) has no significant impact on ‘RoA’ which indicates Return on Asset.

H0: 'FC RESERVE REQUIREMENT' (foreign currency reserve requirement rate) has no significant impact on 'RoA' which indicates Return on Asset.

We still need to reject the first hypothesis at this step. However the second hypothesis cannot be rejected if the value is being compared to 0.05 p-value level. Also the third hypothesis needs to be rejected.

**Table 3.7: Variable selection process step 3, analysis of variance**

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.08193	0.02731	21.20	<.0001
Error	19	0.02447	0.00129		
Corrected Total	22	0.10640			

**Table 3.8: Variable selection process step 3, variable statistics**

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	112.123	0.16628	0.05856	45.47	<.0001
FC RESERVE REQUIREMENT	-0.03724	0.01293	0.01068	8.29	0.0096
OVERNIGHT BORROWING_lead1	-0.00384	0.01049	0.00017229	0.13	0.7186
OVERNIGHT LENDING_lead1	-0.02842	0.00812	0.01577	12.24	0.0024

In Step 4, a variable has been removed from the model which is 'OVERNIGHT BORROWING\_LEAD1' (overnight borrowing rate with lead 1 period). This is expected, because the variable has really high p-value with other variables and there is almost no impact on R-square (from 0.7700 to 0.7684). Removing this variable has additional impact on the p-values of the other variables (both are <0.0001). And the overall p-value for the model is still less than 0.0001. New parameter estimates for remaining variables are -0.04118 and -0.03085 for 'FC RESERVE REQUIREMENT' (reserve requirement ratio for foreign currencies) and 'OVERNIGHT LENDING\_LEAD1' (overnight lending rate with one period lead) respectively.

H0: 'OVERNIGHT BORROWING\_LEAD1' (Overnight borrowing rate with lead 1 period) has no significant impact on 'RoA' which indicates Return on Asset.

H0: 'FC RESERVE REQUIREMENT' (foreign currency reserve requirement ratio) has no significant impact on 'RoA' which indicates Return on Asset.

We still need to reject the first hypothesis at this step. Also the second hypothesis needs to be rejected. Below there are summary tables which explain the Step 4.

**Table 3.9: Variable selection process step 4, analysis of variance**

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.08176	0.04088	33.17	<.0001
Error	20	0.02464	0.00123		
Corrected Total	22	0.10640			

**Table 3.10: Variable selection process step 4, variable statistics**

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	116.836	0.10280	0.15917	129.18	<.0001
FC RESERVE REQUIREMENT	-0.04118	0.00701	0.04254	34.52	<.0001
OVERNIGHT LENDING_lead1	-0.03085	0.00457	0.05613	45.56	<.0001

In the Step 5, the remaining possibilities have been tested and none of them could meet significance level for entry to the model, and none of them could be removed since remaining variables are significant.

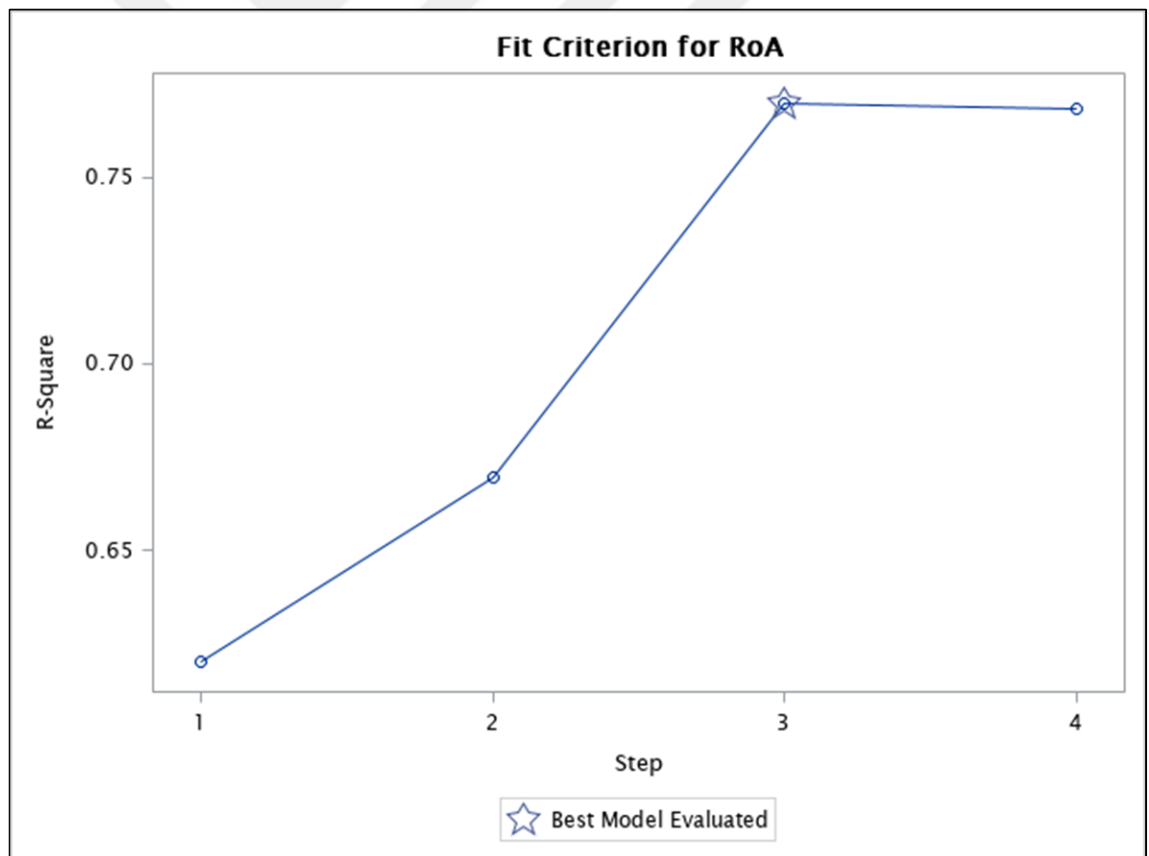
To sum up, in the model there are two variables (FC RESERVE REQUIREMENT, OVERNIGHT LENDING\_LEAD1) with R-square 0.7684.

### 3.3.3 Model Findings

In this chapter, the model results will be discussed from the technical point of view and will be discussed for the interpretation of it. The predictions for four quarters in 2017 will be shared and the results will be compared with the actual ones.

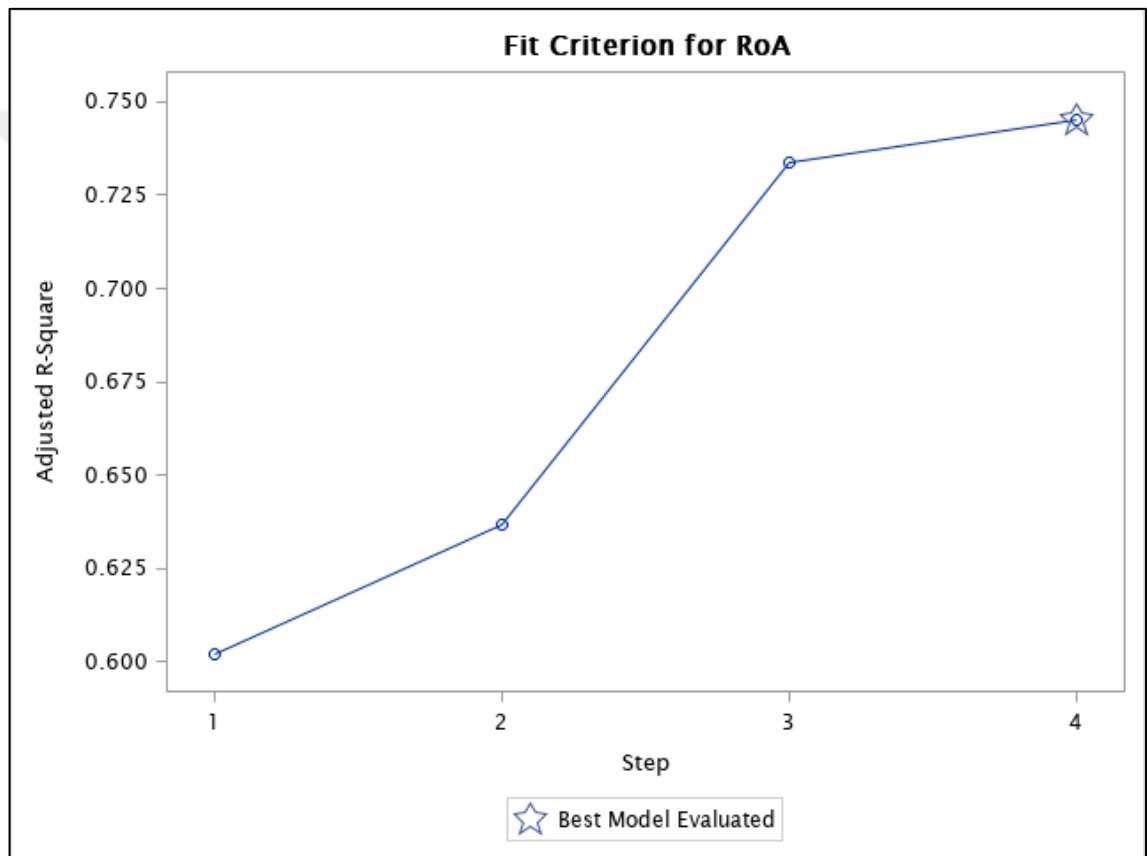
The model has to be investigated further by using some indicators to indicate if it is the best model that can be obtained. In order to do that, some indicators will be used. The most important ones are R-square, adjusted R-square, AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion). SAS can generate these indicators as a part of the result report of the model.

**Figure 3.9: R-square values in each step of the variables selection process**



R-square indicator is a statistic that shows us how close the data to the model that has been developed. According to the R-square indicator, we observed the best model at Step 3. However as stepwise selection suggested, the algorithm went on. From the graph, it can be seen that there is no significant impact on R- square removing this variable from the model, however it has a major impact on the p-values of individual remaining variables.

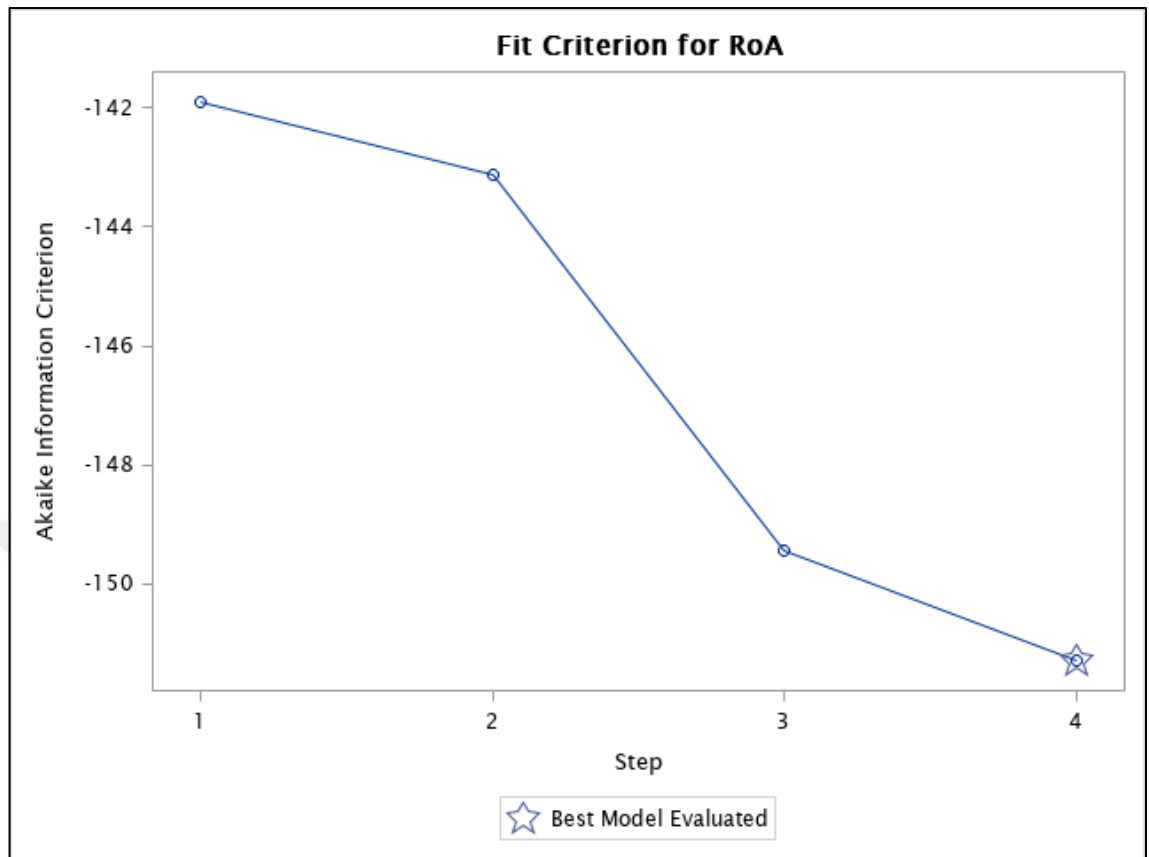
**Figure 3.10: Adjusted R-square values in each step of the variables selection process**



Adjusted R-square indicator is a statistic that has is derived from R-square. This derivation is depending on the number of predictors. When we look at the adjusted R-square ratio, we observed the best model at Step 4 (almost 75%). By removing that variable at Step 4, the model has been improved in terms of adjusted R-square indicator.

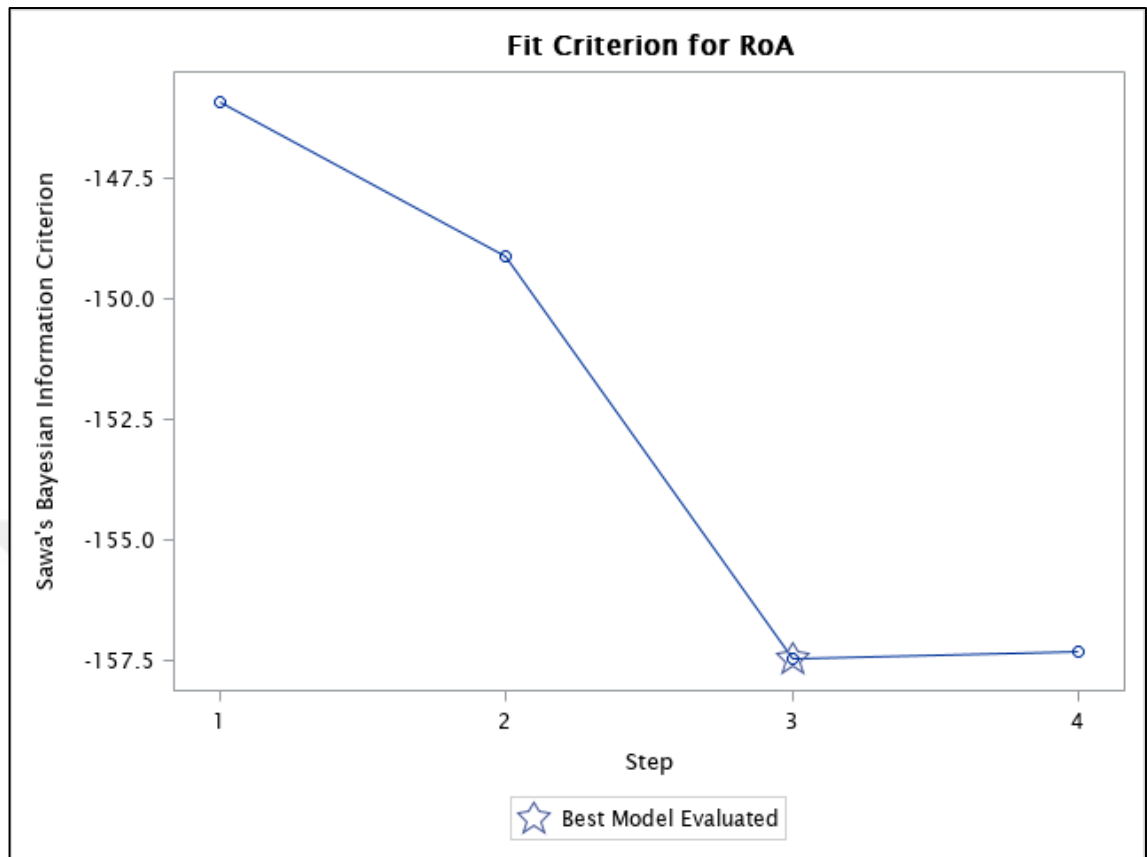


**Figure 3.11: AIC values in each step of the variables selection process**



The Akaike Information Criterion is used for comparing different models. The lower this statistic the better for the models. In terms of AIC indicator, again we observed the best model at Step 4 similar with adjusted R-square ratio.

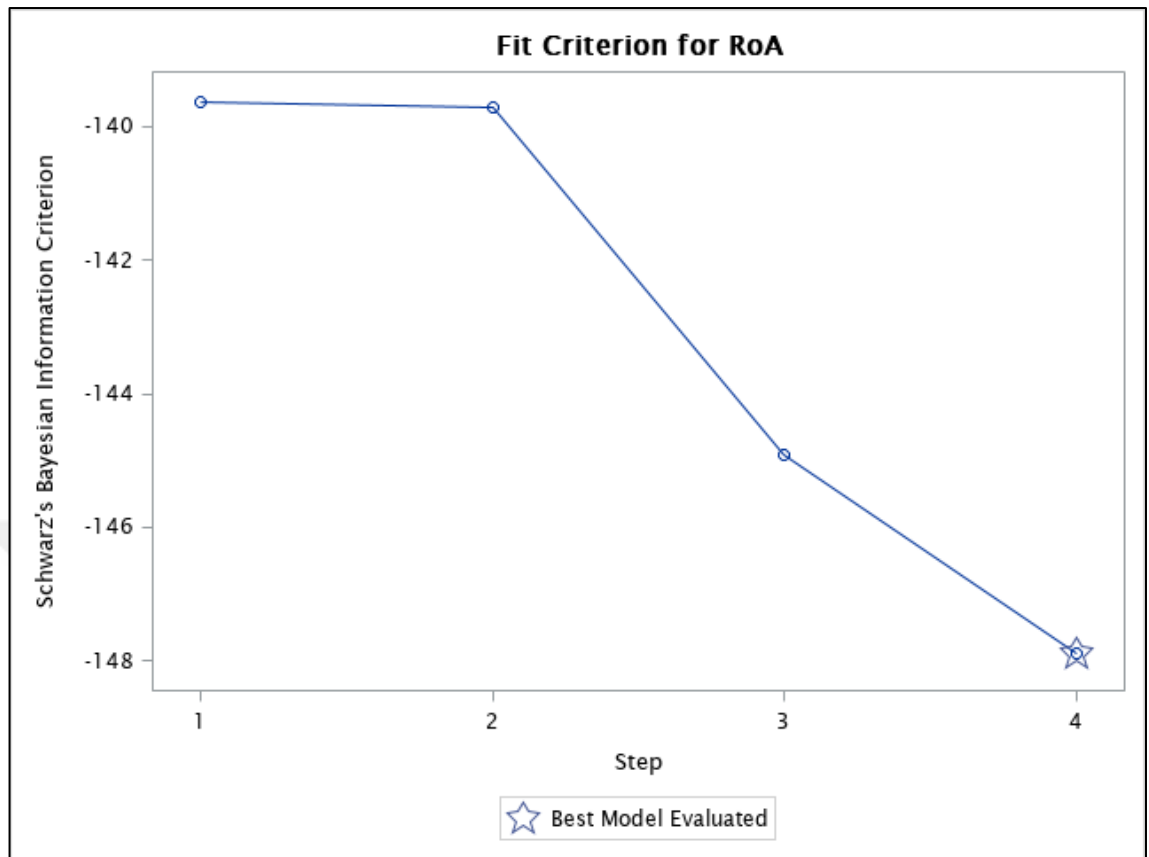
**Figure 3.12: BIC values in each step of the variables selection process**



The Bayesian Information criterion is also used for comparing the models. Again the lower the better the model is. If we look at BIC graph, it can be seen that the best model had been observed at Step 3. However, when we compare it with Step 4, there is no significant change in the indicator.

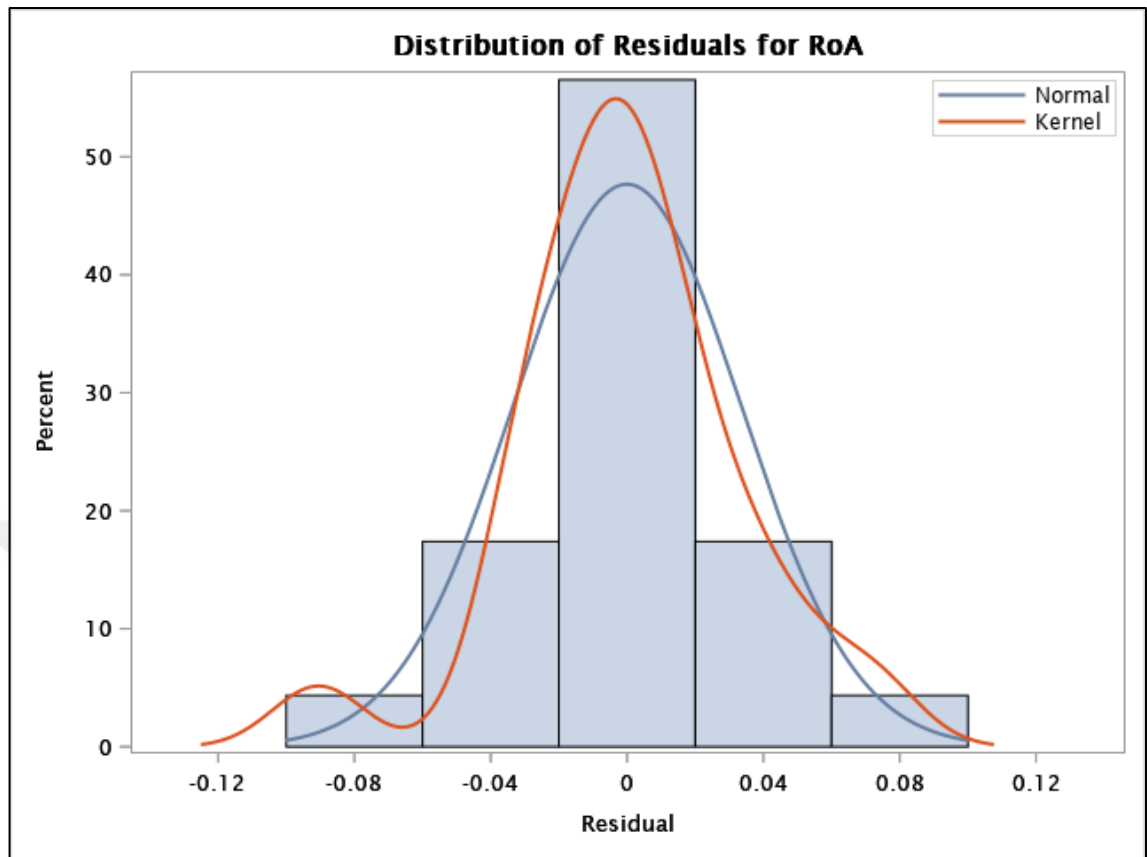
There is another indicator that needs to be seen which is SBC (Schwarz's Bayesian Information Criterion). This indicator also suggest that the best model was created at Step 4. The figure can be seen below.

**Figure 3.13: SBC values in each step of the variables selection process**



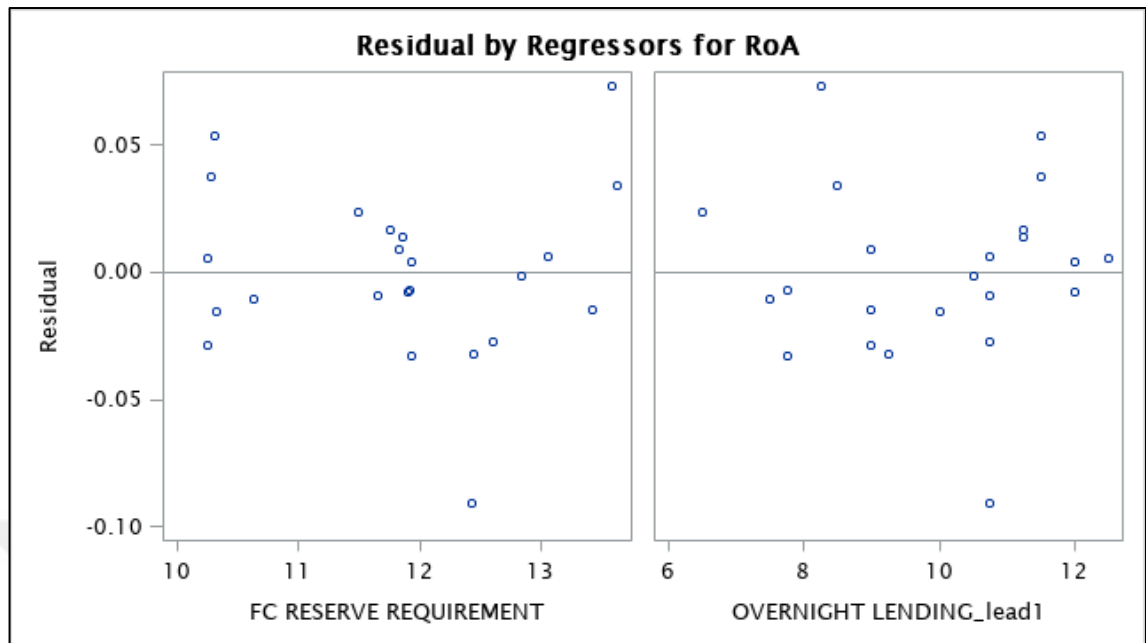
The residuals are also important for the model. In order to be sure that there is no bias in the model, residuals should be distributed normally. The graph below proves that residuals is distributed normally.

**Figure 3.14: Distribution of Residuals**



In order to be completely sure about the residuals, the relation between residuals and each individual variable should be checked. And this distribution should be randomly distributed in order to conclude there is no endogeneity. The graph below proves this case.

**Figure 3.15: Residual vs selected variables distribution**



With all these check points, from the technical point of view, it can be concluded that the model looks healthy and can be investigated for the further steps which include predictions.

The data set has been divided in to 2 parts. One of them had been used to develop the model which covers the first quarter of 2011 until the last quarter of 2016. The other part had been used for the prediction purposes which covers 4 quarters in 2017. The reason of this split is not to include data points for making the predictions which are already used for training the model.<sup>8</sup>

Prediction results of the model can be seen below :

<sup>8</sup> Towards Data Science [Online] <https://towardsdatascience.com/train-test-split-and-cross-validation-in-python-80b61beca4b6> [Accessed 9 December 2019]

**Table 3.11: Prediction results**

Q	FC RESERVE REQUIREMENT	OVERNIGHT LENDING_lead1	RoA	predicted_RoA
31-3-2017	12,4350	9.25	0.46	0.3709099328
30-6-2017	12,3973	9.25	0.41	0.3724606738
30-9-2017	12,5060	9.25	0.37	0.3679831676
31-12-2017	12,3659	9.25	0.38	0.3737532661

It can be seen from the data and the Table 3.11 above, for the first quarter, reserve requirement ratio for foreign currencies is almost 12,44 when overnight lending ratio for lead 1 is 9.25. The real value for Return on Asset is 0.46 while the prediction value for Return on Asset ratio is almost 0.371.

For the second quarter, reserve requirement ratio for foreign currencies is almost 12,4 when overnight lending ratio for lead 1 is 9.25. The real value for Return on Asset is 0.41 while the prediction value for Return on Asset ratio is almost 0.372.

For the third quarter, reserve requirement ratio for foreign currencies is almost 12,51 when overnight lending ratio for lead 1 is 9.25. The real value for Return on Asset is 0.37 while the prediction value for Return on Asset ratio is almost 0.368.

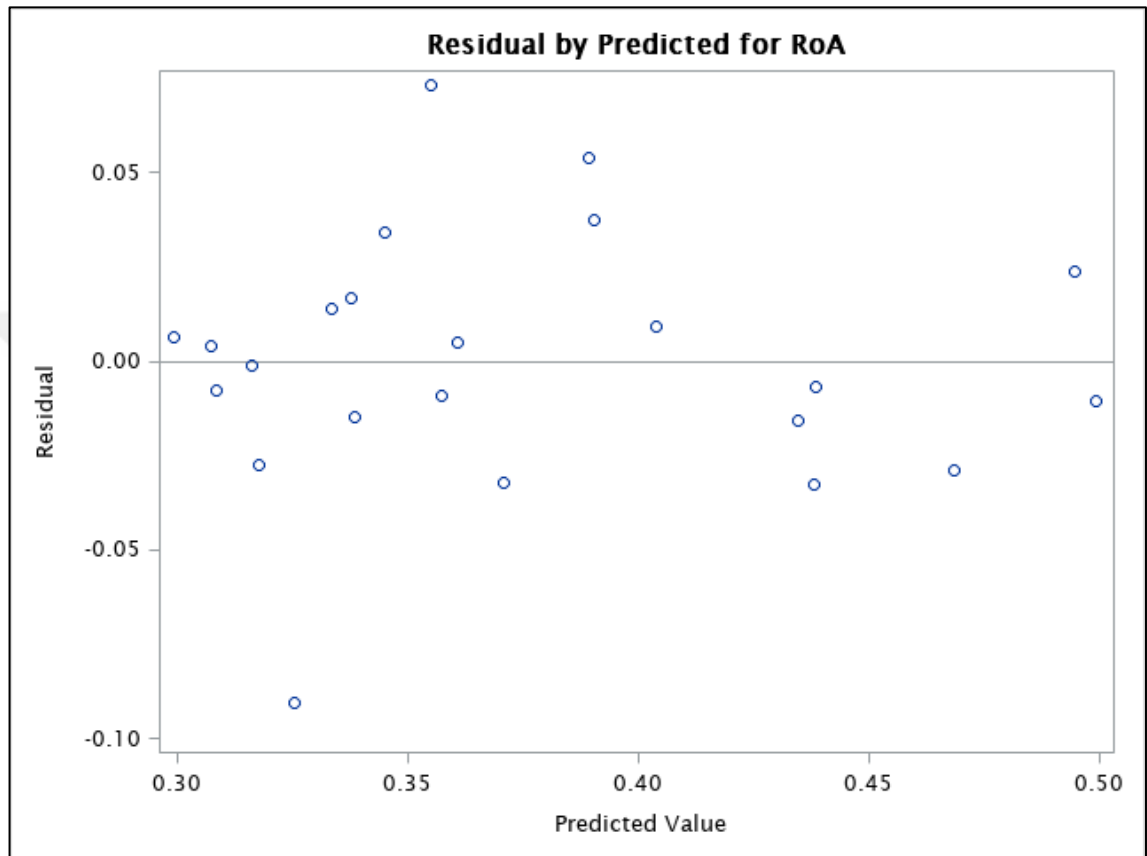
For the last quarter, reserve requirement ratio for foreign currencies is almost 12,37 when overnight lending ratio for lead 1 is 9.25. The real value for Return on Asset is 0.38 while the prediction value for Return on Asset ratio is almost 0.374.

We can conclude that when reserve requirement for foreign currencies decreases then the predictions for Return on Asset ratio is increasing. When reserve requirement for foreign currencies increases then the predictions for Return on Asset ratio is decreasing as expected because of the coefficients in the model.

After the first quarters realized results, according to the model we expect an increase in the Return on Asset ratio. However the realized figure is decreasing. But after that point, the model can correctly estimate whether it is going to be increase or decrease. For the third quarter of 2017, a decrease is expected, so the realized figure is also decreasing. For the last quarter of 2017, an increase is expected, so the realized figure is also increasing.

In this part, the validity of the prediction will be discussed from the technical point of view with the help of some figures from the software.

**Figure 3.16: Residual vs predicted values**



The above figure is about the residuals. Residuals are the variations that cannot be explained by the model.<sup>9</sup> The residuals need to be distributed roughly normal.<sup>10</sup> This means that if there is a roughly normal distribution for residuals, this case refers that there is no systematic error in the model.

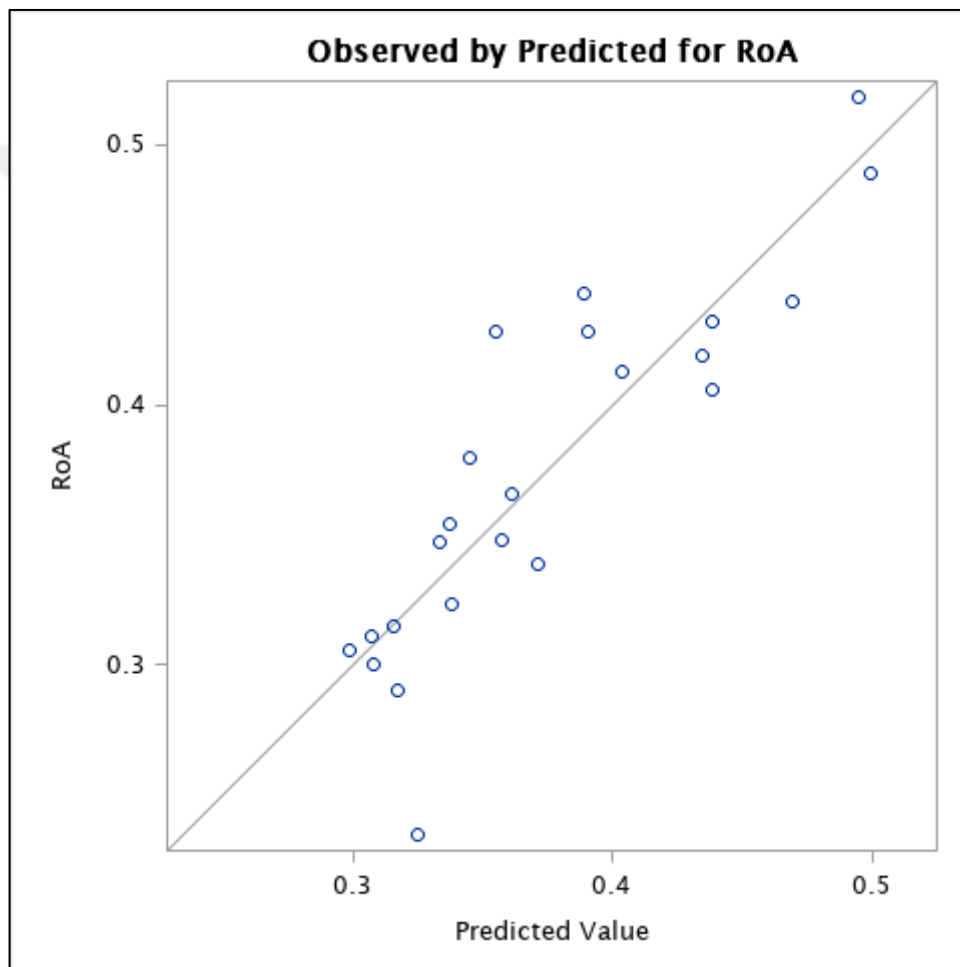
<sup>9</sup> Stattek [Online] <https://stattrek.com/statistics/dictionary.aspx?definition=residual> [Accessed 9 December 2019]

<sup>10</sup> Statistic Solutions [Online] <https://www.statisticssolutions.com/testing-assumptions-of-linear-regression-in-spss/> [Accessed 9 December 2019]

In this graph, we can say that residuals are distributed randomly and there is no systematic error in the predictions. There is one above and one below outlier, but apart from that they are distributed between 0.05 and -0.05.

The Figure 3.14 explains this phenomena better. The distribution of the residuals reflects the behavior of a normal distribution.

**Figure 3.17: Observed vs predicted values**



In this Figure 3.17, we can comment on how close the predictions to the real data points. Out of 24 data points, it can be said that even though there are some outliers, the fitted model can explain the real data. But apart from that, there is no analytical explanation in this graph that can be commented on. This graph is basically the source of the analysis above for the residuals. Because residual means the difference between the real data point



and the model value. We can see from Figure 3.17 that if the predicted value is between 0.3 and 0.4, we expect that one of the residuals is really off. If we look at the Figure 3.17, that case can be observed.



#### 4. DISCUSSION

According to the model, there are two important instruments that have been used by The Central Bank of the Republic of Turkey: overnight lending rate (lead 1) and reserve requirement ratio for foreign currencies.

In order to understand the lead 1 variables, this example can be examined:

- i. Let's take December 2011.
- ii. The value for overnight lending rate: 12,5
- iii. The value of overnight lending rate lead 1 (which is actually the value of overnight lending rate in March 2012) : 11,5

With this model, it is claimed that Return of Asset ratio of the banking industry in Turkey in a specific time can be modeled by overnight lending rate which belongs to the upcoming quarter. This information enables us to predict the Return on Asset Ratio with expected overnight lending rates.

The other variable is reserve requirement ratio for foreign currencies. Reserve requirement ratios have been an important and effective instrument for the Central Bank of the Republic of Turkey. It can be seen from the Figure 3.2 that for a long period of time ( between 2013 / 2014 and 2017 / 2018) it is almost stable. These two periods are relatively stable periods for Turkish economy. However it can be seen that in 2015 and 2016 there is a pick that can be easily detected. This period is a relatively complicated period for Turkish economy because of the political occasions. Also in this period, we can see that the Return on Asset ratio has been increasing constantly for the Turkish banks. It seems that the banks in Turkey had handled these complication in the economy very well. Because of these reasons, it was expected before the modeling process that this instrument can be a valuable input for the model.

The final equation can be seen from the table below.

**Table 3.12: Final model**

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	116.836	0.10280	0.15917	129.18	<.0001
FC RESERVE REQUIREMENT	-0.04118	0.00701	0.04254	34.52	<.0001
OVERNIGHT LENDING_lead1	-0.03085	0.00457	0.05613	45.56	<.0001

This table states the below equation:

$$RoA = 1.16836 + (-) 0.04118 * 'FC RESERVE REQUIREMENT' + (-) 0.03085 * 'OVERNIGHT LENDING\_lead1' \quad (4.1)$$

This means that 1 unit increase in reserve requirement ratios for foreign currencies will lead 0.04118 unit decrease in Return on Asset ratio while overnight lending rate for lead 1 remains same.

On the other hand, 1 unit increase in overnight lending ratio for lead 1 variable will lead 0.03085 unit decrease in Return on Asset ratio while reserve requirement ratio for foreign currencies remains same.

So the study that have been researched by Alper, Binici, Demiralp, Kara and Ozlu (2014), suggest that there is a strong relation between reserve requirement ratios and banks' behavior. We can say that, the conclusion of this paper has supportive results for that study, since the thesis concludes that there is a relation between reserve requirement ratios and Return on Asset ratio. However this relation is limited with only foreign currency reserve requirement ratio.

## 5. CONCLUSION

The question for this study is that whether there is a positive or negative relation between monetary instruments that the Central Bank of the Republic of Turkey holds. The question has been answered by developing a linear regression model that is explained below.

Out of 24 candidate variables (8 of them with real values, 8 of them with lag values and 8 of them with lead values) 2 of them has entered the fitted model (reserve requirement ratio for foreign currencies and overnight lending ratio with lead1). With these 2 variables, the model has been developed with 0.7684 R- square. The fitted model shows us that there is negative relation between reserve requirement ratio for foreign currencies and Return on Asset ratio. It also shows that there is a negative relation between overnight lending ratio for lead 1 variable and Return on Asset ratio.

In parallel to the development process, the predictions have been performed to test the prediction power of the model on the data that had not been used for the training purposes. After that results has been compared, and some statistics like residuals has been discussed with the help of graphs. However the predictions are not far from the real values and also this comment has been assessed by the technical point of view.

There were some limitations regarding the data gathering process. Those limitations has been examined one by one and has been tackled with some additional checks on the data and the model. Most of them has been addressed to the literature, however still there might be some improvements in the research topic.

There is no major problem observed and the results suggest that the model can provide valuable inputs for the next researches. In this paper, the banking industry has been evaluated as a whole, but this study can be applicable for each bank to investigate the relationship with their Return on Asset ratio and these variables, maybe additional macroeconomic variables to monthly/yearly inflation.

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## APPENDIX





## Appendix 1

### Reserve Requirement Ratios

(%)

Start Date	End Date	TL	FC
7-1-2011	21-1-2011	7,4	11,0
21-1-2011	4-2-2011	7,4	11,0
4-2-2011	18-2-2011	9,4	11,0
18-2-2011	4-3-2011	9,4	11,0
4-3-2011	18-3-2011	9,4	11,0
18-3-2011	1-4-2011	9,4	11,0
1-4-2011	15-4-2011	13,2	11,0
15-4-2011	29-4-2011	13,1	11,0
29-4-2011	13-5-2011	13,3	11,8
13-5-2011	27-5-2011	13,3	11,8
27-5-2011	10-6-2011	13,2	11,8
10-6-2011	24-6-2011	13,2	11,8
24-6-2011	8-7-2011	13,2	11,8
8-7-2011	22-7-2011	13,1	11,8
22-7-2011	5-8-2011	13,2	11,5
5-8-2011	19-8-2011	13,1	11,0
19-8-2011	2-9-2011	13,1	11,0
2-9-2011	16-9-2011	13,1	11,0
16-9-2011	30-9-2011	13,1	11,0
30-9-2011	14-10-2011	12,6	10,2
14-10-2011	28-10-2011	12,6	10,3
28-10-2011	11-11-2011	10,5	10,3
11-11-2011	25-11-2011	10,5	10,3
25-11-2011	9-12-2011	10,5	10,3
9-12-2011	23-12-2011	10,5	10,3
23-12-2011	6-1-2012	10,5	10,3
6-1-2012	20-1-2012	10,5	10,3
20-1-2012	3-2-2012	10,5	10,3
3-2-2012	17-2-2012	10,5	10,3
17-2-2012	2-3-2012	10,5	10,3
2-3-2012	16-3-2012	10,5	10,3
16-3-2012	30-3-2012	10,5	10,3
30-3-2012	13-4-2012	10,5	10,3
13-4-2012	27-4-2012	10,5	10,3
27-4-2012	11-5-2012	10,5	10,3
11-5-2012	25-5-2012	10,5	10,3
25-5-2012	8-6-2012	10,5	10,3
8-6-2012	22-6-2012	10,5	10,3

22-6-2012	6-7-2012	10,5	10,3
6-7-2012	20-7-2012	10,5	10,3
20-7-2012	3-8-2012	10,6	10,3
3-8-2012	17-8-2012	10,6	10,3
17-8-2012	31-8-2012	10,6	10,3
31-8-2012	14-9-2012	10,6	10,3
14-9-2012	28-9-2012	10,6	10,3
28-9-2012	12-10-2012	10,6	10,2
12-10-2012	26-10-2012	10,6	10,3
26-10-2012	9-11-2012	10,6	10,2
9-11-2012	23-11-2012	10,6	10,2
23-11-2012	7-12-2012	10,6	10,2
7-12-2012	21-12-2012	10,6	10,2
21-12-2012	4-1-2013	10,6	10,6
4-1-2013	18-1-2013	10,6	10,6
18-1-2013	1-2-2013	10,5	10,7
1-2-2013	15-2-2013	10,8	11,1
15-2-2013	1-3-2013	10,7	11,1
1-3-2013	15-3-2013	11,0	11,5
15-3-2013	29-3-2013	10,9	11,5
29-3-2013	12-4-2013	10,9	11,5
12-4-2013	26-4-2013	10,9	11,5
26-4-2013	10-5-2013	10,9	11,5
10-5-2013	24-5-2013	10,9	11,5
24-5-2013	7-6-2013	10,9	11,9
7-6-2013	21-6-2013	10,9	11,9
21-6-2013	5-7-2013	10,9	11,9
5-7-2013	19-7-2013	10,9	11,9
19-7-2013	2-8-2013	10,9	11,9
2-8-2013	16-8-2013	10,9	11,9
16-8-2013	2-9-2013	10,9	11,9
2-9-2013	13-9-2013	10,9	11,9
13-9-2013	27-9-2013	11,0	11,9
27-9-2013	11-10-2013	11,0	11,9
11-10-2013	25-10-2013	11,0	11,9
25-10-2013	8-11-2013	11,0	11,9
8-11-2013	22-11-2013	11,0	11,9
22-11-2013	6-12-2013	11,0	11,9
6-12-2013	20-12-2013	11,0	11,9
20-12-2013	3-1-2014	11,0	11,9
3-1-2014	17-1-2014	11,0	11,9
17-1-2014	31-1-2014	11,0	11,9
31-1-2014	14-2-2014	11,0	11,9
14-2-2014	28-2-2014	11,0	11,9
28-2-2014	14-3-2014	11,0	11,9
14-3-2014	28-3-2014	11,1	11,9

28-3-2014	11-4-2014	11,0	11,9
11-4-2014	25-4-2014	11,0	11,9
25-4-2014	9-5-2014	11,0	11,9
9-5-2014	23-5-2014	11,0	11,9
23-5-2014	6-6-2014	11,0	11,9
6-6-2014	20-6-2014	11,0	11,9
20-6-2014	4-7-2014	11,0	11,9
4-7-2014	18-7-2014	11,0	11,8
18-7-2014	1-8-2014	11,0	11,7
1-8-2014	15-8-2014	11,0	11,7
15-8-2014	29-8-2014	11,0	11,8
29-8-2014	12-9-2014	11,0	11,8
12-9-2014	26-9-2014	11,0	11,7
26-9-2014	10-10-2014	11,0	11,7
10-10-2014	24-10-2014	11,0	11,7
24-10-2014	7-11-2014	11,0	11,7
7-11-2014	21-11-2014	11,0	11,7
21-11-2014	5-12-2014	11,0	11,7
5-12-2014	19-12-2014	11,0	11,7
19-12-2014	2-1-2015	11,0	11,6
2-1-2015	16-1-2015	11,0	11,6
16-1-2015	30-1-2015	11,0	11,7
30-1-2015	13-2-2015	11,0	11,6
13-2-2015	27-2-2015	11,0	12,7
27-2-2015	13-3-2015	11,0	12,7
13-3-2015	27-3-2015	11,0	13,1
27-3-2015	10-4-2015	11,0	13,1
10-4-2015	24-4-2015	11,0	13,0
24-4-2015	8-5-2015	11,1	12,9
8-5-2015	22-5-2015	11,1	12,9
22-5-2015	5-6-2015	11,1	12,9
5-6-2015	19-6-2015	11,1	12,8
19-6-2015	3-7-2015	11,1	12,6
3-7-2015	20-7-2015	11,0	12,7
20-7-2015	31-7-2015	11,0	12,7
31-7-2015	14-8-2015	11,1	12,6
14-8-2015	28-8-2015	11,1	12,6
28-8-2015	11-9-2015	11,1	12,5
11-9-2015	28-9-2015	11,1	12,5
23-9-2015	9-10-2015	11,1	12,4
9-10-2015	23-10-2015	11,1	12,7
23-10-2015	6-11-2015	11,1	12,7
6-11-2015	20-11-2015	11,1	12,7
20-11-2015	4-12-2015	11,1	12,8
4-12-2015	18-12-2015	11,1	12,8
18-12-2015	4-1-2016	11,1	12,8

31-12-2015	15-1-2016	11,1	12,8
15-1-2016	29-1-2016	11,1	12,8
29-1-2016	12-2-2016	11,1	12,8
12-2-2016	26-2-2016	11,1	13,4
26-2-2016	11-3-2016	11,1	13,4
11-3-2016	25-3-2016	11,1	13,4
25-3-2016	8-4-2016	11,1	13,4
8-4-2016	22-4-2016	11,1	13,4
22-4-2016	6-5-2016	11,0	13,4
6-5-2016	20-5-2016	11,1	13,4
20-5-2016	3-6-2016	11,1	13,5
3-6-2016	17-6-2016	11,1	13,6
17-6-2016	1-7-2016	11,1	13,6
1-7-2016	15-7-2016	11,1	13,6
15-7-2016	29-7-2016	11,1	13,6
29-7-2016	12-8-2016	11,1	13,6
12-8-2016	26-8-2016	10,6	13,6
26-8-2016	9-9-2016	10,5	13,6
9-9-2016	23-9-2016	10,0	13,6
23-9-2016	7-10-2016	10,1	13,6
7-10-2016	21-10-2016	10,1	13,6
21-10-2016	4-11-2016	10,1	13,5
4-11-2016	18-11-2016	10,1	13,6
18-11-2016	2-12-2016	10,1	13,0
2-12-2016	16-12-2016	10,1	13,0
16-12-2016	30-12-2016	10,1	13,0
30-12-2016	13-1-2017	10,1	12,4
13-1-2017	27-1-2017	10,1	12,4
27-1-2017	10-2-2017	10,1	12,4
10-2-2017	24-2-2017	10,1	12,4
24-2-2017	10-3-2017	10,1	12,4
10-3-2017	24-3-2017	10,1	12,5
24-3-2017	7-4-2017	10,1	12,4
7-4-2017	21-4-2017	10,1	12,4
21-4-2017	5-5-2017	10,1	12,4
5-5-2017	22-5-2017	10,0	12,4
18-5-2017	2-6-2017	10,0	12,4
2-6-2017	16-6-2017	10,0	12,4
16-6-2017	30-6-2017	10,0	12,4
30-6-2017	14-7-2017	10,0	12,4
14-7-2017	28-7-2017	10,0	12,4
28-7-2017	11-8-2017	10,0	12,4
11-8-2017	25-8-2017	10,0	12,5
25-8-2017	8-9-2017	10,0	12,5
8-9-2017	22-9-2017	10,0	12,5
22-9-2017	6-10-2017	10,0	12,5

6-10-2017	20-10-2017	10,0	12,5
20-10-2017	3-11-2017	10,0	12,5
3-11-2017	17-11-2017	10,0	12,5
17-11-2017	1-12-2017	10,0	12,5
1-12-2017	15-12-2017	10,0	12,5
15-12-2017	29-12-2017	10,0	12,5
29-12-2017	12-1-2018	10,0	12,4
12-1-2018	26-1-2018	10,0	12,4
26-1-2018	9-2-2018	10,0	12,4
9-2-2018	23-2-2018	10,0	12,4
23-2-2018	9-3-2018	10,0	12,4
9-3-2018	23-3-2018	10,0	12,4
23-3-2018	6-4-2018	10,0	12,4
6-4-2018	20-4-2018	10,0	12,4
20-4-2018	4-5-2018	10,0	12,4
4-5-2018	18-5-2018	10,0	12,4
18-5-2018	1-6-2018	10,0	12,4
1-6-2018	18-6-2018	10,0	12,4
14-6-2018	29-6-2018	10,0	12,4
29-6-2018	13-7-2018	10,0	12,4
13-7-2018	27-7-2018	10,0	12,4
27-7-2018	10-8-2018	7,6	11,6
10-8-2018	27-8-2018	7,6	11,5
20-8-2018	7-9-2018	7,6	11,5
7-9-2018	21-9-2018	7,6	11,4
21-9-2018	5-10-2018	7,6	11,4
5-10-2018	19-10-2018	7,6	11,3
19-10-2018	2-11-2018	7,6	11,3
2-11-2018	16-11-2018	7,5	11,3
16-11-2018	30-11-2018	7,5	11,3
30-11-2018	14-12-2018	7,4	11,3
14-12-2018	28-12-2018	7,4	11,3
28-12-2018	11-1-2019	7,4	11,3
11-1-2019	25-1-2019	7,4	11,2
25-1-2019	8-2-2019	7,4	11,2
8-2-2019	22-2-2019	6,4	11,2
22-2-2019	8-3-2019	6,4	11,2
8-3-2019	22-3-2019	6,5	11,2
22-3-2019	5-4-2019	6,5	11,2
5-4-2019	19-4-2019	6,5	11,1
19-4-2019	3-5-2019	6,5	11,2
3-5-2019	17-5-2019	6,5	12,2
17-5-2019	31-5-2019	6,5	13,6
31-5-2019	14-6-2019	6,5	13,5
14-6-2019	28-6-2019	6,5	13,5
28-6-2019	12-7-2019	6,4	13,6

12-7-2019	26-7-2019	6,4	13,6
26-7-2019	9-8-2019	6,4	14,3



## Appendix 2

### Inflation Rates

	YEARLY	MONTHLY
jul-19	16,65	1,36
jun-19	15,72	0,03
mei-19	18,71	0,95
apr-19	19,5	1,69
mrt-19	19,71	1,03
feb-19	19,67	0,16
jan-19	20,35	1,06
dec-18	20,3	-0,4
nov-18	21,62	-1,44
okt-18	25,24	2,67
sep-18	24,52	6,3
aug-18	17,9	2,3
jul-18	15,85	0,55
jun-18	15,39	2,61
mei-18	12,15	1,62
apr-18	10,85	1,87
mrt-18	10,23	0,99
feb-18	10,26	0,73
jan-18	10,35	1,02
dec-17	11,92	0,69
nov-17	12,98	1,49
okt-17	11,9	2,08
sep-17	11,2	0,65
aug-17	10,68	0,52
jul-17	9,79	0,15
jun-17	10,9	-0,27
mei-17	11,72	0,45
apr-17	11,87	1,31
mrt-17	11,29	1,02
feb-17	10,13	0,81
jan-17	9,22	2,46
dec-16	8,53	1,64
nov-16	7	0,52
okt-16	7,16	1,44
sep-16	7,28	0,18

aug-16	8,05	-0,29
jul-16	8,79	1,16
jun-16	7,64	0,47
mei-16	6,58	0,58
apr-16	6,57	0,78
mrt-16	7,46	-0,04
feb-16	8,78	-0,02
jan-16	9,58	1,82
dec-15	8,81	0,21
nov-15	8,1	0,67
okt-15	7,58	1,55
sep-15	7,95	0,89
aug-15	7,14	0,4
jul-15	6,81	0,09
jun-15	7,2	-0,51
mei-15	8,09	0,56
apr-15	7,91	1,63
mrt-15	7,61	1,19
feb-15	7,55	0,71
jan-15	7,24	1,1
dec-14	8,17	-0,44
nov-14	9,15	0,18
okt-14	8,96	1,9
sep-14	8,86	0,14
aug-14	9,54	0,09
jul-14	9,32	0,45
jun-14	9,16	0,31
mei-14	9,66	0,4
apr-14	9,38	1,34
mrt-14	8,39	1,13
feb-14	7,89	0,43
jan-14	7,75	1,98
dec-13	7,4	0,46
nov-13	7,32	0,01
okt-13	7,71	1,8
sep-13	7,88	0,77
aug-13	8,17	-0,1
jul-13	8,88	0,31
jun-13	8,3	0,76



mei-13	6,51	0,15
apr-13	6,13	0,42
mrt-13	7,29	0,66
feb-13	7,03	0,3
jan-13	7,31	1,65
dec-12	6,16	0,38
nov-12	6,37	0,38
okt-12	7,8	1,96
sep-12	9,19	1,03
aug-12	8,88	0,56
jul-12	9,07	-0,23
jun-12	8,87	-0,9
mei-12	8,28	-0,21
apr-12	11,14	1,52
mrt-12	10,43	0,41
feb-12	10,43	0,56
jan-12	10,61	0,56
dec-11	10,45	0,58
nov-11	9,48	1,73
okt-11	7,66	3,27
sep-11	6,15	0,75
aug-11	6,65	0,73
jul-11	6,31	-0,41
jun-11	6,24	-1,43
mei-11	7,17	2,42
apr-11	4,26	0,87
mrt-11	3,99	0,42
feb-11	4,16	0,73
jan-11	4,9	0,41
dec-10	6,4	-0,3
nov-10	7,29	0,03
okt-10	8,62	1,83
sep-10	9,24	1,23
aug-10	8,33	0,4
jul-10	7,58	-0,48
jun-10	8,37	-0,56
mei-10	9,1	-0,36
apr-10	10,19	0,6
mrt-10	9,56	0,58

feb-10	10,13	1,45
jan-10	8,19	1,85
dec-09	6,53	0,53
nov-09	5,53	1,27
okt-09	5,08	2,41
sep-09	5,27	0,39
aug-09	5,33	-0,3
jul-09	5,39	0,25
jun-09	5,73	0,11
mei-09	5,24	0,64
apr-09	6,13	0,02
mrt-09	7,89	1,1
feb-09	7,73	-0,34
jan-09	9,5	0,29
dec-08	10,06	-0,41
nov-08	10,76	0,83
okt-08	11,99	2,6
sep-08	11,13	0,45
aug-08	11,77	-0,24
jul-08	12,06	0,58
jun-08	10,61	-0,36
mei-08	10,74	1,49
apr-08	9,66	1,68
mrt-08	9,15	0,96
feb-08	9,1	1,29
jan-08	8,17	0,8
dec-07	8,39	0,22
nov-07	8,4	1,95
okt-07	7,7	1,81
sep-07	7,12	1,03
aug-07	7,39	0,02
jul-07	6,9	-0,73
jun-07	8,6	-0,24
mei-07	9,23	0,5
apr-07	10,72	1,21
mrt-07	10,86	0,92
feb-07	10,16	0,43
jan-07	9,93	1
dec-06	9,65	0,23

nov-06	9,86	1,29
okt-06	9,98	1,27
sep-06	10,55	1,29
aug-06	10,26	-0,44
jul-06	11,69	0,85
jun-06	10,12	0,34
mei-06	9,86	1,88
apr-06	8,83	1,34
mrt-06	8,16	0,27
feb-06	8,15	0,22
jan-06	7,93	0,75
dec-05	7,72	0,42
nov-05	7,61	1,4
okt-05	7,52	1,79
sep-05	7,99	1,02
aug-05	7,91	0,85
jul-05	7,82	-0,57
jun-05	8,95	0,1
mei-05	8,7	0,92
apr-05	8,18	0,71
mrt-05	7,94	0,26
feb-05	8,69	0,02
jan-05	9,24	0,55

### Appendix 3

#### Overnight Interest Rates

DATE	BORROWING	LENDING
20.02.02	57	62
14.03.02	54	61
08.04.02	51	58
30.04.02	48	55
05.08.02	46	53
11.11.02	44	51
25.04.03	41	48
04.06.03	38	45
16.07.03	35	41
06.08.03	32	38
18.09.03	29	35
15.10.03	26	31
05.02.04	24	29
17.03.04	22	27
08.09.04	20	24
20.12.04	18	22
11.01.05	17	21
09.02.05	16,5	20,5
09.03.05	15,5	19,5
11.04.05	15	19
10.05.05	14,5	18,5
09.06.05	14,25	18,25
11.10.05	14	18
09.11.05	13,75	17,75
09.12.05	13,5	17,5
02.01.06	13,5	16,5
28.04.06	13,25	16,25
08.06.06	15	18
26.06.06	17,25	20,25
28.06.06	17,25	22,25
21.07.06	17,5	22,5
14.09.07	17,25	22,25
17.10.07	16,75	21,5
15.11.07	16,25	20,75

14.12.07	15,75	20
18.01.08	15,5	19,5
15.02.08	15,25	19,25
16.05.08	15,75	19,75
17.06.08	16,25	20,25
18.07.08	16,75	20,25
23.10.08	16,75	19,75
20.11.08	16,25	18,75
19.12.08	15	17,5
16.01.09	13	15,5
20.02.09	11,5	14
20.03.09	10,5	13
17.04.09	9,75	12,25
15.05.09	9,25	11,75
17.06.09	8,75	11,25
17.07.09	8,25	10,75
19.08.09	7,75	10,25
18.09.09	7,25	9,75
16.10.09	6,75	9,25
20.11.09	6,5	9
17.09.10	6,25	8,75
15.10.10	5,75	8,75
12.11.10	1,75	8,75
17.12.10	1,5	9
05.08.11	5	9
21.10.11	5	12,5
22.02.12	5	11,5
19.09.12	5	10
19.10.12	5	9,5
21.11.12	5	9
23.01.13	4,75	8,75
20.02.13	4,5	8,5
27.03.13	4,5	7,5
17.04.13	4	7
17.05.13	3,5	6,5
24.07.13	3,5	7,25
21.08.13	3,5	7,75
29.01.14	8	12
18.07.14	7,5	12

28.08.14	7,5	11,25
25.02.15	7,25	10,75
25.03.16	7,25	10,5
21.04.16	7,25	10
25.05.16	7,25	9,5
22.06.16	7,25	9
20.07.16	7,25	8,75
24.08.16	7,25	8,5
23.09.16	7,25	8,25
25.11.16	7,25	8,5
25.01.17	7,25	9,25
01.06.18	15	16,5
08.06.18	16,25	19,25
14.09.18	22,5	24
21.09.18	22,5	25,5
26.07.19	18,25	21,25

## Appendix 4

### Late Liquidity Interest Rates

DATE	BORROWING	LENDING
20.02.02	5	62
14.03.02	5	61
08.04.02	5	58
30.04.02	5	55
01.07.02	5	65
05.08.02	5	63
11.11.02	5	61
20.03.03	5	56
25.04.03	5	53
04.06.03	5	50
16.07.03	5	46
06.08.03	5	43
18.09.03	5	40
15.10.03	5	36
05.02.04	5	34
17.03.04	5	32
08.09.04	5	28
20.12.04	5	26
11.01.05	5	25
09.02.05	5	24,5
09.03.05	5	23,5
11.04.05	5	23
10.05.05	5	22,5
09.06.05	5	22,25
11.10.05	5	22
09.11.05	5	21,75
09.12.05	5	21,5
02.01.06	9,5	19,5
28.04.06	9,25	19,25
08.06.06	11	21
26.06.06	13,25	23,25
28.06.06	13,25	25,25
21.07.06	13,5	25,5
14.09.07	13,25	25,25

17.10.07	12,75	24,5
15.11.07	12,25	23,75
14.12.07	11,75	23
18.01.08	11,5	22,5
15.02.08	11,25	22,25
16.05.08	11,75	22,75
17.06.08	12,25	23,25
18.07.08	12,75	23,25
23.10.08	12,75	22,75
20.11.08	12,25	21,75
19.12.08	11	20,5
16.01.09	9	18,5
20.02.09	7,5	17
20.03.09	6,5	16
17.04.09	5,75	15,25
15.05.09	5,25	14,75
17.06.09	4,75	14,25
17.07.09	4,25	13,75
19.08.09	3,75	13,25
18.09.09	3,25	12,75
16.10.09	2,75	12,25
20.11.09	2,5	12
17.09.10	2,25	11,75
15.10.10	1,75	11,75
12.11.10	0	11,75
17.12.10	0	12
21.10.11	0	15,5
22.02.12	0	14,5
19.09.12	0	13
19.10.12	0	12,5
21.11.12	0	12
23.01.13	0	11,75
20.02.13	0	11,5
27.03.13	0	10,5
17.04.13	0	10
17.05.13	0	9,5
24.07.13	0	10,25
29.01.14	0	15
25.04.14	0	13,5



28.08.14	0	12,75
25.02.15	0	12,25
25.03.16	0	12
21.04.16	0	11,5
25.05.16	0	11
22.06.16	0	10,5
20.07.16	0	10,25
24.08.16	0	10
23.09.16	0	9,75
25.11.16	0	10
25.01.17	0	11
17.03.17	0	11,75
27.04.17	0	12,25
15.12.17	0	12,75
26.04.18	0	13,5
24.05.18	0	16,5
08.06.18	0	20,75
14.09.18	0	27
26.07.19	0	22,75

## Appendix 5

### One Week Repo Interest Rates

DATE	BORROWING	LENDING
20.05.2010	-	7
17.12.2010	-	6,5
21.01.2011	-	6,25
05.08.2011	-	5,75
19.12.2012	-	5,5
17.04.2013	-	5
17.05.2013	-	4,5
29.01.2014	-	10
23.05.2014	-	9,5
25.06.2014	-	8,75
18.07.2014	-	8,25
21.01.2015	-	7,75
25.02.2015	-	7,5
25.11.2016	-	8
01.06.2018	-	16,5
08.06.2018	-	17,75
14.09.2018	-	24
26.07.2019	-	19,75

# Appendix 6

## Final Data Set Part 1

Q	TL RESERVE REQUIREMENT RATIO_lag1	TL RESERVE REQUIREMENT RATIO_lead1	TL RESERVE REQUIREMENT RATIO	YP RESERVE REQUIREMENT RATIO_lag1	YP RESERVE REQUIREMENT RATIO_lead1	YP RESERVE REQUIREMENT RATIO
31.03.2011		13,17435955	9,388108275		11,82260802	10,99999857
30.06.2011	9,388108275	12,56288811	13,17435935	10,99999857	10,244529	11,82260802
30.09.2011	13,17435955	10,47568418	12,56288811	11,82260802	10,27418864	10,244529
31.12.2011	12,56288811	10,49457392	10,47568418	10,244529	10,30812852	10,27418864
31.03.2012	10,47568418	10,5275125	10,49457392	10,27418864	10,32720814	10,30812852
30.06.2012	10,49457392	10,57766579	10,5275125	10,30812852	10,24936562	10,32720814
30.09.2012	10,5275125	10,57824342	10,57766579	10,32720814	10,63109236	10,24936562
31.12.2012	10,57766579	10,91782509	10,57824342	10,24936562	11,49332005	10,63109236
31.03.2013	10,57824342	10,86518241	10,91782509	10,63109236	11,91981142	11,49332005
30.06.2013	10,91782509	10,9868388	10,86518241	11,49332005	11,92675724	11,91981142
30.09.2013	10,86518241	11,00672911	10,9868388	11,91981142	11,89726847	11,92675724
31.12.2013	10,9868388	11,043553	11,00672911	11,92675724	11,92591365	11,89726847
31.03.2014	11,00672911	11,0062746	11,043553	11,89726847	11,8505013	11,92591365
30.06.2014	11,043553	11,018536	11,0062746	11,92591365	11,74867747	11,8505013
30.09.2014	11,0062746	11,02524885	11,018536	11,8505013	11,6469223	11,74867747
31.12.2014	11,018536	11,03812454	11,02524885	11,74867747	13,05558566	11,6469223
31.03.2015	11,02524885	11,1269612	11,03812454	11,6469223	12,60872887	13,05558566
30.06.2015	11,03812454	11,08996477	11,1269612	13,05558566	12,427696	12,60872887
30.09.2015	11,1269612	11,08342253	11,08996477	12,60872887	12,83149949	12,427696
31.12.2015	11,08996477	11,06692818	11,08342253	12,427696	13,41561749	12,83149949
31.03.2016	11,08342253	11,068	11,06692818	12,83149949	13,575	13,41561749
30.06.2016	11,06692818	10,05172603	11,068	13,41561749	13,62494188	13,575
30.09.2016	11,068	10,07678696	10,05172603	13,575	12,43740121	13,62494188
31.12.2016	10,05172603	10,06551065	10,07678696	13,62494188	12,43495037	12,43740121
31.03.2017	10,07678696	10,01936194	10,06551065	12,43740121	12,39729332	12,43495037
30.06.2017	10,06551065	10,03128286	10,01936194	12,43495037	12,50602178	12,39729332
30.09.2017	10,01936194	10,02656087	10,03128286	12,39729332	12,36590496	12,50602178
31.12.2017	10,03128286	10,03886855	10,02656087	12,50602178	12,4162802	12,36590496
31.03.2018	10,02656087	10,03271718	10,03886855	12,36590496	12,38910574	12,4162802
30.06.2018	10,03886855	7,581394213	10,03271718	12,38910574	11,4067918	12,38910574
30.09.2018	10,03271718	7,363554572	7,581394213	11,4067918	11,29972109	11,4067918
31.12.2018	7,581394213		7,363554572	11,29972109		11,29972109

## Appendix 7

### Final Data Set Part 2

Q	INFLATION YEARLY_lag1	INFLATION YEARLY_lead1	INFLATION YEARLY	INFLATION MONTHLY_lag1	INFLATION MONTHLY_lead1	INFLATION MONTHLY
31.03.2011		6,24	3,99		-1,43	0,42
30.06.2011	3,99	6,15	6,24	0,42	0,75	-1,43
30.09.2011	6,24	10,45	6,15	-1,43	0,58	0,75
31.12.2011	6,15	10,43	10,45	0,75	0,41	0,58
31.03.2012	10,45	8,87	10,43	0,58	-0,9	0,41
30.06.2012	10,43	9,19	8,87	0,41	1,03	-0,9
30.09.2012	8,87	6,16	9,19	-0,9	0,38	1,03
31.12.2012	9,19	7,29	6,16	1,03	0,66	0,38
31.03.2013	6,16	8,3	7,29	0,38	0,76	0,66
30.06.2013	7,29	7,88	8,3	0,66	0,77	0,76
30.09.2013	8,3	7,4	7,88	0,76	0,46	0,77
31.12.2013	7,88	8,39	7,4	0,77	1,13	0,46
31.03.2014	7,4	9,16	8,39	0,46	0,31	1,13
30.06.2014	8,39	8,86	9,16	1,13	0,14	0,31
30.09.2014	9,16	8,17	8,86	0,31	-0,44	0,14
31.12.2014	8,86	7,61	8,17	0,14	1,19	-0,44
31.03.2015	8,17	7,2	7,61	-0,44	-0,51	1,19
30.06.2015	7,61	7,95	7,2	1,19	0,89	-0,51
30.09.2015	7,2	8,81	7,95	-0,51	0,21	0,89
31.12.2015	7,95	7,46	8,81	0,89	-0,04	0,21
31.03.2016	8,81	7,64	7,46	0,21	0,47	-0,04
30.06.2016	7,46	7,28	7,64	-0,04	0,18	0,47
30.09.2016	7,64	8,53	7,28	0,47	1,64	0,18
31.12.2016	7,28	11,29	8,53	0,18	1,02	1,64
31.03.2017	8,53	10,9	11,29	1,64	-0,27	1,02
30.06.2017	11,29	11,2	10,9	1,02	0,65	-0,27
30.09.2017	10,9	11,92	11,2	-0,27	0,69	0,65
31.12.2017	11,2	10,23	11,92	0,65	0,99	0,69
31.03.2018	11,92	15,39	10,23	0,69	2,61	0,99
30.06.2018	10,23	24,52	15,39	0,99	6,3	2,61
30.09.2018	15,39	20,3	24,52	2,61	-0,4	6,3
31.12.2018	24,52		20,3	6,3		-0,4

## Appendix 8

### Final Data Set Part 3

Q	GECELİK BORC ALMA_lag1	GECELİK BORC ALMA_lead1	GECELİK BORC ALMA	GECELİK BORC VERME_lag1	GECELİK BORC VERME_lead1	GECELİK BORC VERME
31.03.2011		1,5	1,5		9	9
30.06.2011	1,5		1,5	9		9
30.09.2011	1,5	5	5	9	12,5	9
31.12.2011	5	5	5	9	11,5	12,5
31.03.2012	5	5	5	12,5	11,5	11,5
30.06.2012	5	5	5	11,5	10	11,5
30.09.2012	5	5	5	11,5	9	10
31.12.2012	5	4,5	5	10	7,5	9
31.03.2013	5	3,5	4,5	9	6,5	7,5
30.06.2013	4,5	3,5	3,5	7,5	7,75	6,5
30.09.2013	3,5	3,5	3,5	6,5	7,75	7,75
31.12.2013	3,5	8	3,5	7,75	12	7,75
31.03.2014	3,5	8	8	7,75	12	12
30.06.2014	8	7,5	8	12	11,25	12
30.09.2014	8	7,5	7,5	12	11,25	11,25
31.12.2014	7,5	7,25	7,5	11,25	10,75	11,25
31.03.2015	7,5	7,25	7,25	11,25	10,75	10,75
30.06.2015	7,25	7,25	7,25	10,75	10,75	10,75
30.09.2015	7,25	7,25	7,25	10,75	10,75	10,75
31.12.2015	7,25	7,25	7,25	10,75	10,5	10,75
31.03.2016	7,25	7,25	7,25	10,75	9	10,5
30.06.2016	7,25	7,25	7,25	10,5	8,25	9
30.09.2016	7,25	7,25	7,25	9	8,5	8,25
31.12.2016	7,25	7,25	7,25	8,25	9,25	8,5
31.03.2017	7,25	7,25	7,25	8,5	9,25	9,25
30.06.2017	7,25	7,25	7,25	9,25	9,25	9,25
30.09.2017	7,25	7,25	7,25	9,25	9,25	9,25
31.12.2017	7,25	7,25	7,25	9,25	9,25	9,25
31.03.2018	7,25	16,25	7,25	9,25	19,25	9,25
30.06.2018	7,25	22,5	16,25	9,25	25,5	19,25
30.09.2018	16,25	22,5	22,5	19,25	25,5	25,5
31.12.2018	22,5		22,5	25,5		25,5

## Appendix 9

### Final Data Set Part 4

Q	GEC LIKIDITE BORC VERME_lag1	GEC LIKIDITE BORC VERME_lead1	GEC LIKIDITE BORC VERME	1 HAFITA REPO BORC VERME_lag1	1 HAFITA REPO BORC VERME_lead1	1 HAFITA REPO BORC VERME	KAR/AKTIF RATIO PERC CUM	KAR/AKTIF RATIO PERC
31.03.2011			12		6,25	6,25	0,5	0,5033257
30.06.2011	12	12	12	6,25	5,75	6,25	0,87	0,412980337
30.09.2011	12	15,5	12	6,25	5,75	5,75	1,19	0,366001789
31.12.2011	12	14,5	15,5	5,75	5,75	5,75	1,62	0,428083203
31.03.2012	15,5	14,5	14,5	5,75	5,75	5,75	0,44	0,442735226
30.06.2012	14,5	13	14,5	5,75	5,75	5,75	0,85	0,418980435
30.09.2012	14,5	12	13	5,75	5,5	5,75	1,27	0,4395631132
31.12.2012	13	10,5	12	5,75	5,5	5,5	1,7	0,488639153
31.03.2013	12	9,5	10,5	5,5	4,5	5,5	0,52	0,518339952
30.06.2013	10,5	10,25	9,5	5,5	4,5	4,5	0,92	0,431636248
30.09.2013	9,5	10,25	10,25	4,5	4,5	4,5	1,25	0,405441852
31.12.2013	10,25	15	10,25	4,5	10	4,5	1,49	0,300476165
31.03.2014	10,25	13,5	15	4,5	8,75	10	0,31	0,310972202
30.06.2014	15	12,75	13,5	10	8,25	8,75	0,65	0,346986991
30.09.2014	13,5	12,75	12,75	8,75	8,25	8,25	0,97	0,353976885
31.12.2014	12,75	12,25	12,75	8,25	7,5	8,25	1,29	0,348138891
31.03.2015	12,75	12,25	12,25	8,25	7,5	7,5	0,31	0,305513229
30.06.2015	12,25	12,25	12,25	7,5	7,5	7,5	0,58	0,290116656
30.09.2015	12,25	12,25	12,25	7,5	7,5	7,5	0,77	0,234651152
31.12.2015	12,25	12	12,25	7,5	7,5	7,5	1,1	0,314636193
31.03.2016	12,25	10,5	12	7,5	7,5	7,5	0,32	0,323591116
30.06.2016	12	9,75	10,5	7,5	7,5	7,5	0,74	0,427981344
30.09.2016	10,5	10	9,75	7,5	8	7,5	1,1	0,379219926
31.12.2016	9,75	11,75	10	7,5	8	8	1,36	0,338662097
31.03.2017	10	12,25	11,75	8	8	8	0,46	0,459776153
30.06.2017	11,75	12,25	12,25	8	8	8	0,85	0,405940818
30.09.2017	12,25	12,75	12,25	8	8	8	1,2	0,373703519
31.12.2017	12,25	12,75	12,75	8	8	8	1,48	0,381080618
31.03.2018	12,75	20,75	12,75	8	17,75	8	0,41	0,412867832
30.06.2018	12,75	27	20,75	8	24	17,75	0,77	0,38581067
30.09.2018	20,75	27	27	17,75	24	24	0,95	0,281414281
31.12.2018	27		27	24		24	1,37	0,324527387

