

Leading Indicators of Turkey's Financial Crises

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Banking and Finance

Eastern Mediterranean University
February 2017
Gazimağusa, North Cyprus

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ABSTRACT

This study empirically observes the leading indicators of 1994, 2000/2001 and 2009 Turkish financial crises. Stepwise regression, Probit and Logit models have been applied to three sets of quarterly data covering the periods of Q1-1990 to Q4- 1999 to investigate the leading indicators of the 1994 crisis, from Q3-1996 to Q2-2005 to capture the 2000/2001 twin crises, and from Q3-2005 to Q3-2015 to see the global financial crisis effect on Turkey. Results assert that the three crises of Turkey are different in structure and each has different characteristics with different leading indicators. The results provide a new set of leading indicators that includes capital adequacy and long-term interest rates as well as international variables, and these indicators are compatible with the new structure of Turkish economy. Regulators and policymakers should pay close attention to macroeconomic variables and the banking sector stability of Turkey as well as the status of the global economy as the results show that many banking and international related variables increase the probability of the crisis, this can be through imposing tighter regulations on banks to avoid default and credit risk, following the liquidity levels in the markets and closely following the stability of global economic indicators.

Keywords: Financial crisis, Turkey, stepwise regression, probit and logit models, leading indicators.

ÖZ

Bu çalışmada, 1994, 2000/2001 ve 2009 Türkiye finansal krizlerinin öncü göstergeleri Stepwise regresyon, Probit ve Logit tahmin yöntemleri kullanılarak ampirik olarak incelenmiştir. 1990-2015 yıllarını kapsayan çeyreklik veri seti her bir krizin öncü göstergelerinin tespit edilebilmesi amacıyla 1990-1999, 1996-2005, 2005-2015 olmak üzere üç alt gruba ayrılmıştır. Sonuçlar, Türkiye’de yaşanan her üç krizin de birbirinden yapısal olarak belirli ölçüde farklı olduğunu göstermiş ve her bir kriz için elde edilen öncü göstergelerde farklılıklar olduğu görülmüştür. Çalışma sermaye yeterliliği, uzun vadeli faiz oranları ile uluslararası değişkenleri içeren ve Türk ekonomisinin değişen yapısıyla uyumlu yeni bir öncü göstergeler seti önermektedir. Bulgular bankacılık sektörü ile ilgili çeşitli değişkenlerin yanında, ülke dışında yaşanan olumsuz gelişmelerin de ülkede bir kriz yaşanma ihtimalini artırdığını göstermektedir. Elde edilen sonuçlar politika yapımcıların ve düzenleyici organların ülkenin temel makroekonomik göstergeleri yanında, küresel ekonomideki gelişmeleri de yakından takip etmelerinin ve bankacılık sektöründe istikrarın sağlanmasının önemine işaret etmektedir. Uygulanabilecek önlemler arasında piyasalardaki likidite seviyesinin kontrol altında tutulması, kredi riskini azaltabilmek için bankaların gözetim-denetimine önem verilmesi ve küresel ekonomik şoklara karşı alınacak önlemlerin planlanması sayılabilir.

Anahtar Kelimeler: Finansal kriz, Türkiye, stepwise regresyonu, probit ve legit modelleri, öncü göstergeler.

ACKNOWLEDGMENT

I would like to record my gratitude to my supervisor Assoc. Prof. Dr. Korhan Gökmenoğlu for his overall supervision, advice, comments, and guidance throughout the thesis writing process as well as giving me the motive to work and improve myself constantly. In addition, he provided me with new knowledge and methods for me to use in the research area. His encouragement, ideas, experience and deadlines is the reason that I came to this point.

My thanks go to my mother, father, brother Abdulkader, and my four lovely sisters who made it all possible by their help and support. Thanks to my friends and colleagues who pushed me to work harder, most especially Rawan who has been there for me with encouragement and advice, Emmanuella and Siamand for their constant support.

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Chapter 1

INTRODUCTION

There is no consensus about the right definition of financial-economic crisis as researchers provide various definitions in different contexts. For instance, Kindleberger and Aliber (1978) and Minsky (1970) defined the crisis as the falls in asset prices, the bankruptcy of large financial and nonfinancial institutes, deflation, disturbances in foreign exchange markets, or some combination of all of these. Kaminsky, Lizondo, and Reinhart (1997) define a currency crisis as follows: “A crisis is defined as a situation in which an attack on the currency leads to a sharp depreciation of the currency, a substantial decline in international reserves, or a combination of the two.” A more recent definition Links the term of the financial crisis to a status where the economic equilibrium has been shifted, creating disorder, uncertainty, and capital redistribution (Sevim, Oztekin, Bali, Gumus and Guresen, 2014).

The concept of financial and economic crises have been present since the early 3rd century with the inflation crisis in the state of Rome, where the government was obligated to distribute free grains but did not have much income because taxes only came from conquered populations. To do so, the emperor decided to devalue the currency by decreasing silver weight in coins (Citéco, 2016). However, the concept of financial crisis has evolved and changed over the time. Financial crises in its modern definition have frequently engulfed the world since the panic of 1907 until

the recent global crisis which has impacted the entire world negatively. In a similar vein, other financial shocks such as The 1992/1993 Western Europe crisis, the 1994/1995 Latin America crisis, the 1994 Turkish currency crisis, the 1997/1998 Asian crisis, the 1998 Russian crisis, the 2000/2001 Turkish twin financial crises and the Japanese lost decade, all had shattering effects on the economic, political and social aspects of their host countries. In light of these financial imbalances, many lessons have been presumably learned.

The flourishing victory of capitalism over socialism and the less frequency of crises called Robert Lucas to Comment on. He stated at the American Economic Association Conference in 2003 that central problem of depression prevention has been solved for all practical purposes. Researchers including the Federal reserves' Chairman Ben Bernanke and Lucas believed that the business cycle had been controlled. Lucas claimed that focusing on small errors in the short term economic growth yields zero benefits for the society; instead, the focus must be on crucial issues such as long-term growth. However, the eruption of the recent global crisis in 2007-08 has denied Lucas's view, which was approved to be wrong. (Krugman, 2009).

Interestingly, all the crises above have some features in common. Among these features are the attempts of these countries to attract capital inflows to invest in the economy, credit loss, currency difficulties, confidence loss, investor expectations, and the collapse of the financial system. Among these factors, the issue of confidence plays a significant role in intensifying a financial crisis. In this context, Krugman (2009) suggested a 4 step process explaining how confidence affects a financial crisis:

- Starts with confidence
- Influence the financial markets
- Impact the real economy
- Ends with confidence.

This process can work in two directions, helping to flourish an economy or deepening an economic, financial crisis. Contributors to the economy start with a significant amount of confidence enabling them to set high expectations in response to a growing economy. On the other hand, a financial crisis starts with an event reducing confidence, resulting in a major panic in the markets. One more significant issue relevant to confidence lie in difficulty in restoring it as suggested by Krugman.

Also, an emergence of a financial disturbance in a particular country might be attributed to the non-satisfactory performance of the public and governmental institutions operating in this country. One example is Turkey's 1994 crisis where the government made a series of wrong decisions related to the finance of public deficit, along with the central bank actions that approved to be weak in timing and effect (Celasun, 1998). Another example is the inappropriate stabilization program set by the Turkish government in corporation with the International Monetary Fund before the twin crisis of 2000/2001. The negative consequences of this program resulted in one of the worst financial shocks in Turkey (Ozkan, 2005). One more example is The Washington consensus in which the United States Treasury Department and IMF pushed the countries of emerging markets to handle the financial crisis through raising the interest rates, lowering public spending, spiking taxes and praising privatization. This system was applied on Argentina to face off a massive failure led partially to Argentina's great depression of 1999-2002.

The negative consequences of a financial crisis at the macro and micro levels drew the attention of many researchers, causing the topic to be widely researched. These negative effects include high unemployment rates, a significant drop in the gross domestic products ratio of the affected country, low foreign direct investments low financial inflows to the country, and an increase in the inflation rate which mirrors the purchasing power of people and requires high-interest rates to be handled. No doubt this would hinder people's access to funds.

The nature of the financial crisis has changed and got more complex over the time, particularly in light of the lack of effective economic policies and poor decisions made in this area. Currency crises were evolved over the time due to changes taking place in the exchange rate system, state's policies as well as the change in the economy as a whole. Three generations of currency prices can be underlined. The first generation blames the fundamentals of a country and the bad-weak macroeconomic government policies applied in it. The first generation model can be seen from 1979 when it was established by Krugman. The second generation of currency crises emerged at the beginning of the 1990s after the first generation model. However, it could not explain the crises in countries such as the United Kingdom and Spain as they had healthy reserves and well-controlled domestic growth. Indeed, this model focused mainly on the expectation of people and the governments' policy change regarding the exchange rate. Lastly, the third generation of currency crises was developed to explain events like the Asian currency crises of 1997/1998 which was unexplained in previous models. The primary focus of this is the contagion effect of crises.

Due to the reasons mentioned above, financial crises are one of the major research areas of finance. Researchers tried to identify and forecast the financial crises for decades, but they have failed due to many factors including the complex nature of a financial crisis, the diversity of its contributing factors, as well as the changing nature of these factors. In a similar line, the latest global financial crisis drew the attention of researchers, indicating that more work has to be done in this field to explain and predict the crisis and to avoid its consequences. Economic and financial crises are not new or rare, as its roots are traced back centuries in history (Citéco, 2016). It hit almost every single part of the world with different severity and effects. Researchers sought to find the root of the problem and understand the nature of financial crisis by studying various factors and indicators that are estimated to have an effect on the crisis. By doing so, they tried to build early warning systems through using different methodologies that fit the examined sample. Despite all these efforts, financial crises continued to be one of the most serious challenges for economists around the globe, having a high potentially to emerge. The reason might be the changing nature of the economy, being evolved naturally or by government interventions in certain situations (inflation is a good example of government intervention, as it is known that higher inflation might cause financial disturbances, governments are closely watching this macroeconomic factor and controlling it to stay on certain levels). As the economic structure of the country changes, different factors affect the economy and put it into recession which can develop into a crisis.

In the last two decades, the Turkish economy was hit by several financial crises, starting with the 1994 currency crisis which had severe effects on the economy as a whole, the 2000/2001 twin crises which began with a banking crisis and ended with a currency crisis, and the effects of global financial crisis on the Turkish economy. The

1994 crisis with its characteristics fits the first generation model well, but on the other hand, the twin crises of 2000/2001 structure have changed dramatically and cannot be explained only by the first generation model, but a mixture of both first and second generation models can explain these crises, the latest disturbance of 2009 clearly follows the third generation model as it has a pure contagion effect. These financial disruptions raise a crucial issue, with the continuously changing nature of the economy and the changing structure of the crises, the leading indicators found by previous studies might not be valid to signal a financial disturbance or to keep the economy healthy.

This paper aim is to create a new set of economic and financial indicators that are more relevant to the present structure of Turkey's economy to maintain the economy's health in good shape with good fundamentals. Also, this paper tries to understand the differences in the structure between the financial crises that have hit Turkey over the last 20 years through studying the change in the leading indicators of all of these crises and comparing these changes to know what went wrong. Understanding the changes of financial crises would give an insight to economists and policy makers, and help them in correcting the fundamentals of the country to lessen the effect of any economic or financial disturbance on the economy and eventually prevent it from happening after a full awareness of the structure of financial crises.

To examine the leading indicators of three Turkish financial crises (1994, 2000/2001, and 2009), three econometrics methods were applied on a quarterly data set that has variables varying for each crisis as each crisis was studied individually. Stepwise regression was used to choose the most suitable variables to be indicators of crises.

Afterward, probit and logit models were used to assure that the indicators filtered by stepwise regression fit the model. One contribution of this paper is using stepwise regression to study the leading indicators of Turkish financial crises. To our knowledge, only one study in literature has used stepwise regression to forecast the recession condition in the US economy (Silvia, Bullard and Lai, 2008).

The following sections are as follows: the following chapter will brief the history of financial crises in Turkey. Chapter 3 will review the theoretical and empirical literature on the issue. Chapter 4 will outline the data and methodology used in this thesis while the empirical results are summarized in chapter 5. Chapter 6 offers the concluding remarks for the thesis with policy recommendations.

Chapter 2

LITERATURE REVIEW

Researchers sought to understand financial and economic crises through studying these crises theoretically and empirically using all sorts of data sets and econometric methods. The following chapter will present the theoretical background of financial crises literature, followed by an empirical survey of past studies. Lastly, it will provide a literature review on Turkey's financial crises.

2.1 Theoretical literature review

After decades of studying financial and economic crises, researchers classified crises into categories according to their causes. In the following section, a brief theoretical literature review is presented.

2.1.1 Currency crises

Theoretical models of currency crises can be categorized into three generations, based on the causes of the crisis. The first generation was brought by Krugman (1979) and was called the Canonical model. It focuses on the fundamentals, and it blames the false government's macroeconomic policies that are incompatible with a pegged exchange rate system and would lead to the collapse of the currency. The model is based on the hypothesis that government is using monetization to finance the budget deficits. The central bank has to reduce international reserves to keep the peg exchange rate stable. Speculators would launch a speculative attack on the currency when the reserves are low. The model suggests that signs of the currency crisis would be: decline in international reserves before the crisis, growing budget deficit and growth in domestic credit.

Second generation model was established after the exchange rate mechanism crisis in 1992-93 where first generation model failed to explain the crisis in countries like the United Kingdom and Spain, the international reserves were sufficient and domestic credit growth was under control, but their currencies still had a speculative attack. This event motivated Obstfeld (1994) to adjust the existing models of the currency crisis. Krugman (1998) noted three fundamental components of the second generation. The first is that government wants to maintain the linked exchange rate for reasons like stabilization. Second, the government seeks to end the peg exchange rate for purposes of reducing unemployment. The third is that when people expect the government to end the peg exchange rate, the cost of defending it will increase. Those, the government's policies are affected by people's expectations, and people's expectations are influenced by the government's policies.

The third generation of currency crisis models shed light on the issue of contagion, in other words, why the event of a crisis in anywhere in the world can raise the probability of a crisis occurring in other countries. Crisis in the 1990s had a close regional distribution (Western Europe, 1992/93; Latin America, 1994/95 and Asian crises, 1998). Three reasons explain this regional distribution was suggested by Masson (1998). First, like the global supply shocks (the oil crises), there could be common external factors which can hit the countries in the same region; these factors are called mosoonal effects named after Masson. Second, if one country experienced a crisis, the effects of this crisis could spill over to its neighbouring countries or countries that have trade agreements with by affecting the competitiveness of the partner country. Lastly, a crisis can spread to other nations through (pure contagion effects) as Masson called it. In other words, the crisis would spread depending on the market behavior and the "herding" behavior.

2.1.2 Moral hazard

Moral hazard behavior has two sides: the banks' side and the depositors' side, banks would offer insured deposits with slightly higher interest rates and undertake risky investments. On the other hand, investors would put their money in banks even though it has a risky profile, but it pays higher interest rates and the deposits are insured, even if the bank is insolvent, it could gather a big amount of money in the shape of insured deposits (Yilmaz and Muslumov, 2008). Mishkin (1992) defines moral hazard as the result of Asymmetric information that the lender has little information about the borrower's activities and credit history. Moral hazard occurs after a loan has been granted to a bad borrower as this borrower might engage in risky investments since most of the risk is on the lender not on the borrower.

2.1.3 Adverse selection

Adverse selection is the product of Asymmetric information according to Mishkin (1992), it occurs when borrowers, who have the biggest probability to have the worst (adverse) outcome, to be selected to have the credit. This procedure will enlarge the amount of bad loans as lenders have minimal information about the borrowers' riskiness profile.

2.2 Empirical literature

Researchers have sought to predict and forecast the downturn of the economy in many different statistical ways that produced a vast amount of research using a variety of econometrics methods. The classification used for this part is based on an empirical methodology to review all the main methods used to predict the crises through the literature. Stepwise regression, probit and logit models and signal approach will be examined in the next sections.

2.2.1 Stepwise regression

Stepwise regression is extensively used in the scientific world in all disciplines, mainly in medicine (Adebayo and Gayawan, 2014), engineering (Zhou, Pierre, and Trudnowski, 2012) and chemistry (Nazarpour, Paydar, and Carranza, 2016). Zhou, Pierre, and Trudnowski, (2012) showed that stepwise regression is more robust and has more advantages than sorting energy method through running Monte Carlo simulation. However, stepwise regression is not used in the field of Predicting crises or building early warning systems. The literature on using stepwise regression in predicting financial crises or identifying leading indicators is very limited. Actually to our knowledge, there has been only one paper using stepwise regression in this field. Silvia, Bullard, and Lai (2008) employed stepwise regression alongside with probit model to predict recession condition in the United States economy. They suggested that the model generated by probit and stepwise models had much more forecasting power and could correctly predict recessions in the U.S. since 1980. This minimal usage of stepwise regression in the field of identifying leading indicators of financial crises leaves a gap in the literature that this paper is trying to cover in the case of Turkey.

2.2.2 Probit and Logit models

Probit and logit models are used widely by researchers in the field of forecasting crises and the most important branches of literature on this matter are based on either logit/probit models (Eichengreen, Rose, and Wyplosz, 1996; Frankel and Rose, 1996). Eichengreen, Rose, and Wyplosz (1996) utilized probit model to examine the currency crisis focusing on contagion. They studied 20 industrialized countries over a period of three decades and found that a speculative attack in a different country will increase the probability of a domestic currency crisis by 8%. Frankel and Rose

(1996) used probit model to study currency crash in over 100 developing countries over a period of more than two decades. They concluded that these crashes tend to occur when gross domestic products growth is slow, and when domestic credit growth is high, the ratio of foreign direct investments to total debt is low, and foreign interest rates are high.

Researchers tried to predict crises using logit and probit models or one of the models alone. Woo, Carleton and Rosario (2000) utilized logit model to predict the Asian financial crisis of 1997, they used a sample of 57 countries. The model was not able to predict the crisis, and the authors concluded that contagion might be a more suitable explanation for the Asian financial crisis. Another example is Giovanis (2010) where he used logit model for predicting the crisis periods in the United States economy alongside with neural networks self-organizing map to examine the performance of the prediction. The author found that logit model's estimation was accurate 75% by forecasting the 2008 financial crisis. Moreover, he found that the logit model sends a signal that the crisis is going to occur before three-quarters than the official date of the crisis. Karasavoglou and Polychronidou (2014) studied the probability of an economic crisis in the western Balkan countries by using a logit model and the effect of contagion from Europe debt crisis. The authors concluded that current account deficit and domestic bank loans are two strong predictors in the case of the Balkan countries examined. Also, they found that the probability of a crisis occurring in the near future is more than 50% and that the real economy won't be affected as the banking and financial sectors will.

Researchers also utilized probit model alone to predict crises in different countries and samples. Komulainen and Lukkarila (2003) used probit model on a sample of 31

emerging economies to predict currency crisis. They found that inflation, unemployment, foreign liabilities of banks and private sector liabilities forecasts the currency crisis accurately. They also added that currency crisis is often associated with the banking crisis. Esaka (2010) relied on probit model to examine whether de facto exchange rate regimes cause a currency crisis. He examined a sample consists of 84 countries in the period of 1980-2001. He found that pegged exchange rate regime decrease the probability of currency crisis compared to floating exchange rates. He also found that pegged exchange rate regimes with capital account liberalization minimize the possibility of currency crisis compared to other exchange rate regimes. Zhao, de Haan, and Scholtens (2014) tried to see the effect of exchange rate system on leading indicators of currency crises in 88 countries using probit model. They concluded that external indicators like the growth of international reserves and deviations of real exchange rate have more forecasting powers under the fixed exchange rate system. The authors found that monetary policy and credibility indicators like inflation and domestic credit growth have more predictive power under the floating exchange rate regime.

Eichengreen, Rose, and Wyplosz (1996) studied the correlation between currency crises on a panel of 20 industrialized countries applying probit model. The results indicated that a currency crisis in the world would increase the possibilities of attacks on the domestic currency. In addition, they found that there is a correlation between crisis and contagion spreading to countries with high international trade easier than countries with similar macroeconomic fundamentals. Similarly, Fedorova and Lukasevich (2012) using probit model on a data set consist of CIS countries; they found that the spread of a crisis is more likely in neighboring countries with strong trade links.

Researchers have also used both logit and probit models alone or alongside with other predicting techniques to forecast crises before happening. (Dreger and Kholodilin, 2013; El-Shazly, 2011; Kemme and Roy, 2012; Layton and Katsuura, 2001; Lin, 2009; Rafindadi, 2015; Reynolds, Fowles, Gander, Kunaporntham and Ratanakomut, 2002; Roy and Kemme, 2011). Dreger and Kholodilin (2013) employed logit and probit models alongside with signal approach to predict the housing bubbles of 12 OECD countries. Their results indicate that probit and logit models offer a more precise prediction of the bubbles than Signal approach does, and that logit and probit have high accuracy that can be relied on for forecasting future housing bubbles, and that policy maker should count on these methods to detect price bubbles fast.

Kemme and Roy (2012) used probit and logit models with Vector Error Correction models to investigate the predictions of Shiller (2005) of the 2008 global financial crisis. The authors focused on one variable which is real house prices. Their results came in line with Shiller's prediction, and they found that house prices were sufficient to forecast the global financial crisis.

Rafindadi (2015) utilized probit and logit models to study whether the Nigerian economy is suffering from a currency crisis or not. His findings suggest that the Nigerian economy is experiencing a currency crisis even though the gross domestic product growth is not affected by this crisis. He also found that the Nigerian currency is highly overvalued and reaching unsustainable levels. In addition, he noted that external debt, domestic credit growth rate, and money growth rate are main reasons for the ongoing crisis.

Researchers also used the variations of logit model to predict crises like multinomial logit model (Bussiere and Fratzscher, 2006; Davis and Karim, 2008) and weighted logistic regression (Asanović, 2013; Cuaresma and Slacik, 2009; Gómez-Puig and Sosvilla-Rivero, 2016).

Bussiere and Fratzscher (2006) constructed an early warning system using a multivariate logistic regression to predict financial crisis in 20 emerging markets. They used a multinomial logit model to overcome the post-crisis bias caused by binomial logit model; they defined this bias as the bias that arises from not differentiating between tranquil periods where economic indicators are safe and sound and between post-crisis period where economic indicators are adjusting and getting more stable. Davis and Karim (2008) used Multinomial Logistic model alongside with signal extraction procedures to examine the EWS of banking crisis for a data set that includes 105 countries. They found that logit model is the most appropriate method for constructing an early warning system worldwide, while signal extraction might be better for country specific EWS. They also found that real GDP growth and terms of trade are primary indicators for predicting a banking crisis.

Researchers have also used modified probit models to predict financial crises, namely (Licchetta, 2011) using random effect probit model, (Li and Ouyang, 2011) utilizing the rolling probit model and (Falcetti and Tudela, 2006; Falcetti and Tudela, 2008) using dynamic probit model. Licchetta (2011) used a random effect probit model to examine the role of external balance sheet variables as leading indicators of currency crises in 40 countries focusing on emerging markets. The results showed that the size and nature of the external balance sheet are important in triggering a crisis. In addition, emerging markets and countries with the fixed exchange rate

regime are more affected by external balance sheet variables than developed countries.

2.2.3 Signal approach

Kaminsky, Lizondo, and Reinhart (1997) developed the Signal approach which uses binary crisis variable and transforms the independent variables to binary signals. An explanatory variable sends a signal if it exceeds a threshold which is equal to 1 and sends a 0 signal if the value is below the threshold. The authors used the KLR model for predicting the leading indicators of currency crises in 20 countries, 5 of them are developed, and 15 of them are developing. They found that exports, deviations of real exchange rate, output, equity prices and broad money to gross international reserves have leading roles in predicting the crisis. Kaminsky and Reinhart (1999) went on with the signal approach to examine the case of twin crises (banking crisis alongside with currency crisis). Their findings suggest that turmoil in banking sector predates the currency crisis and that financial liberalization precedes a banking crisis. In addition, they found that currency crisis amplifies banking crisis. Many researchers followed the steps of KLR and used their method to foresee crisis such as (Christensen and Li, 2014; El-Shagi, Knedlik and Schweinitz, 2013; Karacor and Gokmenoglu, 2012; Megersa and Cassimon, 2015; Peng and Bajona, 2008; Shi and Gao, 2010).

Christensen and Li (2014) examined the case of 13 OECD countries to predict the financial stress using KLR methodology (Signal approach). The authors formed three composite indicators considered in Kaminsky, Lizondo, and Reinhart (1997), namely, the summed composite indicator, the weighted composite indicator and the extreme composite indicator. The results show that the three indicators have strong prediction capacity and that no indicator showed privilege over the others but in the

case of out-of-sample, the weighted composite indicator performed better than the other two indicators.

El-Shagi, Knedlik, and Schweinitz (2013) examined the bias of Signal approach, which is that this method cannot differentiate between randomly achieved an in-sample fit and predictive power. They tested the hypothesis of no correlation between variables and crisis probability in the three signal approach composites. Afterward they constructed bootstraps specifically for the dataset. They found that previous empirical researchers of the KLR method have come up with meaningful results and that the significant indicators in “in-sample” analysis are also significant in “out-of-sample” analysis.

Megersa and Cassimon (2015) utilized the Signal approach to investigate the indicators of the currency crisis in Ethiopia using a dataset that spans from January 1970 to December 2008. The results of their study suggest that m2 multiplier, exports, bank deposits, terms of trade, deviations of the real exchange rate from the trend, lending rate and deposit rate signal the crisis before it happens.

In Addition to stepwise regression, probit and logit models and Signal approach, many researchers used the intelligence modeling (operation research models) to predict financial failures and banking crises (Alam, Booth and Thordarson, 2000; Boyacioglu, Kara and Baykan, 2009; Celik and Karatepe, 2007; Fioramanti, 2008; Haslem, Scheraga and Bedingfield, 1999; Olmeda and Fernandez, 1997; Ravi and Pramodh, 2008; Yu, Wang, Lai and Wen, 2010).

We captured the literature on the papers studying financial and economic crises in
Table (1) below

Table (1): Review of the literature

<i>Paper</i>	<i>Countries</i>	<i>Period</i>	<i>variables</i>	<i>Methodology</i>	<i>Results</i>
Asanović (2013)	Montenegro	Monthly, from January 2005 to September 2012	Total assets, total gross loans, total loan loss provisions, total net loans, total deposits, borrowings, total capital, loans-to-deposits, total interest income, reserve requirements, stock index, annual growth rate of consumer prices, monthly growth rate of consumer prices, 1-month EURIBOR, 3-month EURIBOR, industrial production, exchange rate.	Logit models	1-month Euribor, exchange rate, total assets, loans, net loans, loan loss provisions, deposits, loans-to-deposits, capital, borrowings, reserve requirements, interest income, Stock index are the significant indicators in this study
Babecky, Havranek, Mateju, Rusnak, Smidkova and Vasicek (2013)	EU and OECD countries	Yearly, from 1970 to 2010.	Corporate bond spread, gross total fixed capital formation, commodity prices, current account, domestic credit to private sector, FDI, government consumption, government debt, private final consumption expenditure, gross liabilities of personal sector, house price index, industrial production index, industry share, inflation, M1, M3, money market interest rate, nominal effective exchange rate, net national savings, stock market index, total tax burden, terms of trade, trade, trade balance, global domestic credit to private sector, global FDI inflow, global inflation, global GDP, global trade, long term bond yield – money market interest rate.	Bayesian model averaging.	The significant indicators that have forecasting powers are: debt-to-GDP ratio, the inflow of foreign direct investment, world credit growth, the current account balance to GDP, asset price crashes (both share prices and house prices), corporate bond spread, growth in domestic credit to the private sector.
Barrell, Davis , Karim and Liadze (2010)	Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Spain, UK and the US	Yearly, from 1980–2007.	Real GDP growth, real interest rate, inflation, fiscal surplus/GDP, M2/foreign exchange reserves, real domestic credit growth, liquidity ratio, un-weighted capital adequacy ratio, real property price growth	Logit crisis models	Bank capital adequacy, bank liquidity and property prices were found to be the most suitable indicators of banking crises.
Boduroglu and Erenay (2007)	Turkey	Monthly, from Apr 1992 to Oct 2006	Current account to GNP, short term outstanding external debt, to the total outstanding external debt, short term outstanding external debt to GNP, international reserves to GNP, short term capital to international reserves, nonperforming bank credits to total bank credits, international reserves to short term outstanding external debt.	Pattern recognition paradigm and logistic regression	Constructed a composite leading indicator that predicts financial crisis and was able to predict the 1994 crisis of Turkey in 6 months in advance
Broome and Morley (2003)	Thailand, Malaysia, South Korea, Indonesia and the Philippines	Monthly, from Jan 1996 to Dec 1999.	Domestic stock prices	Granger causality test and probit models	The results suggest that domestic stock market is a significant leading indicator of the recent East Asian currency crisis.
Bucevska (2015)	Croatia, Macedonia and Turkey	Monthly, from Jan 2005 to June 2010	Trade balance, current account balance, real effective exchange rate, real interest rate differential, short-term capital outflow, short-term external debt to GDP, domestic bank loans to GDP, growth rate of bank deposits, fiscal balance, real GDP growth rate, participation in an IMF program, election period	Logit model	Real GDP growth rate, participation in an IMF loan program, current account and fiscal balance and short-term external indebtedness are the most significant common predictors of currency crises across EU candidate countries.

Burkart and Coudert (2002)	Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, Indonesia, Malaysia, Philippines, Thailand, Turkey, Hungary, Poland, and South Africa.	Quarterly, from Q1/1980 to Q4/1998	Exchange rate, total reserves less gold, foreign reserves, foreign assets, monetary base, external liabilities, domestic credit, liabilities on the private sector, Money, quasi-money, market rates, stock price index, consumption price index, exports in domestic currency, imports in domestic currency, exports in dollars, imports in dollars, unit value of exports, unit value of imports, export prices, import prices, trade balance, current account, exports of goods, imports of goods, capital account, account of financial operations, foreign direct investment, portfolio investment, errors and omissions, deficit or surplus, public debt (internal, external, in domestic currency and in foreign currency), investment, GDP, real GDP.	Fisher's linear discriminant analysis	Significant indicators by area Latin America: reserves/ M2, reserves/ total debt, reserves /imports, deviation of the real effective exchange rate from its long-term value, and inflation. Asia: reserves /M2, short-term debt/ total debt, deviation of the real effective exchange rate from its long-term value, growth rate of real domestic credit, and exports+ imports /GDP.
Bussiere and Fratzscher (2006)	Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand. Czech Republic, Hungary, Poland, Russia, and Turkey.	Yearly, from 1993-2001	REER overvaluation, current account, trade balance, terms of trade, export and import growth, short-term debt/reserves, total debt/reserves, debt composition, FDI, portfolio investment, total net capital inflows, foreign exchange reserves, real GDP growth rate, fiscal stance, public debt, inflation rate, domestic investment ratios, real estate sector, domestic credit to private and government sector, deposit/lending interest rate spreads, M1, M2, equity market indices, bank deposits, trade channel, financial interdependence.	Multinomial logit model	Included in the EWS: REER overvaluation, current account, Short-term debt/reserves, real GDP growth rate, domestic credit to private and government sector (level and growth rate), financial interdependence because these variables has the most prediction power.
Candelon, Dumitrescu and Hurlin (2014)	Argentina, Brazil, Chile, Colombia, Ecuador, Indonesia, Malaysia, Mexico, Peru, Philippines, South Africa, South Korea, Turkey, Thailand, Uruguay Venezuela.	Monthly, from 01/1985 to 01/2011	Growth rate of international reserves, growth rate of imports, growth rate of exports, M2 to foreign reserves, growth rate of M2 to foreign reserves, domestic credit over GDP, growth rate of domestic credit over GDP, real interest rate, real exchange rate overvaluation.	Dynamic logit models	The results were robust and these results show the degree of importance of taking crisis dynamics into consideration and using an econometric methodology that can show the dynamics of crisis in order to have an accurate prediction of the crises.
Christensen and Li (2014)	13 OECD countries	Quarterly, from Q2 1981 to Q3 2007	Real GDP growth, exchange rate, real short-term interest rate, inflation, M2/foreign exchange reserve, bank reserve/bank asset, growth rate of real private credit, return on stock market index, return on house price index, current account/GDP, contagion indicator, three-quarter moving average of FSI.	The signal approach	Three composite were formed, summed composite indicator, the extreme composite indicator and the weighted composite indicator, the three of them are helpful in predicting financial crisis. Out of sample results suggests that weighted composite indicator perform better predicting financial crisis than other indicators.
Cuaresma and Slacik (2009)	Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Venezuela, China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, Slovak Republic, Slovenia, and Turkey	Monthly, from Jan 1994 to March 2003	Exchange rate, lending boom, short-term debt/reserves, total debt/reserves, current account balance, government balance, Financial contagion, DataStream index, total market, DataStream index, banks, DataStream index, financial institutions, GDP growth rate.	Bayesian model averaging techniques	The results indicate that none of the macroeconomic variables that are traditionally used as indicators of financial crises are robust in this case. Coefficients estimated have the expected sign which align with the financial theory.

Davis and Karim (2008)	105 countries	1979–2003	Real GDP growth, change in terms of trade, nominal depreciation, real interest rate, inflation, fiscal surplus/GDP, M2/foreign exchange reserves, credit to private sector/GDP, bank liquid reserves/total bank assets, real domestic credit growth, real GDP per capita, deposit insurance.	Multivariate logit models	In in sample data, the model is not performing that well. On the other hand, in out of sample data, on average the model is a working well and has prediction powers although there may be variations between what the model forecasts and the actual happening.
El-Shazly (2011)	Egypt	Monthly , from Jan 1995–Jan 2001) (Feb 2001–Jan 2003)	Import–export ratio, real interest rate, stock prices, M2/net international reserves	logit, probit and Gompit models	All variables are statistically significant so all of them signals the crisis. Moreover, the results show that Gompit model is the most appropriate method to choose the best indicators for the crisis in this case.
Falcetti and Tudela (2006)	92 emerging and developing countries	ranging between 45 to 107 observations	Real GDP growth, CPI inflation, RER, foreign exchange reserves over total imports, growth of total domestic credit, world interest rate, fuel inflation, metals inflation, growth of banks deposits over GDP, growth of banks liabilities over GDP, lending minus deposit interest rate, growth of external debt over reserves, short-term debt over reserves, and private non-guaranteed debt over long-term debt.	Dynamic LDV model	The most important determinants of currency crisis are macroeconomic and financial variables. Exchange rate plays an important role because overvalued exchange rate would increase the probability of currency crisis. Countries that had sharp devaluations in the past have less probability in having other crisis in the future. Moreover, banking crisis is a strong indicator of currency crisis.
Falcetti and Tudela (2008)	92 developing and emerging markets	Quarterly, from 1970 to 1997	Total exports of goods and services, total imports of goods and services, real exchange rate, M2 over reserve money, reserves (FX) over total imports, growth of claims on the private sector over GDP, growth of net claims on the government over GDP, growth of banking deposits over GDP, growth of banking liabilities over GDP, total external debt over total reserves, total debt service payments over total exports, short-term debt over reserves, private nonguaranteed debt over long-term debt, capital account restrictions, financial liberalization, US inflation, change in the US interest rate, change in world interest rates, fuel inflation, metals inflation.	Dynamic Probit model	Both crisis share common fundamentals and both have intertwined and are interconnected, but there was no evidence on any causal relationship between the two twins.
Fedorova and Lukasevich (2012)	CIS countries	Yearly, from 2000 to 2010	Budget balance/GDP, M2/reserves, Inflation, Unemployment rate, Growth in domestic credits, GDP growth, Real GDP, Deposit rate, Credit rate, Credit rate/deposit rate, M2, Net foreign assets/GDP, Current account/GDP, Direct investment/GDP, Export, Trade surplus, (Export + Import)/GDP, Trade balance/GDP, Exchange rate, Increase in the exchange rate	Probit models	M2/reserves, Inflation, Growth in domestic credits, Real GDP, Deposit rate, M2, Export, Trade balance, (Export + Import)/GDP, Increase in the exchange rate are all significant leading indicators.
Frankel and Rose (1996)	over 100 developing countries	Yearly, from 1971 to 1992	debt lent by commercial banks, amount that is concessional, amount that is variable-rate, amount that is public sector, amount that is short-term, amount lent by multilateral development banks, FDI, debt to GNP, reserves to monthly import values, current account surplus or deficit, the degree of overvaluation, total government budget surplus or deficit , domestic credit growth rate, growth rate of real GDP per capita.	Event study and probit models	Most of debt variables are not significant, FDI is significant and provides information regarding the crisis, debt, reserves and real exchange rate are all significant and affects the crisis. Domestic credit growth and interest rates if increased will increase the

					probability of a crisis.
Giovanis (2010)	United states	Yearly, from 2007-2009 and 2010	National income , balance of accounts, industrial production, bank prime loan rate, unemployment rate ,Total investments, total loans, inflation rate, oil price, S&P 500, three-monthly treasury bill interest rates, total borrowings, public debt.	Logit regression and neural networks	The model constructed did not give good forecast in the in-sample period, especially for the prediction of financial crisis periods; however, the model gave a warning signal two quarters before the latest global financial crisis.
Gómez-Puig and Sosvilla-Rivero (2016)	Austria, Belgium, Finland, France and the Netherlands, Greece, Ireland, Italy, Portugal and Spain	Daily, from 1 January 1999 to 31 December 2012	Stock returns, stock volatility, index of economic policy uncertainty, index of the fiscal stance, consumer confidence indicator, rating, credit spread, European 5-year CDS, interest rate volatility indices, implied volatility quotes of caps, Euro instability, Euro area default risk, global risk aversion, Kansas city financial stress index, net position vis-à-vis the rest of the world, growth potential, competitiveness, fiscal Position, market liquidity, banks debt, non-financial corporations debt, households debt.	Granger causality and Probit models	Results assert on that to determine the contagion, the proxy variables for market sentiment and macroeconomic fundamentals are very important. This importance explains that when the sovereign risk premium increased in Euro area, it was not solely because of insolvency of member states or the changes in expectations and market confidence.
Karacor and Gokmenoglu (2012)	Turkey	Monthly, from Jan 2004 to Dec 2008, and Nov 2005 to Dec 2008 for monetary indicators	Production index, international reserves, M1, M2/gross international reserves, domestic credits/GDP, real exchange rates, export, foreign trade rate, real deposit interest rates	Signal approach (KRL model)	M2/gross international reserves and real deposit interest rates signal the crisis between the 8 variables. The general result is that signal's approach is not successful in predicting the crisis and the model was not able to detect the 2007 crisis.
Kemme and Roy (2012)	Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, Norway, New Zealand, Spain, Sweden, Britain, US.	Yearly, from (1950-1989) (1950-1997)	Real house prices	VECM and probit and logit models	With only one single variable, this study shows that if researchers tracked the real house prices, bubble would have been discovered and this variable signaled the latest financial distress.
Knedlik and Scheufele (2008)	South Africa	Monthly, from Jan 1995 to Dec 2004, and from Jan 1995 to Jun 2005.	Budget deficits, dom. Interest rate, foreign debt, gold price, industrial prod., lend./deposit rates, credit/GDP, bank deposits, exports, M2, inflation differential, inter. liq. position, interest differential, imports.	Signal's approach, probit models and Marcov regime switching approach	Changes in the international liquidity position and the domestic interest rate are significant in 5 out of 6 models. Growth rate of bank deposits of individuals, the growth rate of foreign debt of government and changes in the price of gold are significant in three or four models out of the six models. Signal's approach and probit models did not perform as well as Markov switching approach.
Komulainen and Lukkarila (2003)	31 emerging market countries	Yearly, from 1980–2001	Budget balance/GDP, public debt/GDP, M2/reserves, industrial production, inflation, unemployment rate, domestic credit growth, exports, current account/GDP, real exchange rate, banks deposits, claims on private s./GDP, banks for. Liabilities/GDP, lending rate/deposit rate, banks reserves/assets, banking crisis dummy,	Probit models	Private sector liabilities, public debt, foreign liabilities of banks, unemployment and inflation increase will increase the probability of crisis. Currency and banking crises are interconnected. High private

			FDI/GDP, short-term capital inflows/GDP, interest rate differential, US interest rate, EM index, fixed exchange rate, intermediate regime, internal liberalization, external Liberalization.		sector liabilities, high public indebtedness and a low lending to deposit rate are the significant indicators of banking crisis
Lang and Paul (2016)	70 countries	Monthly, from Jan 1970 to Jan 2010	Banking crisis, bank deposits, bank assets/GDP, bank investment assets/GDP, bank investment assets and liabilities/GDP, bank investment liabilities/GDP, broad liquidity ratio, current account/GDP, currency crisis, demand deposits, discount rate, domestic credit/GDP, goods exports/GDP, exports, financial account/GDP, foreign bank assets/total bank assets, foreign bank liabilities/total bank assets, free floating exchange rate regime, GDP volume, government expenditures–revenues ratio, government expenditures, government revenues, house price index, goods imports/GDP, imports, inflation, lending–deposit rate ratio, M2 multiplier, M2/Reserves, narrow liquidity ratio, overall balance/GDP, pegged exchange rate regime, production, real domestic credit, real effective exchange rate, reserves, real house price index, real interest rate, real interest rate differential, real private sector credit, real stock prices in LCU, stock price volatility in LCU, terms of trade, balance of trade/GDP, un-weighted capital adequacy ratio, unemployment	Visualization approach (combination of event study analysis and a fan chart technique)	Growth in domestic credit/GDP, demand deposits, liquidity ratio, domestic real interest rates, stock prices and house prices, government expenditures–revenues are the strongest indicators of the banking crisis.
Li and Ouyang (2011)	Argentina, Bangladesh, Botswana, Brazil, Bulgaria, Chile, China, Columbia, Czechoslovakia, Ecuador, Egypt, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Jordan, Kenya, Korea, Latvia, Lithuania, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Russia, Singapore, Slovak, Slovenia, South Africa, Sri Lanka, Thailand, Turkey, Ukraine, Uruguay, Venezuela and Zimbabwe.	Yearly, from 1989 to 2003	Current account deficit, the appreciation of REER, real GDP growth, domestic credit expansion, reserve requirements, short term external debt.	Probit model	Reserves does not help in the situation that fundamentals are bad to the degree that it is hopeless. The model constructed forecasts that higher amounts of reserves will be needed as the fundamentals are weaker in order to stop the occurrence of a crisis. There is a strong positive relationship between weak fundamentals and high reserves.
Licchetta (2011)	40 developing and developed countries (28 developing and 12 developed)	Monthly, from Jan 1980 to Dec 2004	Deviation of the real effective exchange rate, current account deficit/GDP, budget balance /GDP, exports, imports, M2 /Reserves, M2 Multiplier, domestic credit/GDP, real GDP, real interest rate differential, hyperinflation, bank foreign liabilities/GDP, short-term debt /foreign exchange Reserve, portfolio capital flow/GDP, FDI /GDP, debt/total liabilities, FDI /total liabilities, external asset minus liabilities, external asset plus liabilities, total liabilities /GDP, nominal exchange rate, international reserves minus gold	Random effect probit model	The components of a country's external balance sheet and the size of this balance sheet play a major role in the beginning of crises. International capital flows is a really important indicator of financial crises in Emerging markets. In addition, emerging markets are more sensitive to external balance sheet variables than developed countries.

Lin (2009)	Taiwan	1998 to 2005	Total debt/total assets, market value of equity/book value of total debt, net sales/total assets, current assets/current liabilities, ROA, retained Earnings/total assets, gross profit/net sales, income before taxes/net sales, bad debt expenses/net sales, Cash from operations/current liabilities, interest cost/average borrowings, growth rate of gross profit, growth rate of income before taxes, growth rate of equity, growth rate of depreciable assets, interest cost/net income +interest expenses * (1 tax rate), (debt/equity), contingent liability/equity), net sales /average receivables, cost of goods sold/average inventory	Multiple discriminant analysis, logit, probit and neural networks models	Results suggest that the three methods used have higher prediction accuracy and the results can be generalized. However, the authors note that the predictive accuracy of the three most commonly used financial crises prediction models is lower with Taiwan data.
Mangir and Erdogan (2011)	Italy, Greece, Spanish, Portugal, Ireland and Turkey	Yearly, from 2002 to 2009	Economic growth, inflation rate, unemployment rate, current account balance, budget balance rate	Technique for order preference by similarity to ideal solution method	The analysis shows that the Euro area and Turkey were clearly affected by the global financial crisis. However, comparing to the other countries, Turkey's economy did much better and was more resilient to the crisis effects.
Mariano, Gultekin, Ozmucur, Shabbier and Alper (2004)	Turkey	Monthly, from Feb 1964 to Aug 2002	Industrial production index, GNP growth rate, inflation rate, real wage rate, share of wages in national income, trade-weighted real effective exchange rate, REER, exports, imports, export import ratio, import prices, export prices, terms of trade, foreign exchange reserves, share of balance of goods and services in GDP, balance of goods and services, capital flows, domestic credit, income velocity of circulation, net foreign assets of the financial system, money multiplier, M2/foreign exchange reserves, foreign currency deposits /M2Y, foreign currency deposits/total assets of the financial system, Istanbul stock exchange national index, real interest on 12-month deposit, 3 month deposit rate 3-month US treasury bill rate, cost of borrowing, reserve ratio, share of consolidated budget balance in GDP, share of consolidated primary, excluding interest, budget balance in GDP, total consolidated budget revenue/total consolidated budget expenditures, total consolidated budget interest expenditures/total consolidated budget expenditures, domestic debt outstanding/GDP ratio, External debt outstanding/GDP ratio, short-term external debt/total external debt, external debt of the public sector/total external debt, Total debt (domestic +foreign)/GDP ratio	Markov regime switching model	Real exchange rate, foreign exchange reserves and domestic credit/deposit ratio are the most important determinants of financial vulnerability.
Megersa and Cassimon (2015)	Ethiopia	Monthly, from Jan 1970 to Dec 2008	Real exchange rate, imports, exports, terms of trade, foreign reserves, M2/ reserves, real interest rate differential, M2 multiplier, domestic credit/GDP, domestic real interest rates, lending/deposit interest rates, excess real M1 balances, bank deposits, industrial production, equity indices	The signal approach	The M2 multiplier, bank deposits, exports, terms of trade, deviation of real ER from trend and lending-deposit rate ratio were significant
Oztunç , Serin and Kılıç (2013)	Turkey	Monthly, from Jan 1990 to Dec 2010	Total export, consumer price index, total deposits/gross domestic product, foreign exchange rate in dollars, total import, net international reserves, money supply, banking sector domestic loan on private sector/domestic credit amount, treasury bills, government bonds, Istanbul stock exchange 100 index.	Arima model	Export, net international reserves and, total deposits in banks are the most important determinants of financial vulnerability

Peng and Bajona (2008)	China	Monthly, from Jan 1991 to Dec 2004	M2 multiplier, domestic credit/GDP, real interest rate, lending-deposit rate ratio, excess M1 balances, M2/reserves, bank deposits, stock prices, exports, real exchange rate, imports, terms of trade, reserves, real interest rate differential, output.	The signal approach	Results suggest that China had weak fundamentals and could have experienced contagion from the Asian crisis. Moreover, the results showed two periods where China had high probability of crisis, July 1992 to July 1993 and August 1998 to May 1999, the first period was China's devaluation, the second predict contagion effect from Asian crisis which did not happen.
Rafindadi (2015)	Nigeria	Quarterly, from Q1/1980 to Q4/2011	Net foreign assets, terms of trade shocks, Index of crude oil price volatility, government fiscal stance, monetary policy, productivity.	Probit and logit models	Results show that high degree of currency overvaluation is present in the country and that the country is actually suffering from a currency crisis. External debt, money growth rate and domestic credit growth are the most influential to the crisis.
Reynolds, Fowles, Gander, Kunaporntham and Ratanakomut (2002)	Thailand	Yearly, from 1993–96.	Total assets, total investment capital, authorized capital, net income, nonperforming loans, short-term debt, long-term debt, ratio of STD to LTD, business lending, business lending /authorized capital, business lending/total investment capital, nonperforming loans /business lending	Probit and logit models.	Companies with more short-term debt and more nonperforming loans appear to survive more often, and bigger companies with less STD and nonperforming loans have more probability of moral hazard.
Roy and Kemme (2011)	US, UK, Spain and Ireland	Yearly, (1967–1994) (2007–2008)	Current account, public debt, growth rate of per capita real GDP, real interest rate, real share price, and real house price.	Panel logit models	All six indicators are significant; the authors also found that the latest financial crisis and historical crises are similar in terms of prior stock and housing bubbles.
Sevim , Oztekin , Bali, Gumus and Guresen (2014)	Turkey	Monthly, from Jan 1992 to Dec 2011	Change current account balance, change in terms of trade, change crude-oil prices, change in treasury domestic debt, change in ISE 100 index, export to import, change in export, change in production index, import to output, change in import, short-term capital inflows to output, budget balance to output, change in capacity utilization rate, change in M1, M2 to CB's gross reserves, change in M2 multiplier, change in M2, monthly change in foreign exchange deposit to M2, change in CB's domestic assets, foreign liabilities to foreign assets, change in net past due loans, change in total deposit, change domestic credits to output, domestic credits to total assets, change in domestic credits, change in banking sector credits to private sector, change in budget balance, trade balance/output, change in actual exchange rate index, change in consumer price index, change in short term gross external debt to CB's gross reserves, change in USA-TR actual interest rate differential	Artificial neural networks (ANN), decision trees, and logistic regression models.	The significant indicators that have forecasting powers are: export to import, deposit money banks domestic credits to total assets, change in consumer price index, change in terms of trade. predicted the 1994 and 2001 crises 12 months earlier, Turkey's economy is not expected to have a currency crisis (ceteris paribus) until the end of 2012

Shi and Gao (2010)	Chile, Euro Zone, Iceland, India, Japan, Korea, Malaysia, Mexico, Pakistan, Russia, Britain, the United States, and Vietnam	Monthly, from Jan 2007 to Dec 2009	international reserves, imports, exports, terms of trade, deviations of the real exchange rate, the differential between foreign and domestic real interest rates on deposits, “excess” real M1 balances, the money multiplier of M2, domestic credit to GDP, the real interest rate on deposits, lending to deposit interest rates, the stock of commercial banks deposits, broad money to gross international reserves, an index of output, and an index of equity prices.	The signal approach	Overall possibility of crisis for developed countries is higher than the emerging markets, the possibility of crisis will decline for all the sample countries at the end of 2010, and the global economy may recover then.
Silvia, Bullard and Lai (2008)	United States	Quarterly, from Q1 1964 to Q4 2005	570 variables	Probit regression	When using stepwise regression alongside with probit regression models, the result is a model with more powerful forecasting power. This model would outperform any standard model in both in-sample and out-of-sample.
Tamgac (2011)	Turkey	Monthly, from Jan 1980 to May 2005	Bank deposits/M2, bank reserves/total bank assets, current account/GDP, central bank credit to banks/total bank liabilities, foreign debt/exports, short term foreign debt/reserves, short term debt, government fiscal deficit/GDP, private credit by domestic money banks/GDP, export growth, import growth , loans/deposits (level and growth), growth rate of broad money to reserves, growth rate of M1 ,cumulative non-FDI flows, growth rate of portfolio investment/GDP, industrial production, world real interest rate, growth rate of real domestic credit, growth rate of real GDP, deviation of the real exchange rate from trend ,stock market performance, terms of trade, trade balance, external debt, long term debt, short term debt/exports.	Markov switching approach	M2/reserves growth, trade balance, bank deposits/M2 growth, short term debt/reserves, external debt/exports are significant leading indicators of the financial crises. Devaluation in the currency had a big effect on the crises and that’s why one should use Markov switching approach as it is suitable for shifts and would capture the effect.
Woo, Carleton and Rosario (2000)	57 countries	Yearly, from 1970 to 1996.	Growth rate of M2, government budget surplus to GDP, trade account balance, current account balance, foreign assets of central bank, net foreign assets of the whole banking sector.	Logit models	The authors show that the contagion effect is the real logical reason behind the crises and not because of weak fundamentals.
Yurdakul (2014)	Turkey	Monthly, from Jan 1998 to July 2012	foreign exchange rate, money supply, growth rate, interest rate, the ISE index, and inflation rate	Logit model	All indicators were significant but money supply, the crises in the past were accurately estimated by applying the logit model.
Zhao , Haan, Scholtens and Yang (2014)	88 countries	Yearly, from 1981 to 2010	government budget deficit, growth rate of foreign reserves, unemployment, exports, deviation of real exchange rate from trend, interest rate differential, GDP growth or industrial output growth, inflation, external debt to exports, short-term debt to foreign reserves, M2 growth, domestic credit growth, US interest rate, lending rate to deposit rate, Industrial production	Probit models and KLR model	In fixed exchange rate regimes, indicators like deviations of the real exchange rate from trend and the growth of international reserves are the most appropriate. On the other hand, in floating exchange rate regimes monetary policy and credibility indicators, like domestic credit growth and inflation, have the most forecasting power.

2.3 Literature review on Turkey

This section is going to consider the crises that hit Turkey's economy which are the 1994 currency crisis, 2000/2001 twin crises and the latest crisis in 2009, and discuss the causes and consequences of each and then compare the structures of these three crises.

2.3.1 1994 currency crisis

At the beginning of 1994, the Turkish economy was hit by one of the most severe crises that the economy ever encountered which affected every aspect of the real economy. In this section, a review of 1994 crisis is presented.

Preceding the crisis, Turkey had growingly weak fundamentals after the financial account liberalization in 1989. In 1989 the capital account was completely liberalized which caused the currency to appreciate immediately to more than 20% and increased the interest rates. This appreciation of currency alongside the small tariffs led to worsening the balance of payment as the imports increased to high levels. The deficit in the balance of payments doubled because of this increase in imports. Due to the appreciation of the currency, labor wages were more expensive, and as a result of that, the exports of Turkey became higher in cost which -in turn- led to a wider deficit in the balance of payments.

In the same period, the fiscal imbalances were growing wider. Public expenditures rose because of the agricultural grants, the unsatisfying outcome of the state-owned companies, the increase in military expenditures and the increased interest payments due to the increase in the public borrowing to cover the expenditures. The fiscal deficit grew bigger as the expenditures grew with not enough growth in the public

revenues. The Turkish government, since the late 1980s, relied on domestic debt to finance public deficit, and since the public deficit was growing larger and larger, interest rates rose steadily. The Treasury started depending on the central bank to lower the high-interest rates on domestic debt. The financial sector's expectations were that the public debt requirements to be tightened, but instead it was rising.

The commercial banks of Turkey borrowed excessively from abroad which left them with an open foreign currency position. After the downgrade of Turkey's credit by multiple international agencies, commercial banks were trying to buy foreign currency to close their open positions, the central bank intervened in order not to lose its reserves and increased the REPO rates to incredibly high levels, but that did not help. Even in commercial banks that could acquire foreign currency, reserves of foreign currency started to drain after the public withdraw their foreign exchange deposits. These reasons (the cash advances from the central bank to the treasury and the decline in international reserves) led to the 1994 currency crisis (Celasun, 1998; Ozatay, 2000). After the crisis had hit Turkey, the damage it left was enormous, the Turkish economy was in the worst shape in its history, it shrank by 6%, the currency was devaluated to more than 60% against the United States dollar, interest rates reached unsustainable levels, and inflation rate reached more than 114%. The central bank intervened in the foreign exchange markets which cost him to lose more than 50% of its reserves. Repurchase agreement rates jumped into three digits numbers such as 650% (Celasun, 1998).

2.3.2 2000/2001 twin crises

After 1994 crisis, the Turkish economy partially recovered but the effects of the crisis of 1994 remained. Inflation rates and interest rates were high, and public debt was severely increasing. The Turkish government in cooperation with the

International Monetary Fund (IMF) launched a stabilization program in Turkey in December 1999 which was meant to control inflation and interest rate through a new monetary policy which is based on exchange rate stabilization using active crawling peg system. The program had the support and praise of the International Monetary Fund, and had a lot of public confidence, and seemed promising in the first period. However, the program started facing problems which lead to the eruption of the twin crises.

Several reasons were behind these twin crises. External debt repayments were in massive amounts, Ozkan (2005) shows that the amount of debt repayments of Turkey before the crisis exceeded the amounts of debt repayments of Asian countries who borrowed heavily during the 1990s. Also, the competitiveness of Turkey in the world was decreasing due to high levels of inflation which in turn affected the repayment of external debt. Maturity dates of existing debt accompanied with interest payments to domestic debt placed the treasury in a weak fiscal situation. These maturity mismatches had its effects on the already weak banking system of Turkey. A major reason for the crisis was the fragility of both banking and financial sectors. Since the stabilization program limited the devaluation to 15%, banks started short term borrowing from foreign entities which generated maturity gaps in the banking sector which contributed to the bank runs of 2000 and the insolvency of banks.

Capital outflows exceeded capital inflows, and most of the capital inflows were short term that could be withdrawn easily, this assured the weakness of the financial sector in the face of market tension. The weakness of the financial sector deepened the crisis furthermore. Drawbacks of IMF program scheme were also a major reason for the failure of the Turkish economy, alongside with crisis intervention. After severe

speculative attacks on the currency, the peg exchange system was abandoned in February 2001 to be replaced with free floating exchange rate system (Ghoshal, 2006). The program failed with Turkey entering a new crisis, the economy contracted by 3.5%, unemployment reached 11.5%, and the IMF bailed Turkey with massive amounts of debt.

2.3.3 2009 Crisis

The financial crisis started mainly in the U.S. and spread all over the world through the contagion effect. The primary cause of the financial crisis was the collapse of the U.S housing market, which began in 2006 after huge price increases that coincided with lower mortgage rates. The subprime mortgage business triggered the collapse in house prices. These mortgages were considered safe because it was “backed” by the government, so through securitization, CDOs were made and sold worldwide. Credit markets froze because banks were reluctant to lend each other, and many big banks were at the edge of bankruptcy (a lot of them did go bankrupt). An economic recession took place in the U.S and many other countries, and stock markets suffered a sharp decline.

Contagion effect has two main branches as Calvo and Reinhart (1996) mentioned which are: first, the fundamentals based contagion, which happens when the suffering economy is linked to other economies by trade channels or by finance channels (which is the case here), and second the true contagion which is associated with herding behavior and the rationality of investors. In true contagion, all connections and channels between economies are either accounted for or not present.

Turkey was affected by the global financial crisis on many aspects. Financial institutions were affected because their primary source of debt was from the

international financial system, so their funds were tightened and that constrained the lending powers of Banks. Real sector companies also faced financial constraints as international financing was cut and domestic financial institutions reduced their lending significantly. Also, since major exports of Turkey were targeting the European Union, exports of Turkey faced huge decline because of the decrease in world demand as well as imports due to changes in consumer behavior during the crisis. According to Ersel (2010), Turkey was hit by three waves: First, the direct effect of the crisis on the United States and the European Union on Turkey such as the decline in exports and financing. Second, the indirect effect of Turkey's partners such as Russia and Middle Eastern countries. Last, the direct and indirect consequences of actions taken by other countries on Turkey.

Turkey was affected severely by the global financial crisis. Gross domestic products of Turkey declined by 6.5% at the end of 2008 and by 14.7% in the first quarter of 2009. The decline of GDP did not stop in the first quarter as it continued until the end of the year. Exports and imports dropped sharply by 22.6% drop in exports and 30.3% drop in imports as well as decreases in prices and quantity. Unemployment rate hiked to reach 15.6% at the beginning of 2009 then dropped to 13% at the end of the year to remain bigger than 2008's average by 2%. In addition, financial inflows dropped massively (Ersel, 2010).

Researchers have not come to a consensus that whether Turkey was able to recover quickly out of the global financial crisis or not, and whether the government responded fast enough, some says that the Turkish economy recovered quickly and that the government responded swiftly to the crisis (Aydın, 2012; Birol, 2011). On

the other hand, Ersel (2010) noted that the government response to the crisis was slow and late.

Turkey recovered rather fast from the effects of the crisis, and a big part of this recovery goes to the reaction of the government. The government tried to increase exports and income by making agreements with Russia that all trade between them will be executed by Turkish Lira and Russian Ruble. In addition, the government made close economic relations with Middle Eastern countries such as Iran, Libya, Sudan, Iraq, Lebanon, and Syria, as passport formalities were removed between Turkey and the last three mentioned countries. Moreover, Turkish banks could not acquire derivatives from foreign banks by rules and regulations, and that made them avoid bankruptcy (Birol, 2011).

After reviewing the three financial crises that hit Turkey, it is clear that each crisis has a different nature and structure which also affected the economy with various consequences. Considering this note, the most appropriate way to study these crises would be to take each case individually and see the relevant indicators that signaled each crisis. When generally looking at the causes of all financial crises in Turkey, weak macroeconomic fundamentals and contagion effect seem to be the general causes of the three crises.

2.3.4 Comparative assessment of the three crises

To compare the structure of these three crises one must identify the specific characteristics of each crisis. The exchange rate system in Turkey was determined by a managed float system with interventions before the crisis of 1994 (OECD, 1994), the financial account was liberalized in 1989, and the public debt was increasing. The increasing fiscal instabilities after the liberalization of the financial account, which

caused pressures on the currency, alongside with huge increase in the domestic credit, and the declined attractiveness of Turkish lira's denominated assets, which in turn led to substantial decrease in the central bank's international reserves and created the perfect atmosphere for a crisis. The crisis of 1994 fits Krugman's (1979) model well, as fundamentals were fragile, huge budget deficit were present and international reserves were declining sharply, which led to speculative attacks on the currency and massive depreciation in the currency's value. In addition, the weakness of the banking system of Turkey -because of the maturity gaps of foreign assets and liabilities- had a significant role in this crisis, as the central bank was selling a part of its reserves to commercial banks to close their positions to bail them out.

On the other hand, the 2000/2001 twin crises in Turkey structure is different from the 1994 structure and cannot be explained only by the first generation model proposed by Krugman (1979). In fact, these twin crises are explained by all three generation models and their extensions. The first generation model itself cannot explain the twin crises because many of its components are not shown in the characteristics of the twin crises, such as finance of the budget deficit before the crisis. As Ozatay, Sak, Garber, and Ghosh (2002) suggested, the budget deficit was not financed by the central bank. In addition, reserves of the central bank were not small neither declining. However, Calvo's (1998) extension to the first generation model partly explains the twin crises. Calvo's model does not require a drop in the reserves, but instead, it requires domestic debt to keep increasing to the degree that expected inflation increase, and in turn, devaluation of the currency and increasing speculative attacks. This increase in the expected inflation goes in line with the second generation model, as the expectations about the crisis are the main basis of the

second generation model is the expectation of participants in the market. So the twin crises are also explained partly by the second generation model.

The twin crises have many elements that do not fit with the third generation model, most importantly the budget deficit. But in Kaminsky and Reinhart (1999)'s paper, one definition of the third generation model fits the twin crises event quite well. Kaminsky and Reinhart (1999) states that stabilization programs depending on exchange rates will cause an increase in imports and economic growth which will be financed by foreign debt, which will cause a deficit in the current account. As the deficit in the current account increases, the expectations of the market participants alters, and investors are expecting that the stabilization program is not working which stimulates speculative attacks on the currency. This international borrowing is done by domestic banks, which will suffer after the crash of the market and currency. Also, the inflation rate would decrease slowly to the required levels, which will cause the appreciation of the real exchange rate (Yilmazkuday, 2008).

The latest global financial crisis of 2008 was the event that stimulated the financial disturbance of 2009 in Turkey, so it can be said that the financial turmoil in 2009 of Turkey carried elements from the third generation model as the contagion effect is clearly shown in this crisis (Dapontas, 2011). The most substantial impact of the financial crisis of 2008 on Turkey was through the fluctuations of goods and services market as exports of Turkey are mainly directed to the European Union, and Turkey depends on it to import raw materials for industries. In addition, the short-term capital market was not functioning properly which also affected Turkey's growth and investments (Çetin and Gallo, 2012).

2.3.5 Empirical literature

Various papers have been written with the goal of predicting crises, or to develop an early warning system with variations of methodology and statistical techniques in the case of Turkey (such as Boduroglu and Erenay, 2007; Bucevska, 2015; Celik and Karatepe, 2007; Feridun, 2007; Feridun, 2008; Karacor and Gokmenoglu, 2012; Mangir and Erdogan, 2011; Mariano, Gultekin, Ozmucur, Shabbir and Alper, 2004; Özatay, Sak, Garber and Ghosh, 2002; Öztunç, Serin and Kılıç, 2013; Sekmen and Kurkcu, 2014; Sevim, Oztekin, Bali, Gumus and Guresen, 2014; Yilmazkuday, 2008; Yurdakul, 2014).

Boduroglu and Erenay (2007) designed a composite indicator that predicts the crisis in Turkey six months ahead, which they named “the Turkish Economy Stability Index” or TESI using Pattern Recognition paradigm. The authors tested this index on a dataset from 1994 crisis. Out of 7 financial ratios that they included, they found that only 2 of them can serve as crisis indicators, which are the capital adequacy ratio of banks, which acts as a banking crisis indicator, and the ratio of international reserves to outstanding short-term debt, which serves as an indicator for currency crises.

Celik and Karatepe (2007) utilized artificial neural networks to construct two models to predict the banking crisis in the case of Turkey. The first model works with banking data that belong to the same date, and the second model works with cross-sectional banking data. These models have been tested and found that both models predict the values of the following ratios: Non-performing loans to total loans, capital to assets, profits to assets and equity to assets by using 25 macroeconomic variables inputs. The authors found that these ratios are major indicators of the banking crisis.

Feridun (2007) employed Signal approach alongside with logistic regression to examine the main determinants of currency crises in Turkey. The author used a dataset consisting of a wide variety of explanatory variables in the period of 01/1980 till 06/2006. The results suggest that conventional crisis indicators failed to predict the currency crisis of Turkey. Instead, banking sector fragility index, short-term debt to international reserves, bank reserves to bank assets, GDP of United States, M1, and three months T-bills of the United States were found to have strong forecasting powers. The author isolated a part of the data to examine the effect of financial liberalization of the Turkish capital account. He examined the period from 09/1989 till 06/2006 and found that banking sector fragility index, US federal funds rate, GDP of United States, and three months T-bills of the United States have tremendous importance according to both methods used.

Karacor and Gokmenoglu (2012) utilized the Signal approach method (KLR) to examine the leading indicators of the financial crisis which hit Turkey in 2008/2009, applied on a monthly dataset from January 2004 to December 2008. The authors defined the crisis through three indicators which are: ISE index, exchange rates, and industrial production index. They included eight variables in the analysis, namely: production index, international reserves, M1, M2 to gross international reserves, domestic credit to GDP, real exchange rates, exports, foreign trade rate and real deposit interest rates. The findings suggested that only 2 of the eight variables tested can be classified as crisis indicators which are real deposit interest rates and M2 to gross international reserves. The authors concluded that if the signal approach was used to predict a crisis before two years of happening, the signal method would not be successive in the mission. They recommend using different econometrics techniques.

Yurdakul (2014) used logistic regression to identify the factors that triggered a financial crisis in the case of Turkey between 01/1998 and July 2012. The author represented the crisis with the periods from 02/1999 till 06/2001 and from 06/2007 till 05/2008. The test included seven explanatory variables which are: unemployment rate, the percentage change in M2, nonperforming loans to total loans, ISE index, foreign exchange rate, interest rate and inflation rate. All of the variables were found significant except the percentage change in M2. Coefficients of variables with positive signs meant that they increase the probability of a crisis occurring. All variables had positive signs.

Bucevska (2015) developed an early warning system for forecasting currency crisis in Croatia, Macedonia and Turkey based on a binary logit model applied on a monthly data set over five years (January 2005 - June 2010). The author included a broad set of indicators including financial variables linked to the current account and capital account, political variables, and macroeconomic variables. The author concluded that logit model could predict the currency crisis in the three countries accurately. In addition, the results showed that participation in the International Monetary Fund loan program, short-term debt, current account, fiscal balance and real GDP growth are the strongest predictors throughout the three countries.

Chapter 3

DATA AND METHODOLOGY

In this section, the data is presented with the justification of including each variable into the model. In addition, the econometric methodologies that will be used in this study are presented and discussed with a focus on the identification of the tests and their advantages and discuss any drawbacks present.

3.1 Data Description

Crisis identification: the crisis is identified using the National Bureau of Economic Research standards, as the economic recession is identified when two or more consecutive quarters of decline in the real gross domestic product of the country is present. We used standardized gross domestic products of Turkey and identified the following crises periods: from Q3-1993 to Q1-1995, from Q4-1998 to Q3-1999, from Q4-2000 to Q1-2002, and from Q2-2008 till Q3-2009. The binary dependent variable was formed based on the crises identification that takes values of 0 and 1, 1 when the crisis is occurring and 0 else wise.

42 independent variables were used to examine 3 different periods and capture the effect of these financial disturbances that hit Turkey. The dataset was separated into 3 periods and each period was tested alone: from Q1-1990 to Q4- 1999 to investigate the leading indicators of the 1994 crisis, from Q3-1996 to Q2-2005 to capture the 2000/2001 twin crises, and from Q3-2005 to Q3-2015 to examine the global financial crisis effect on Turkey and the variables that reacted to that. The following are

identifications of the independent variables used in this paper and explanations of why they were chosen to be used. All the data was acquired through Datastream.

Budget balance: as the twin deficit hypothesis states an increase in the budget deficit will increase the deficit in current account which could put pressure on the currency (Normandin, 1999; Zhuang and Dowling, 2002).

Current account balance: While a surplus in the current account balance is a healthy sign and would lower the probability of a crisis because it lowers the likelihood of devaluation, a deficit in the current account is dangerous because it indicates that the country's ability to produce revenues in order to finance balance of payments is less (Lanoie and Lemarbre, 1996).

Deposit rate: high deposit rates can increase the likelihood of loan defaults. In addition, it indicates a liquidity problem in the banking system (Rahman, Tan, Hew and Tan, 2004).

Domestic credit: also indicates the impairment of the banking system if decreased because it increases the chances of bad loans (Bruggemann and Linne, 2002).

Domestic interest rates: interest rates capture the monetary policy of the country and reflect the economic situation that the country is through. Kaminsky et al., (1998) included this variable into their study.

Exports: decreasing exports indicates a lack of competitiveness of the country and lowers the ability to obtain foreign currency. One consequence of decreasing exports

is a possible devaluation of the currency by the government to increase the competitiveness of the country (Kaminsky et al., 1998).

External debt: increasing external debt might indicate a weaker profile of the economy alongside with the possibility of decreasing capital inflow (Lanoie and Lemarbre, 1996).

Foreign direct investment: the cross-border investment associated with a resident in one country which has control over the management of a company that is resident in another country. A decrease in this variable would indicate that the country's profile is getting weaker and the ability to attract investments from the international community is less because this country could be riskier which in turn leads to a weaker economy. On the other hand, an increase in FDI could mean that the country's economic policy and prospects are inviting and that the country's economy is stable to some degree (Kaminsky et al., 1998).

Government expenditures: increasing consumption of the government would increase the probabilities of a crisis, and it would disturb the current account if it exceeded revenues (Zhuang and Dowling, 2002).

Imports: a big increase in imports might indicate overvaluation in the country's currency and that in turn would weaken the trade balance and the current account. It can also indicate the devaluation of the domestic currency. (Kaminsky et al., 1999).

Industrial production: Economies with higher output growth are more resilient to crises and vice versa. Lower industrial production in the country signals an economic downturn (Berg and Pattillo, 1999).

Inflation: high inflation rate would cause nominal interest rates to increase, which indicates poor policies and may lead to disturbances in the banking sector and currency disturbances (Lanoie and Lemarbre, 1996).

International reserves: the declining value of this variable might indicate several important issues, such as that the country is under financial pressure with debt repayment, currency might be under pressure of devaluation, and it might cause an attack on the currency (Kaminsky et al., 1998).

Money supply M1: increasing levels of M1 might point out an increasing liquidity in the market, which may lead to attacks on the currency (Eichengreen et al., 1995).

M2: Serves as a liquidity measure and it is more general than M1 as it includes near money such as checking accounts and money market securities.

M3: serves as a proxy of liquidity as it represents broad money supply including items are not included in M2 such as time deposits and REPO agreements.

Net foreign assets: this variable shows the position of the banking system, if it was increasing, that means that the banking system could cover its foreign liabilities with the existing foreign assets. If it decreased, that would indicate problems in the banking system (Kibritcioglu, 2003). Since this variable starts from 2001, foreign

assets and foreign liabilities variables were used to capture the effect on 1994 and 2000/2001 crises.

Oil price: To oil importer country like Turkey, fluctuations in oil price means fluctuations in the current account and would trigger economic disturbances (Edison, 2003).

Past due loans: an increasing value of this variable could increase the credit risk of the banking system and leads to the weakening of the financial institutions (Feridun, 2007).

Portfolio investment: includes both debt and equity securities, a non-resident investor who has less than 10% of the company's shares would not have an influence on the company's management and contribute only with capital. It indicates foreign investors' confidence if this variable decreased abruptly; it might point out the investors' expectations and may cause a currency crisis (Jotzo, 1999).

Real exchange rate: this variable signals the depreciation or appreciation of the currency, it has been a core variable in almost all studies due to its high importance in explaining the crisis (Feridun, 2007). Alongside with real exchange rate, this study utilized 2 more variables which are TL to USD and TL to EURO to capture the variations in exchange rates with the most important trading partner which is the EU and because many transactions in imports and exports are done with the USA.

Stock market index (BIST100): it indicates the confidence of investors. In addition, a decrease in asset prices may trigger loan defaults (Kaminsky et al., 1998). To

represent the stock market index, BIST100 was chosen as a proxy which is a stock index consisting of Turkey's largest 100 companies.

The ratio of non-performing loans to total loans: serves as an indicator of the quality of banks' loans portfolio, and gives a look on the credit risk and default risk of the bank. An increase in this ratio might lead to troubles in the banking system (Rahman et al., 2004). Another capital adequacy indicator was used, which is nonperforming loans net of provision.

The USD LIBOR rate: changes in the United States interbank interest rate indicates changes in the global liquidity as it is one of the most important sources of money, as well as affecting developing countries and emerging markets risk (Arora and Cerisola, 2001). Two variables were used to see this effect: 3 months LIBOR rate and overnight interbank rate.

Total consumer loans: an increase in this variable may enlarge the ratio of poor quality loans, which in result will increase the fragility of the banking system (Kibritcioglu, 2003). Two variables were used to capture the effect; loans to the private sector and total consumer loans because it does not cover the three periods studied.

Total credit cards: as in consumer loans, an increase in credit cards amount would result in a higher ratio of defaulted credit cards, and would increase the impairment of banking system. Since credit cards are increasingly used all over Turkey, this variable is added to the analysis. Two variables which are credit cards to the private

sector and total credit cards are used to capture the effect of all of the crises because it does not cover the three periods studied.

Total Deposits: the funds available in banks which indicate insolvency risk and the weakness of banking sector. If deposits decrease, it might increase the possibility of bank runs (Berg and Pattillo, 1999).

Total treasury bills: increase in debt would decrease the probability of capital inflows and might lead to a financial disturbance (Lanoie and Lemarbre, 1996).

Trade balance: imbalances and deficits in the trade balance such as decreasing exports or highly growing imports can worsen the current account and cause a currency crisis (Edison, 2003).

Unemployment rate: when industrial production is lower it pushes the unemployment rate to increase. Also if the exports are decreasing, this affects the labor market and drives unemployment to higher rates. Unemployment rate indicates the economic state of the country and the goodness/badness of its government policies. The variable was included in Kaminsky et al., (1998) paper.

United States federal funds rate: is used as a proxy for the accessibility of finance and the cost of funds for emerging markets and developing countries. And it also serves as the indicator of the United States monetary strategy (Arora and Cerisola, 2001).

US Treasury bill rate: this variable is considered to be the point of reference for pricing assets around the globe. So fluctuations in this rate would show changes in the general economic status in the US reflecting the general economic atmosphere (Arora and Cerisola, 2001).

World Gold price: as Jones and Sackley (2016) suggests that an increase in the gold price could be due to the uncertainty of economic policies made by the government.

3.2 Methodology

This study will employ 3 econometric methods to examine the leading indicators of the Turkish financial crises, first, stepwise regression is employed to get the best fitted independent variables that indicate the crises, afterwards, probit and logit models will be used to assure that these variables fits the model and gives the proper information about the crises prediction.

3.2.1 Stepwise regression

Efroymson (1960) was the first to develop the stepwise regression model which is a selective choice of predictive variables done by an automated technique, usually using t-tests or f-tests. The stepwise model has multiple approaches filtering these variables which are:

- Forward selection where the model starts with no variables, and variables suitable for the model are added based on the selection criteria one at a time until there are no variables that improve the model.
- Backward method where this procedure includes all the variables in the model and eliminates the variables that improve the model best by excluding them.
- The bidirectional selection which includes a combination of both forward and backward methods.

Stepwise regression is easy to use and enables the researcher to handle a large amount of potential explanatory variables and gives an easily interpreted result. In addition, the t-values or f-values of independent variables can offer valuable information about the quality of the predictor.

3.2.2 Binary Logit model

Probit and Logit models are statistical tests that were established to examine the association between a dichotomous dependent variable and continuous independent variables. They transform the dependent variable into a probability where the dependent variable is a discrete variable that can take two probabilities, either 0 or 1. Santomero and Vinso (1977), Martin (1977) and Ohlson (1980) were the first to use the Logit model in order to use it to classify bankrupt companies and non-bankrupt companies. The logit model is based on maximum likelihood method to form the conditional logistic regression. The cumulative logistic distribution is defined as

$$Prob (Y = 1) = F(\beta X_i) = \frac{e^{\beta'X}}{1 + e^{\beta'X}}$$

Where Y is representing the dependent binary dummy variable, β is the vector of coefficient to be estimated, X_i is the vector of independent variables and $F(\beta X_i)$ is the cumulative logistic function. The binary logarithm of the likelihood function to estimate parameters is given by this equation

$$Log (L) = \sum_{l=g1}^n \log F(\beta X_l) + \sum_{l=g2}^n \log(1 - F(\beta X_l))$$

And the estimators can be obtained by solving for Max (Log (L)).

The Logit regression examines the binomially distributed data:

$$Y_i \sim B(n_i, p_i) \quad i = 1, 2, 3 \dots n$$

Where n_i is the binomial trial, p_i is the probability of success

Logit equation can be written in a general format as shown below

$$y = \alpha + \sum_{i=1}^n \beta_i X_i + \varepsilon$$

3.2.3 Binary Probit model

Zmijewski (1984) was pioneer to use probit model in his study for the purpose of forecasting financial distress. Probit and Logit models are homogeneous in the way they work and the general equation of both models. However, the main dissimilarity of these models is in the way of calculating the cumulative logistic function $F(\beta X_i)$ which is called in probit model as the cumulative standard normal distribution function, where it is calculated in the probit model by the following formula

$$F(\beta X_i) = \int_{-\infty}^{\beta X_i} \frac{1}{(2\pi)^{1/2}} e^{-z^2/2} dz$$

Probit and Logit models are used widely in all types of research because they are easy to interpret as they sum up all the information in one number which is the probability of the dependent variable. Another advantage of the models is that they allow all the variables whether dependent or explanatory to be discrete, continuous or both. In addition, the models consider the explanatory variables together and look to the contribution of each indicator alone; if the contribution is already represented in a previous indicator, it will be disregarded. Logit model does not require normality assumption while probit model does.

Kaminsky, Lizondo, and Reinhart (1997) mentioned several drawbacks of the two models: First, one cannot rank the independent variables on the base of importance in the prediction of the dependent variable because independent variables are included in the model if significant. But the t-values of the coefficients of the variables offers important information about the strength of correlation between the explanatory variable and the dependent and that measure the accuracy and reliability of forecasting. Second, explanatory variables are significant doesn't mean they are good indicators of the dependent variable, they might be sending wrong signals. But on the other hand, the fact that the variables are significant is alone providing information helping in the process of forecasting. Last, the non-linearity of both models makes it hard to estimate the effect of an indicator to the probability of the dependent variable. However, the non-linearity of both models is well known and accounted for in all standard statistical software programs, and these programs will estimate the contribution of each variable. The two models include non-linear estimations.

All econometric tests were conducted on the statistical program E-views.

Chapter 4

EMPIRICAL ANALYSIS AND DISCUSSION OF THE RESULTS

This chapter will discuss the findings from the empirical analysis. Stepwise regression both backward and forwards alongside with probit and logit models' results applied on the variables discussed in the previous chapter to find the most suitable indicators of each financial crisis.

First, the dataset was divided into three periods to examine the three financial crises episodes that hit Turkey in the last period separately. Afterward, Stepwise regression with both ways (forwards and backward) was applied on the potential indicators taking into consideration different number of lags of independent variables (from 0 to 4 lags of explanatory variables) to acquire the indicators that have a significant relationship with the probability of the crises. Lastly, Probit and Logit models were applied on the variables picked by stepwise regression to assure that these variables are fit to indicate financial crises.

Due to the big number of independent variables, only the ones which are significant are listed in the results; full results are listed in the result appendix. These results were drawn-out from applying stepwise regression backward method and probit model. Forwards method and logit model were also applied on the data, and the results were very similar and are available in the results appendix.

4.1 The financial crisis of 1994

4.1.1 Stepwise regression results

Results of stepwise regression which investigated the relationship between the binary dummy dependent variable with the potential independent variables with consideration of 4 lags of independent variables (30 independent variables mentioned in the appendix) to select the variables that indicate the crisis are presented in table (2).

The signs of coefficient imply the relationship of the variable with the probability of the crisis. If the coefficient has a positive sign, that means that when this variable increases in value, the probability of a crisis is getting higher and vice versa. From table (2) it can be seen that bank lending to private sector, budget balance, credit cards to private sector, deposit rate, domestic credit, domestic debt (treasury bills), external debt, federal funds middle rate, real effective exchange rate, TL to \$ and unemployment have a positive relationship with crisis which means their increase would raise the probability of a crisis. While commercial banks foreign assets, current account balance, federal funds overnight rate, foreign direct investments, government consumption, imports, inflation, LIBOR rate , M1, M2, M3, oil price, trade balance and US T-bills rate are vice versa. Most of the results from stepwise regression are reasonable and compatible with the economic theory. Results show that imports increasing could lower the probability of crisis; this can be explained by imports of raw materials which are a cause of increased industrial production. In addition, increasing imports is associated with increasing gross domestic products (Uğur, 2008). Budget balance also has an unexpected relationship with a positive relationship with the probability of the crisis. An increasing inflation means that the

nominal interest rates will increase in turn which will affect the banking sector (Lanoie and Lemarbre, 1996). Lending to the private sector, credit cards, and domestic debt increasing means the probability of more defaulted loans which would mean the fragility of the banking sector and increased the probability of crisis (Kibritcioglu, 2003). Increasing foreign direct investment would lead to the growth of the economy and the creation of new jobs which in turn would decrease the probability of the crisis.

Table (2): Stepwise regression results for 1994 crisis.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending to private sector			$0.664 \times 10^{-6*}$	0	$0.724 \times 10^{-6*}$	0	$0.357 \times 10^{-6*}$	0.0072		
Budget balance	$0.0846 \times 10^{-6**}$	0.0147					$0.138 \times 10^{-6**}$	0.0215	$0.187 \times 10^{-6**}$	0.0484
Commercial banks foreign assets							$-0.415 \times 10^{-6**}$	0.025	$-0.211 \times 10^{-6**}$	0.025
Credit cards to private sector	$6.92 \times 10^{-6*}$	0.0058	$6.78 \times 10^{-6*}$	0	$8.38 \times 10^{-6*}$	0				
Current account balance					$-0.00015**$	0.0188	-0.00018^*	0.0016		
Deposit rate	0.0133*	0.0057	0.0143*	0.004						
Domestic credit			$0.21 \times 10^{-6**}$	0.0232	$0.486 \times 10^{-6*}$	0.0003	$0.22 \times 10^{-6**}$	0.0171	$0.34 \times 10^{-6**}$	0.0749
Domestic debt (bills)							$0.288 \times 10^{-6**}$	0.0466		
External debt	$4.73 \times 10^{-5*}$	0	$5.48 \times 10^{-5*}$	0	$4.42 \times 10^{-5*}$	0			$-1.51 \times 10^{-5***}$	0.0807

Federal funds middle rate	1.480*	0.0053	0.473**	0.0492			0.471***	0.0787		
Federal funds overnight rate	-1.524*	0.004								
Foreign direct investments									-0.00168***	0.0749
Gold price			0.00958**	0.0309					-0.0119*	0.0014
Government consumption					-1.79×10^{-6} *	0.0007				
Imports	-8.18×10^{-5} *	0.0041	-9.14×10^{-5} **	0.0289	-0.00019*	0.0012				
Industrial production	-0.0248***	0.0864	-0.0255***	0.061			0.0367*	0.0039	0.056*	0.004
Inflation	-0.25626*	0.0079	-0.742*	0	-0.616*	0	-0.264*	0.0024		
LIBOR rate							-0.563**	0.0366		
M1							-0.00211*	0.0072		
M2	9.63×10^{-5} *	0.0027	-0.000281***	0.0836	-0.0009*	0.0002			-0.00073**	0.0437
M3			-0.608* 10^{-6} ***	0.0614			-0.787* 10^{-6} ***	0.0604		
Net international reserves					6.95×10^{-5} *	0.005				
Oil price	-0.0208**	0.0219	-0.0234*	0.0089	-0.0219*	0.0097				

Real effective exchange rate					0.0147***	0.068	0.0241**	0.0182		
Stock price index	-0.00015**	0.0289					0.0004*	0.0039	0.000222***	0.097
TL to \$							5.220**	0.0183		
Trade balance			-0.000219*	0.0086	-0.00015**	0.0317			-0.00015**	0.0249
Unemployment							0.312*	0.0007	0.284*	0.0051
US T-bills rate			-0.633**	0.0172						

Note: 0, 1,2,3,4 indicate the number of lags of independent variables.

4.1.2 Probit/Logit models results

Results from binary probit regression applied to the variables that are nominated by stepwise regression to investigate the relationship between these variables and the dichotomous crisis dependent variable are presented in table (3). Signs of coefficients of variables in probit model have the same indication as in stepwise regression, but the value of coefficients of probit model cannot be interpreted as a marginal effect because of the way they are calculated. Results are consistent with stepwise results with all the relationships having the same direction. Federal funds rate was found significant in throughout the three methods with a consistent sign and a big effect on the probability of the crisis as the coefficient is relatively big. Stock market index (BIST100) had a negative relationship with the crisis for the first case (without lags) which shows the effect of current values of the stock market on the probability of crisis which is not considered to be as an indicator because it is in the same period of the crisis itself. Current account balance was found significant with a negative relationship with the probability of the crisis which means that when the current account balance is in deficit, it indicates the inability to finance the balance of payment which in turn increases the probability of the crisis occurring. Some indicators that were significant in the stepwise regression results were found not significant in probit regression such as commercial banks foreign assets, budget balance, deposit rate, foreign direct investments, and M3. One interesting case here is the net international reserves variable's relationship with the probability of financial crisis of 1994, as it was assumed that 1994 crisis is a first generation model crisis (Celasun, 1998), this variable should have a positive sign with the probability of the crisis but in results it indicates that it has a negative sign.

Table (3): Probit regression results for 1994 crisis.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending to private sector					$4.26 \times 10^{-6}***$	0.0501				
Credit cards to private sector	$6.5 \times 10^{-6}***$	0.0543	$-1.61 \times 10^{-5}***$	0.0745	$4.79 \times 10^{-5}**$	0.0184				
Current account balance					-0.00065***	0.0947	-0.00175*	0.0032		
Domestic credit			$1.28 \times 10^{-6}***$	0.0653			$1.32 \times 10^{-6}***$	0.0626	$1.51 \times 10^{-6}***$	0.0809
External debt			0.000559**	0.0382	0.000179**	0.0167				
Federal funds middle rate	11.042**	0.0413	-3.5761**	0.0254			-0.371***	0.0952		
Federal funds overnight rate	-11.150**	0.0385								
Gold price									-0.0859	0.0391
Imports	-0.00041*	0.0072	-0.00072**	0.0349	-0.00067***	0.0535				
Industrial production							0.1933**	0.0457	0.285**	0.0319
Inflation					-2.951**	0.0418	-4.966**	0.0216		
LIBOR rate							-0.629***	0.0534		

M1							-0.0088***	0.0896		
M2	0.000113**	0.0405	-0.00214***	0.0804	-0.00313**	0.0149			-0.00297***	0.0798
Net international reserves					0.000221**	0.0413				
Oil price	-0.203*	0.0089	-0.515**	0.0248	-0.412*	0.0054				
Real effective exchange rate							0.547***	0.0796		
Stock price index	-0.00112***	0.0593								
TL to \$							243.78**	0.0235		
Trade balance			-0.00156**	0.0258	-0.00079***	0.0663			-0.00087**	0.0161
Unemployment							2.159**	0.0291	2.150***	0.0501
US T-bills rate			-0.756***	0.0909						

Note: 0, 1,2,3,4 indicate the number of lags of independent variables.

4.2 The twin financial crisis of 2000/2001

4.2.1 Stepwise regression results

Results of stepwise regression applied to find the relationship between the independent variables (which are amounted to 34 variables and can be found in the data appendix) and the binary dependent variable representing the twin crises are presented in table (4). The results show that bank lending to private sector, budget balance, deposit rate, domestic credit, external debt, M1, M3, real effective exchange rate and TL to \$ have positive signs across all lags which mean that increasing value of these variables will increase the possibility of crisis occurring. Deposit rate and real exchange rate have the biggest coefficients, and the results are in line with the theory. An increase in deposit rate may indicate that the banks are in a liquidity problem. A growing real exchange rate mean that the currency is appreciating, and that could be troubling to the economy as the exports get more expensive and decrease, and the country's competitiveness would be troubled. As for the exports variable, the coefficient is significantly small which may indicate that if there was an effect of exports on the probability of the crisis it would be small. On the other hand, the results show that commercial banks foreign assets, commercial banks foreign liabilities, credit cards to private sector, imports, M2, past due loans, unemployment, US T-bills rate, and trade balance coefficients are all negative which means that if they increased, it would lower the probability of a crisis. For industrial production, it is reasonable because when industrial production is flourishing, the likelihood of a crisis would be decreased. The M2 increase means broad money increase, which currency in circulation, demand deposits well as time deposits, this could offer the liquidity needed to handle bank runs. Trade balance increase means that exports surpass imports which are a good indicator of a healthy economy. As for

unemployment, past due loans and commercial banks foreign liabilities, they show a different relationship as expected. Some variables such as oil price and federal funds rate show a mixed relationship with the probability of the crisis across different lags. The reason might be that a fluctuating value of these variables could affect the probability of the crisis positively or negatively depending on the lag of the variable itself. Federal funds rates show the availability of short-term funds, and it reflects the monetary policy of the United States.

Table (4): Stepwise regression results for twin crises.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending to private sector	$0.628 \times 10^{-7*}$	0	$0.486 \times 10^{-7*}$	0.0039						
Budget balance					$0.595 \times 10^{-8**}$	0.0446				
Commercial banks foreign assets							$-0.728 \times 10^{-7**}$	0.0458		
Commercial banks foreign liabilities	$-0.106 \times 10^{-6*}$	0	$-0.556 \times 10^{-7*}$	0.001					$0.445 \times 10^{-7***}$	0.0596
Credit cards to private sector	$-0.317 \times 10^{-6*}$	0	$-0.264 \times 10^{-6*}$	0.0001	$-0.123 \times 10^{-6*}$	0.0072	$-0.181 \times 10^{-6*}$	0.0052	$-0.28 \times 10^{-6*}$	0.0072
Deposit rate	0.0223*	0	0.0236*	0.001	0.0167**	0.0238			0.0147**	0.0477
Domestic credit									$0.206 \times 10^{-7*}$	0.0068
Domestic debt (bills)									$-0.412 \times 10^{-7*}$	0.0059
Exports	0.000449*	0.0059			-0.00029*	0.0034	-0.00013*	0.0006		
External debt			$5.27 \times 10^{-5*}$	0	$2.86 \times 10^{-5*}$	0.0006	$3.78 \times 10^{-5*}$	0.0018		
Federal funds middle rate					-1.893*	0.0015			2.0025*	0.0022

Federal funds overnight rate			0.594*	0.0053	2.369*	0.0002	0.437*	0	-1.60**	0.0133
Imports	-0.0004*	0.0045	-0.00023*	0.0005						
Industrial production	-0.0384*	0.0016							0.0537*	0.0032
Inflation			-0.0271*	0					0.022141**	0.0135
M1			0.000123*	0.0004	$8.55 * 10^{-5} **$	0.043				
M2									$-6.63 * 10^{-5} *$	0.001
M3	-0.0378*	0.0017			0.0901*	0	0.0599*	0.007	0.0737*	0.0095
Oil price	-0.0322*	0	-0.0165**	0.0205	-0.0227*	0.0061				
Past due loans							$-0.135 * 10^{-6} *$	0.0017		
Real effective exchange rate	0.0172***	0.0862								
Stock price index			$-6.65 * 10^{-5} *$	0.0001			$3.39 * 10^{-5} **$	0.0371	0.000109*	0
TL to \$							0.891**	0.0488		
Trade balance	-0.00027**	0.0412	-0.00038*	0.0002	-0.00014**	0.0228	-0.00013*	0.0013	-0.00023*	0.0002
Unemployment			-0.101***	0.0823	-0.182*	0.0008				
US T-bills rate			-0.545**	0.0144						

Note: 0, 1, 2, 3, 4 indicate the number of lags of independent variables.

4.2.2 Probit/Logit models results

Table (5) shows the results for probit model applied on the selected variables by stepwise regression to examine the effects of those variables on the likelihood of the crisis. The results indicate that if bank lending to private sector, budget balance, trade balance, deposit rate, credit cards, external debt, stock price index, M1 or real exchange rate increased, the probability of crisis would increase. Higher inflation rate would cause nominal interest rate to increase which in turn would cause disturbances in the currency. The increasing external debt indicates a weak profile of the economy alongside with decreasing capital inflow which leads to financial disturbances. When deposit rates increase, it increases the likelihood of loan defaults and gives a signal that banks need liquidity which will increase the probability of the crisis. As consumer loans and credit cards increase, the ratio of bad loans increases likewise. On the other hand, exports, imports, industrial production, oil price and banks' foreign liabilities are showing a negative relationship with the binary dependent variable which indicates the existence of an inverse relationship. Decreasing exports indicates a lack of competitiveness of the country and lowers the ability to obtain foreign currency. Logit results were compatible with the probit model's results.

Table (5): Probit regression results for twin crises.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending to private sector	0.214* 10 ^{-6**}	0.0111								
Budget balance					0.475* 10 ^{-6***}	0.0972				
Commercial banks foreign liabilities	-0.231* 10 ^{-6***}	0.0572	-1.36* 10 ^{-6**}	0.0497						
Credit cards to private sector	0.468* 10 ^{-6***}	0.0619	-3.23* 10 ^{-6**}	0.0147	0.327* 10 ^{-6***}	0.0643			-2.9* 10 ^{-6***}	0.087
Deposit rate	0.103**	0.0271	0.128**	0.0328					-0.0763**	0.0476
Domestic credit									-0.286* 10 ^{-7**}	0.0114
Domestic debt (bills)									-0.602* 10 ^{-6**}	0.0173
Exports	-0.00128***	0.0836			-0.00063*	0.0089	-0.00034**	0.0409		
External debt			0.000265*	0.0088	0.000349***	0.064	0.000149*	0.008		
Federal funds middle rate					-6.456***	0.0775			15.686***	0.0635

Federal funds overnight rate			4.622**	0.0185	7.571**	0.0428				
Government consumption	-0.439* 10 ^{-6**}	0.0473								
Imports	-0.0007**	0.0156	-0.00157**	0.0152						
Industrial production	-0.232**	0.011							0.201***	0.0944
Inflation			-0.574***	0.0958					0.077***	0.0897
M1			0.000814**	0.023						
M2									-3.22* 10 ^{-5**}	0.0407
Oil price	-0.065***	0.086	-0.180***	0.0514						
Past due loans							-0.616* 10 ^{-6***}	0.06		
Real effective exchange rate	0.088***	0.0588								
Stock price index									0.00068***	0.089
Trade balance	0.000474**	0.0169	-0.00243**	0.0147			-0.00061**	0.0161	-0.00093**	0.0147
Unemployment			-1.725***	0.0668	-4.02**	0.0308				
US T-bills rate			-5.596**	0.0202						

Note: 0, 1,2,3,4 indicate the number of lags of independent variables.

4.3 The financial crisis of 2008/2009

4.3.1 Stepwise regression results

The results for stepwise regression including 42 variables and the dichotomous dependent crisis variable are indicated in Table (6). External debt increasing was found to increase the likelihood of the crisis as it puts a burden on the economy's status. Capital adequacy ratios represented by non-performing loans net of provisions and nonperforming loans to total loans were found to also increase the probability of the crisis by increasing in value as bad loans may lead to the bankruptcy of banks and disturbance to the whole banking system. Oil price was also found to be increasing the possibility of a crisis if increased and it is logical as Turkey is an oil importer country. Variables such as bank lending, commercial banks foreign assets, consumer total loans, credit cards to private sector, current account balance, exports, LIBOR rate, long-term interest rates, real effective exchange rate, TL to Euro and US T-bills rate were also found to have a positive relationship with the probability of the crisis. On the other hand, variables such as M1, M3, domestic credit, stock market index, industrial production, and gold were found to be reducing the probability of a crisis if increased.

Table (6): Stepwise regression results for 2009 crisis.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending	$0.729 \times 10^{-8*}$	0.0011	$0.615 \times 10^{-8*}$	0.002	$0.799 \times 10^{-8*}$	0.0004	$0.259 \times 10^{-8***}$	0.0808		
Bank lending to private sector					$-0.499 \times 10^{-8**}$	0.0119	$-0.445 \times 10^{-8*}$	0.0017	$-0.491 \times 10^{-8*}$	0.0028
Capital adequacy	0.000148**	0.0129	0.000124*	0.0031	$9.24 \times 10^{-5***}$	0.097	0.000131**	0.0123		
Commercial banks foreign assets	$0.12 \times 10^{-7*}$	0.0015			$0.773 \times 10^{-8**}$	0.034			$0.175 \times 10^{-7*}$	0
Commercial banks foreign liabilities	$0.207 \times 10^{-8*}$	0.0004							$-0.615 \times 10^{-8*}$	0
Consumer total loans			$0.297 \times 10^{-8**}$	0.0118	$0.774 \times 10^{-8**}$	0.011				
Credit cards to private sector					$0.123 \times 10^{-6***}$	0.0517				
Current account balance	$2.97 \times 10^{-5*}$	0.0007	$2.59 \times 10^{-5*}$	0.0018						

Net foreign assets			$0.267 * 10^{-5*}$	0.0039	$-1.04 * 10^{-5**}$	0.0201	$-0.429 * 10^{-5}$	0.0629	$-0.613 * 10^{-5***}$	0.0209
Net international reserves									$0.58 * 10^{-5***}$	0.0784
Nonperforming loans/total loans	0.228**	0.0279								
Oil price	0.00419*	0.004	$-0.00287*$	0.003	0.00431*	0.0013	0.00514*	0	0.00707*	0
Past due loans	$-0.529 * 10^{-7**}$	0.0143					$-0.471 * 10^{-7*}$	0.0019	$-0.415 * 10^{-7*}$	0.0051
Real effective exchange rate			0.0186**	0.0146	0.0147***	0.0643	0.0104**	0.0144	0.0324*	0
Stock price index	$-1.48 * 10^{-5*}$	0.0009	$-1.81 * 10^{-5*}$	0	$-1.93 * 10^{-5*}$	0				
TL to \$	$-0.644***$	0.058			$-0.915**$	0.0282	$-1.293*$	0.0098	$-0.940*$	0
TL to Euro	0.886**	0.011					0.8**	0.0412		
Total credit cards					$-0.126 * 10^{-6**}$	0.0427				
Total deposits							$-0.587 * 10^{-8**}$	0.0326	$-0.394 * 10^{-8*}$	0
US T-bills rate	0.293***	0.0533			0.446**	0.0104	0.509*	0.0004		

Note: 0, 1, 2, 3, 4 indicate the number of lags of independent variables.

4.3.2 Probit/Logit models results

Table (7) shows the results of probit model including the chosen variables from stepwise regression. Results show consistency with stepwise results. Bank lending and bank lending to the private sector is a proxy of financial development in the country, a negative relationship between the general bank lending and crisis probability exists in the results, but a positive relationship is present between bank lending to the private sector and the probability of the crisis. This can be justified by the fact that the increase in bank lending to the private sector will increase the rate of bad loans and increase default risk in banks. In the case of bank lending, the negative relationship with the probability of the crisis can be explained by the fact that when banks are lending money that is going to profitable projects. Capital adequacy ratio relationship with the probability of the crisis was in line with expectations; the sign of this indicator was positive indicating a decrease in the quality of loans in banks. M2 increasing would mean higher money supply in the country which can alter the inflation expectations to higher levels and increase expectations towards devaluation of the currency (Bruggemann and Linne, 2002). As the nerve of the economy, industrial production also came in line with the expectations as it has an inverse relationship with the probability of the crisis. The increase in total credit cards would increase the probability of a financial crisis event. This is explainable by the fact that an increase in credit cards would result in a higher ratio of defaulted credit cards and leads to the weakening of banking system. On the other hand, the exchange rate of Turkish Lira against main currencies (Dollar and Euro) variables are different from expectations as the results show that the depreciation of TL against Euro would increase the probability of crisis and vice versa for TL against USD. Gold price came against expectations as well; the results show that an increase in the price of gold

would decrease the likelihood of crisis which does not match with the economic theory.

Table (7): Probit regression results for 2009 crisis.

Variable	Significant									
	0		1		2		3		4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Bank lending to private sector					-0.416* 10^{-7***}	0.0637				
Capital adequacy			0.00186***	0.0917	0.00152**	0.0132	-0.00099**	0.0344		
Commercial banks foreign assets	0.151* 10^{-6***}	0.0633			0.278* 10^{-6***}	0.0918				
Commercial banks foreign liabilities	0.927* 10^{-7***}	0.0663								
Credit cards to private sector					$0.42 * 10^{-6***}$	0.0666				
Current account balance	0.00048**	0.0266	0.000203***	0.0639						
Domestic credit	0.725* 10^{-8***}	0.0934			-0.143* 10^{-7**}	0.0185				
Domestic debt (bills)									-0.43* 10^{-6***}	0.0805

Exports							0.000268*	0.0081		
External debt	$6.59 \times 10^{-5**}$	0.0438					$3.28 \times 10^{-5***}$	0.0505	$-4.45 \times 10^{-5***}$	0.0634
Federal funds middle rate							2.074***	0.0996		
Federal funds overnight rate	-1.275**	0.0298					-3.525***	0.0692		
Gold price	-0.0104*	0.0063					-0.00323**	0.026		
Industrial production	-0.118***	0.0549			-0.815***	0.0889				
LIBOR rate							3.469***	0.0534		
Long term interest rates (6 months)							1.415**	0.0251		
M1	-0.00041***	0.0528	-0.00035**	0.0289	-0.00023**	0.0367	-0.00013***	0.0672		
M2	$7.81 \times 10^{-5**}$	0.0425	$7.35 \times 10^{-5**}$	0.0268	$4.71 \times 10^{-5**}$	0.0318	$-0.974 \times 10^{-5*}$	0.0086		
Net foreign assets			$8.31 \times 10^{-5***}$	0.0863						
Net international reserves									0.000141***	0.0832
Oil price					0.0520**	0.0441	0.0238**	0.0311		
Past due loans	$-0.541 \times 10^{-6**}$	0.0409								

Stock price index	-0.00025***	0.0546			-0.00019***	0.0735				
TL to \$	-10.943**	0.0231			-47.953***	0.0954	-13.794***	0.0518	-19.259	0.0639
TL to Euro	6.864***	0.0813								
Total credit cards					$0.733 \cdot 10^{-6}$	0.0924				
US T-bills rate	-1.836**	0.0103								

Note: 0, 1,2,3,4 indicate the number of lags of independent variables.

Chapter 5

CONCLUSIONS AND RECOMMENDATION

Turkey is familiar with financial crises episodes that had devastating effects on the economy and left the country with bad conditions to recover from, in the last two decades alone there were three financial disturbances which affected the economy severely. However, these crises are different in structure because of the changing nature of the Turkish economy. Researchers have sought to understand the patterns of financial crises using different methodologies and different datasets and were able to find early warning signs that could help lessen the effects of financial disturbances on the economy. However, since the nature of the economy and crisis are changing, some of those warning signs might be misleading and inappropriate for the situation. Need for a new set of indicators arises. The aim of this paper was to investigate the potential leading indicators of the three Turkish financial crises (1994/2000-2004 and 2009) and give a new set of data that is more compatible with the current structure of Turkey's economy. Another goal of this study was to understand the differences between the indicators of these three financial crises through comparing the changes in patterns of the crises.

The dataset includes 42 variables which cover different periods from 1990 to 2015 with a quarterly frequency. The dataset was divided into three periods which are used to study each crisis individually, the first period was from Q1/1990 to Q4/1999 to study the 1994 crisis, the second period was from Q3/1996 to Q2/2005 to investigate the leading indicators of the twin crises, and the third period was from Q3/2005 to Q3/2015 to examine the latest financial

disturbance. The data was analyzed using stepwise regression, logit, and probit models. First, crises were identified and represented as a binary dependent variable. Then the explanatory variables of each period were filtered using two methods of stepwise regression (forward and backward). Stepwise regression's two methods gave very similar sets of explanatory variables. Afterward, the variables' set found in stepwise regression was tested to ensure the effect of these indicators on the probability of the crises using Probit and Logit models. Both models gave a similar set of indicators that are in line with expectations with a few outliers.

The first noticeable result from the analysis is that the 1994 crisis is generally explained by the first generation model suggested by Krugman (1979) which states that weak fundamentals are the base of the currency crisis, results of this study shows that Turkey had weak fundamentals during the period around the crisis of 1994 and these fundamentals played an important part in increasing the probability of the crisis. Current account and trade balance were found to have a negative relationship with the probability of the crisis and real effective exchange rate alongside with unemployment and inflation were found to have a positive relationship with the probability of the crisis. These findings are consistent with the work of several early studies examining the case of Turkey (Kibritcioglu, Kose and Ugur, 1999; Feridun, 2007; and Yenturk, 1999). However, some of the 1994 crisis characteristics were not explained by the first generation model. Relationships crucial to the first generation model such as the negative relation between net international reserves and the probability of the crisis were not present in the leading indicators found by this study.

Analyzing the twin crises of Turkey; it is noticeable that poor macroeconomic performance can increase the probability of the crisis as it was the case. The twin crises can be partially explained by the first generation model as results indicate that a big part of the indicators that explains the first crisis also explain the twin crises. These results are consistent with findings

of Yurdakul (2014). However, the twin crises had some unique features from 1994 crisis such as the fragility of the banking sector played a major role in increasing the probability of the crisis. Variables like deposit rate, domestic bills, bank lending and credit cards have a positive relationship with the probability of the crisis which ensures that the impairment of banking sector is a major indicator of the banking crisis in Turkey. International variables such as oil price, US treasury bills and federal funds rates had prediction power on the twin crises which shows the effect of international economy state on the economy of Turkey.

In the case of 2009 financial disturbance in Turkey, economy's structure of Turkey changed, and there are new indicators in this situation, alongside with most of the indicators of the previous crises, the results clearly indicates that international variables have a strong indication of the probability of the crisis such as the federal funds middle rate, federal funds overnight rate, US treasury bills, gold price, oil price, exchange rates and LIBOR rate. Moreover, new indicators are introduced such as capital adequacy and long-term interest rates which had a positive relationship with the probability of the crisis. However, new variables such as commercial banks' foreign assets, net foreign assets and TL to Euro had unexpected signs, TL to Euro variable sign was positive indicating that the appreciation of the Turkish currency against Euro would increase the probability of the crisis, this can be explained by the fact that EU is the first export market for Turkey and appreciating currency would decrease exports which will increase the probability of the crisis. In conclusion, a new set of indicators have been reached in the results that include variables in the table below

Table(8): leading indicators of Turkish financial crisis

Bank lending	Trade balance	TL to \$
Capital adequacy	Unemployment	TL to Euro
Credit cards to private sector	US T-bills rate	Total credit cards
Current account balance	Past due loans	Long term interest rates (6 months)
Deposit rate	Real effective exchange rate	M1
Domestic credit	Stock price index	M2
Domestic debt (bills)	LIBOR rate	Oil price
Exports	Industrial production	Gold price
External debt	Inflation	Imports
Federal funds middle rate	Federal funds overnight rate	

Since the world is moving into a single unit due to globalization, the economies of the world are changing and developing in regard to globalization with more correlation and connection between economies; Turkey's economy has changed dramatically over the last two decades being influenced by the global economy. The indicators found in this study are compatible with the new structure of Turkish economy. Regulators should pay close attention to macroeconomic variables of Turkey and correct any misalignment to avoid the event of the crisis. However, sound macroeconomic fundamentals alone could not prevent the event of a financial disturbance. This suggest that policy makers and regulators should not just focus on macroeconomic stability and fiscal and monetary policy, but to take into account the stability of the banking system as the results show that many banking related variables increase the probability of the crisis, this can be through imposing higher reserve requirements on loans to prevent subprime loans, imposing tighter regulations on banks to avoid default and credit risk and following the liquidity levels in the markets. Moreover, as globalization is at its peak,

contagion effect is one of the most powerful reasons of financial disturbances; policy makers should also pay close attention to the status of the global economy.

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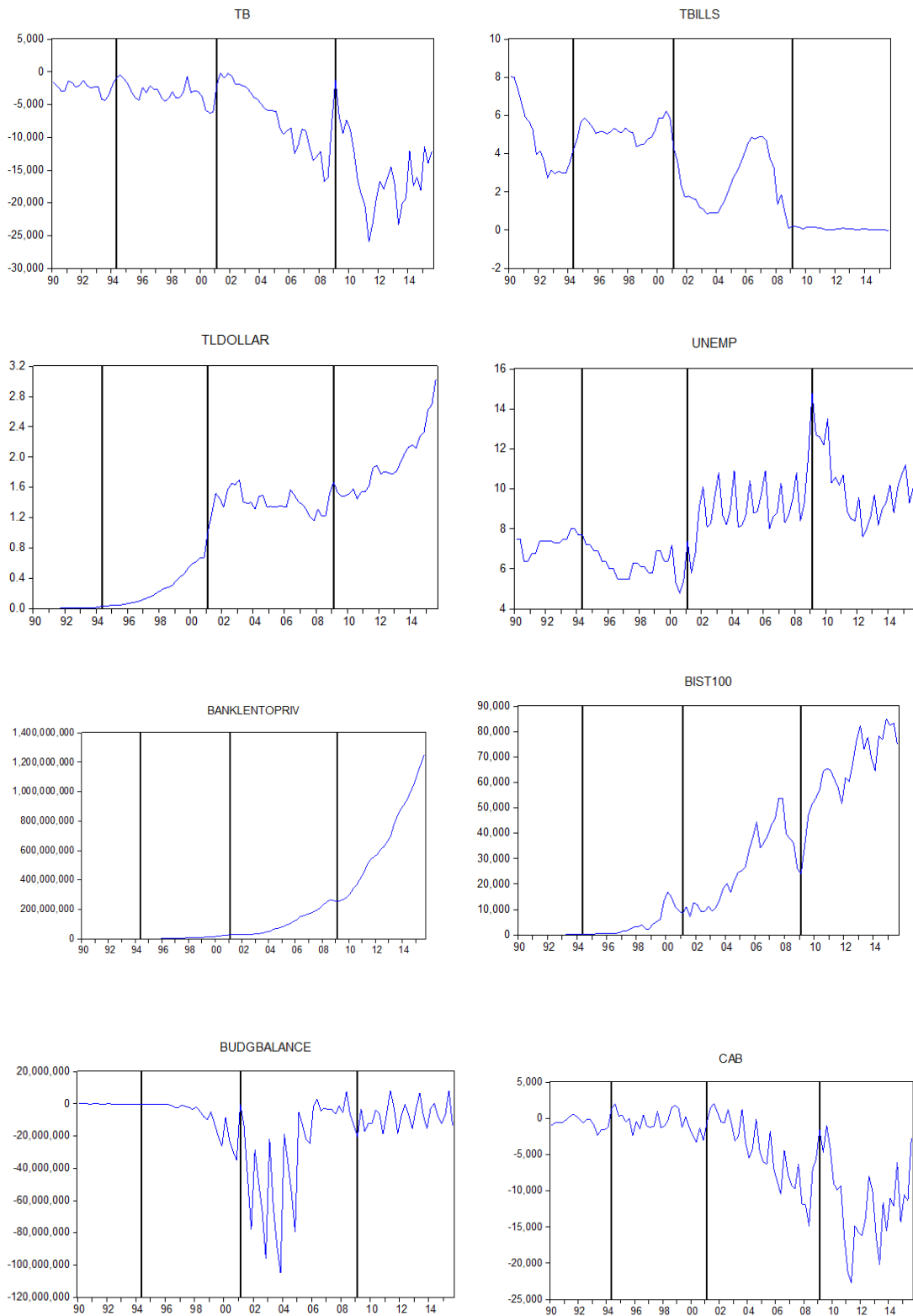
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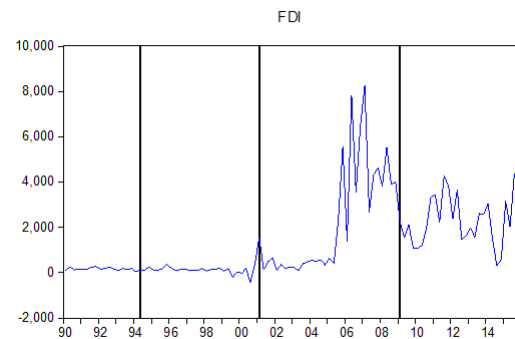
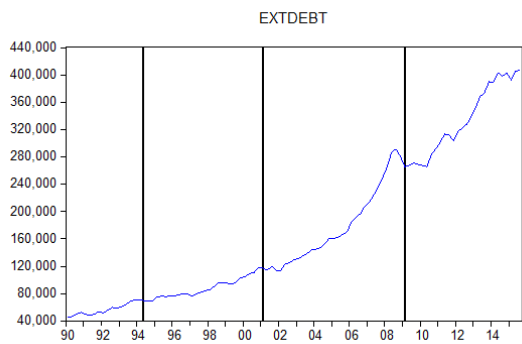
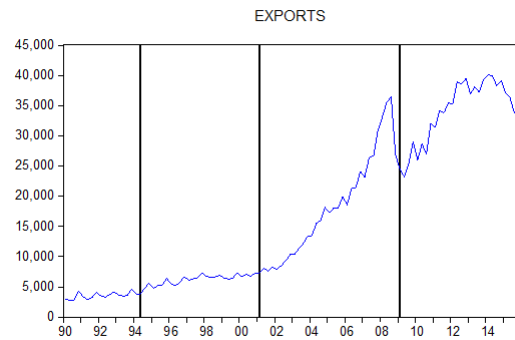
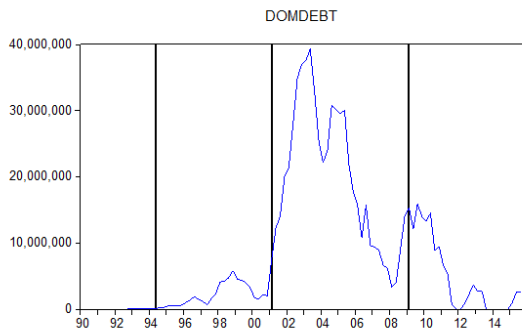
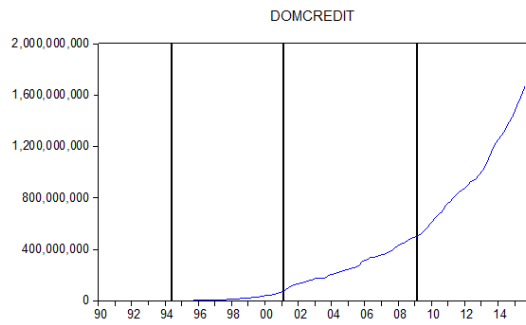
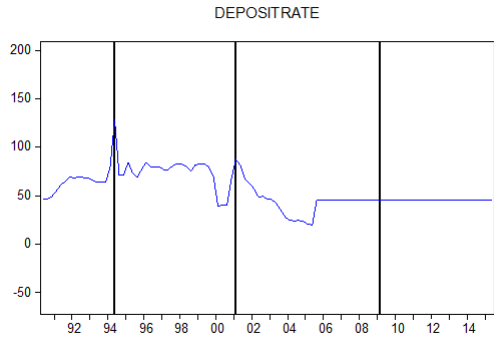
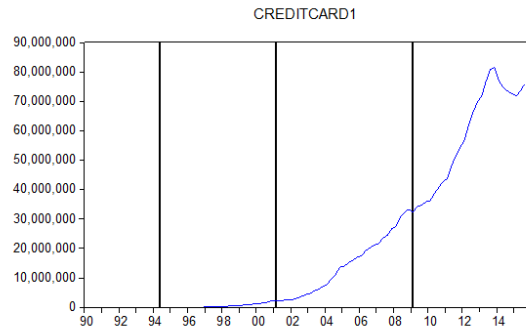
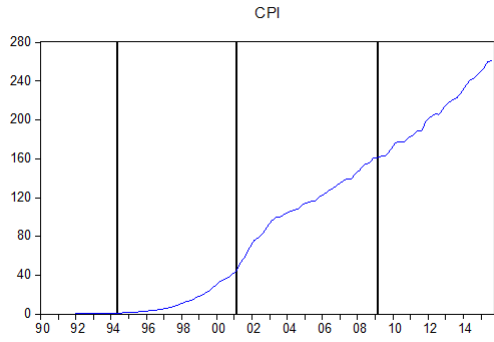
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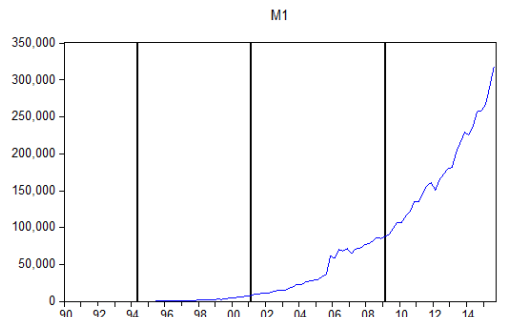
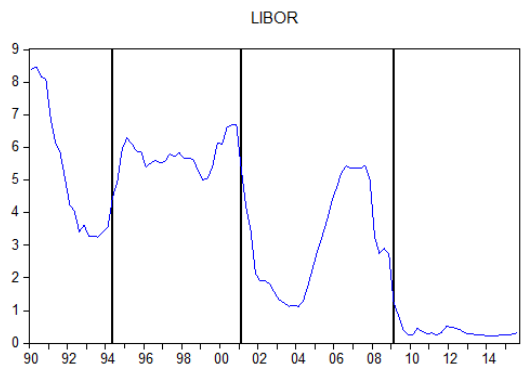
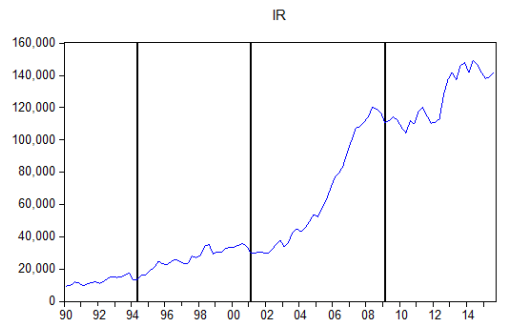
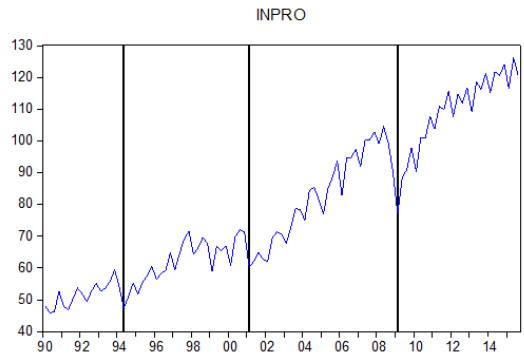
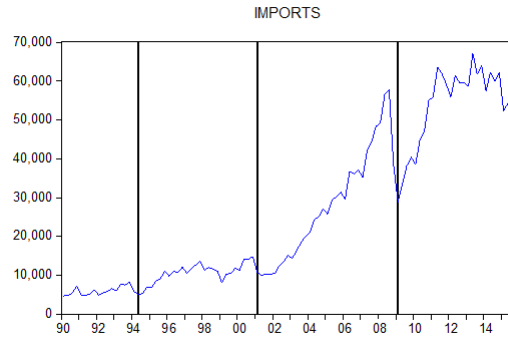
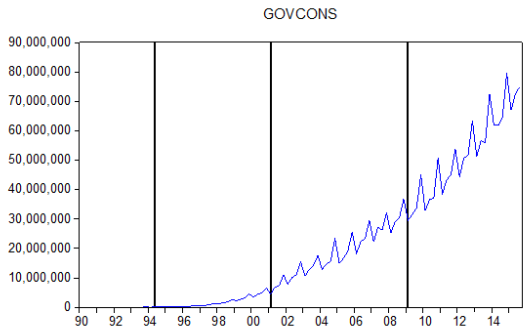
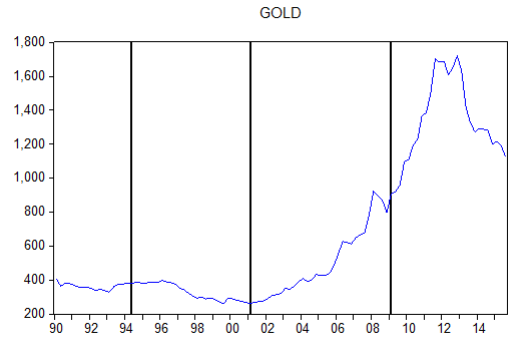
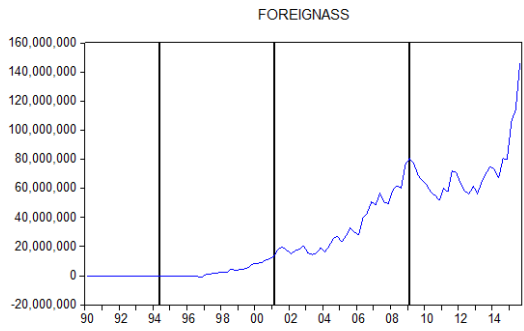
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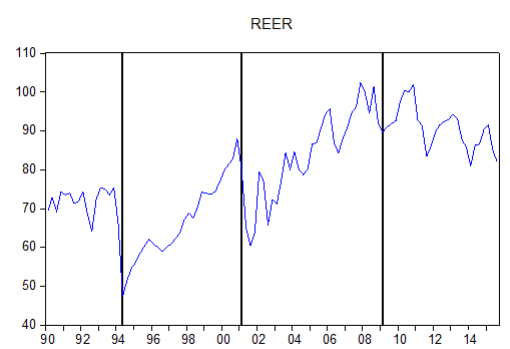
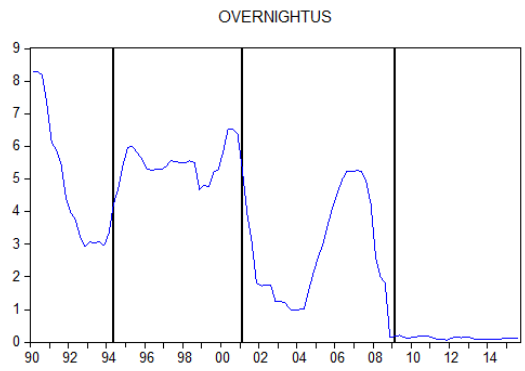
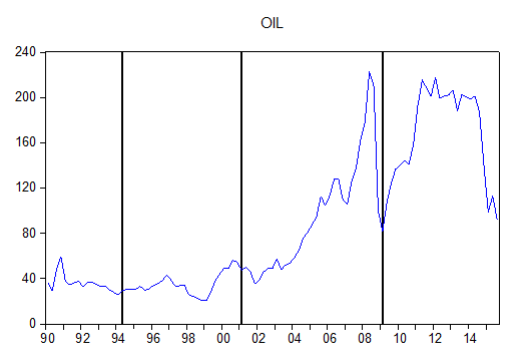
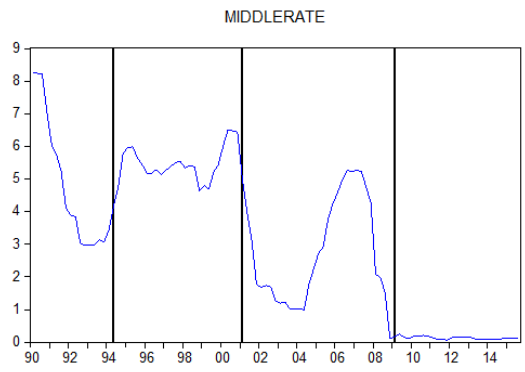
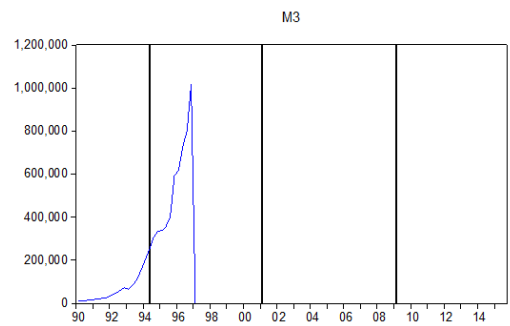
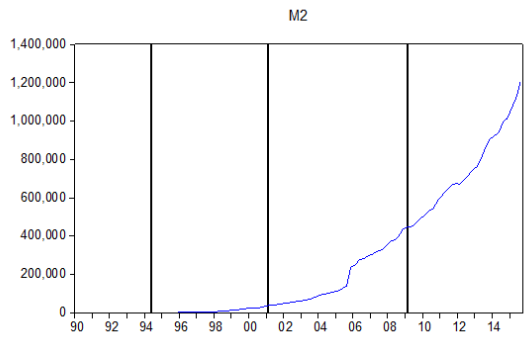
APPENDICES

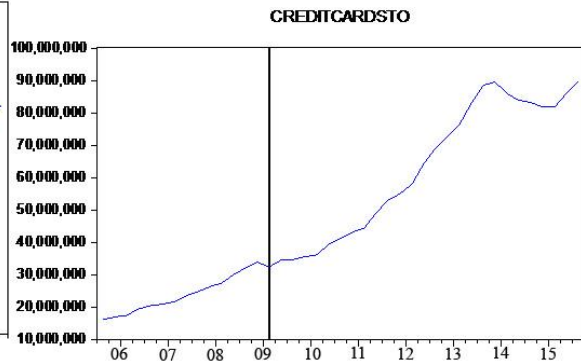
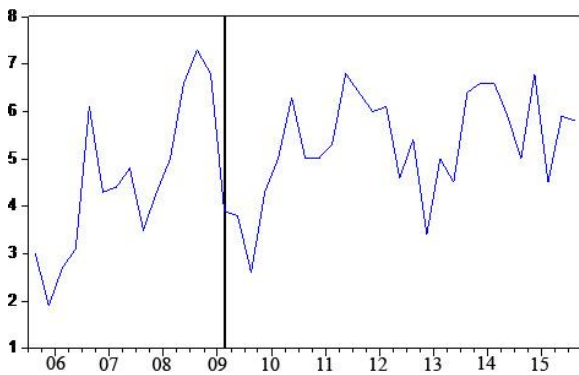
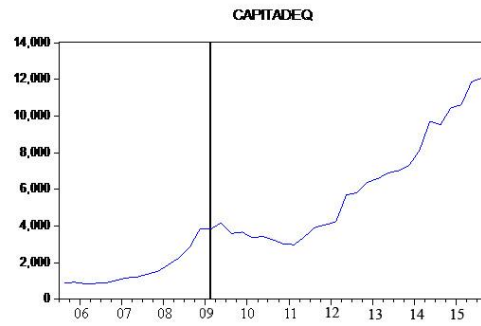
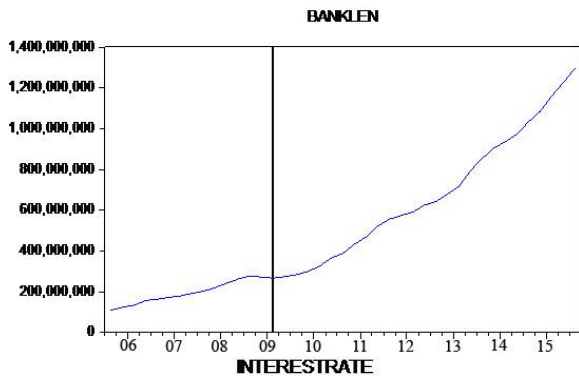
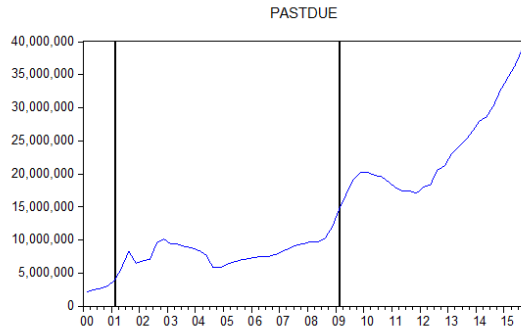
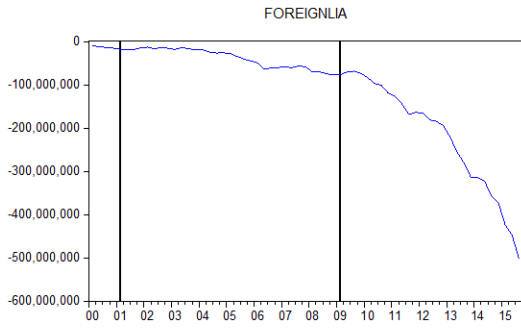
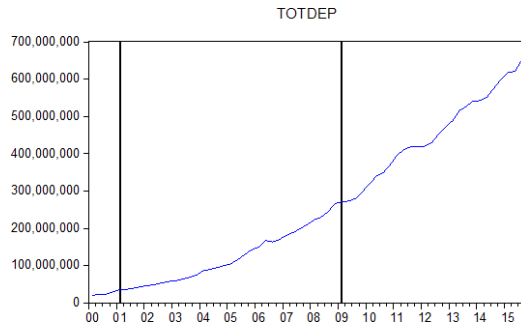
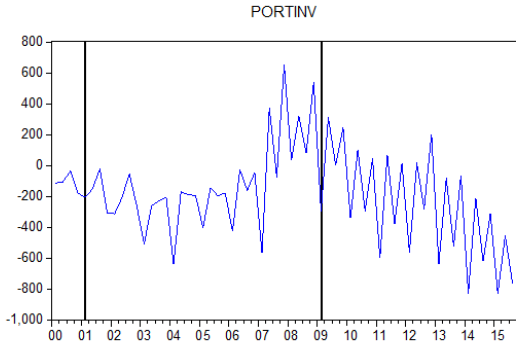
Appendix A: Series graphs

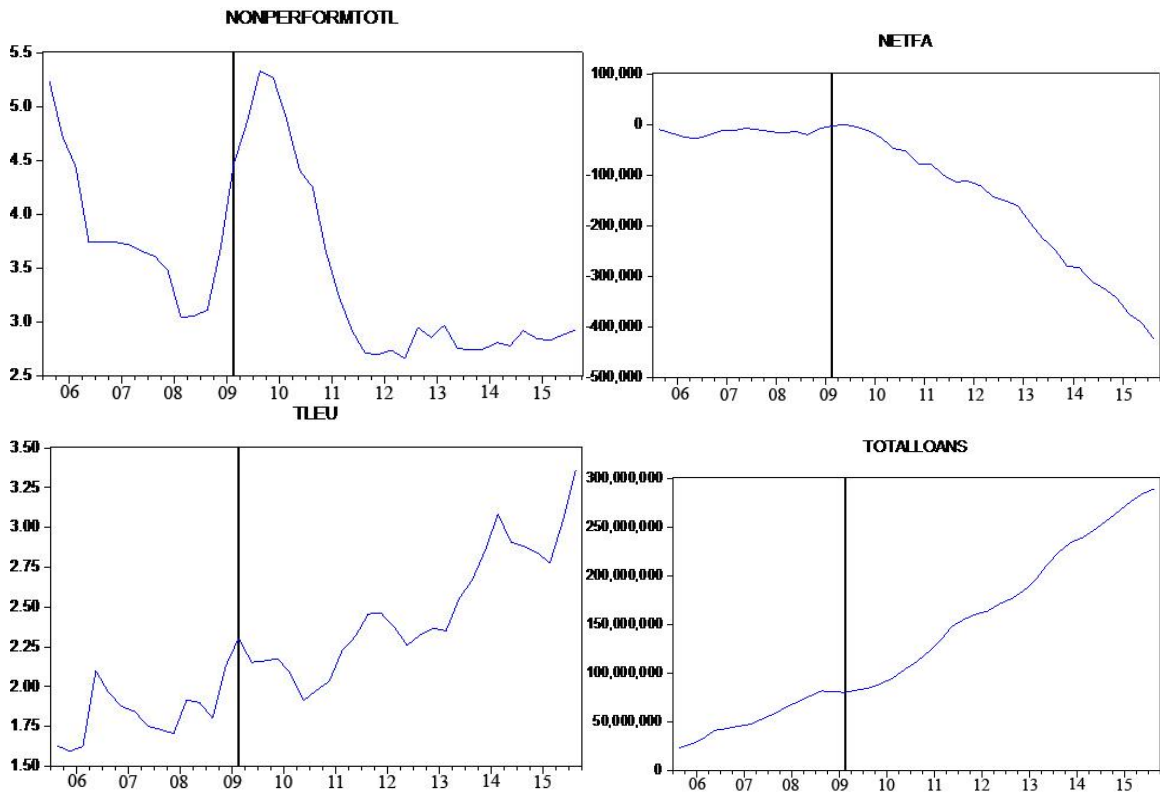












Appendix B: Primary results

1994 significant variables (30 variables, from Q1/1990 to Q4/1999)				
Without	1st lag	2nd lag	3rd lag	4th lag
Imports	Imports	Imports	Current account balance	Trade balance
M2	Trade balance	Trade balance	M1	M2
Deposit rate	M2	Current account balance	Domestic credit	Domestic credit
Stock price index	Domestic credit	International reserves	Inflation	Industrial production
Credit cards	External debt	M2	Industrial production	Unemployment
Federal funds overnight rate	Credit cards	External debt	Unemployment	Gold price
Federal funds middle rate	Federal funds middle rate	Credit cards	TL to \$	
Oil price	T-bills rate of US	Bank lending	Real effective exchange rate	
	Oil price	Inflation	LIBOR rate	
		Oil price	Federal funds middle rate	

2000/2001 significant variables (34 variables, from Q3/1996 to Q2/2005)

Without	1st lag	2nd lag	3rd lag	4th lag
Exports	Imports	Exports	Exports	Trade balance
Imports	Trade balance	International reserves	Trade balance	M2
Trade balance	M1	External debt	External debt	Domestic credit
Deposit rate	Deposit rate	Credit cards	Past due loans	Deposit rate
Credit cards	External debt	Budget balance		Stock price index
Lending to private sector	Credit cards	Unemployment		Credit cards
Government consumption	Inflation	Federal funds overnight rate		Domestic debt (bills)
Industrial production	Unemployment	Federal funds middle rate		Inflation
Real effective exchange rate	Federal funds middle rate			Industrial production
Oil price	T-bills rate of US			Federal funds middle rate
Commercial banks foreign liabilities	Oil price			
	Commercial banks foreign liabilities			

2009 significant variables (42 variables, from Q3/2005 to Q3/2015)

Without	1st lag	2nd lag	3rd lag	4th lag
Current account balance	Current account balance	M2	exports	International reserves
M2	M2	M1	M2	External debt
M1	M1	Domestic credit	M1	Domestic debt (bills)
Domestic credit	Commercial banks net foreign assets	Stock price index	Long term interest rates	TL to \$
Stock price index	Capital adequacy	Capital adequacy	External debt	
External debt		Total credit cards	Capital adequacy	
Past due loans		Credit cards	TL to \$	
Industrial production		Lending to private sector	LIBOR rate	
TL to Euro		Industrial production	Federal funds overnight rate	
TL to \$		TL to \$	Federal funds middle rate	
Federal funds overnight rate		Oil price	Oil price	
T-bills rate of US		Commercial banks foreign assets	Gold price	
Gold price				
Commercial banks foreign assets				
Commercial banks foreign liabilities				

Summary of the results

Variable	Used in	Significant														
		0			1			2			3			4		
		SW	P	L	SW	P	L	SW	P	L	SW	P	L	SW	P	L
Bank lending	3 rd	3 rd			3 rd			3 rd		3 rd	3 rd					
Bank lending to private sector	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd	1 st /2 nd			1 st /3 rd	1 st /3 rd	1 st	1 st /3 rd				3 rd	
Budget balance	1 st , 2 nd & 3 rd	1 st						2 nd	2 nd		1 st				1 st	
Capital adequacy	3 rd	3 rd			3 rd	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd			
Commercial banks foreign assets	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd				3 rd	3 rd	3 rd	1 st /2 nd				1 st /3 rd	
Commercial banks foreign liabilities	2 nd & 3 rd	2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	2 nd	2 nd	2 nd								2 nd /3 rd	
Consumer total loans	3 rd				3 rd			3 rd								
Credit cards to private sector	1 st , 2 nd & 3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd /3 rd	1 st /2 nd /3 rd	1 st /2 nd	2 nd				2 nd	2 nd
Current account balance	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd	3 rd	3 rd	3 rd	1 st	1 st		1 st	1 st	1 st			
Deposit rate	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd	1 st /2 nd	2 nd	2 nd	2 nd							2 nd	2 nd
Domestic credit	1 st , 2 nd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st	1 st	1 st /3 rd	3 rd	3 rd	1 st	1 st	1 st	1 st /2 nd	1 st /2 nd	1 st /2 nd

	& 3 rd															
Domestic debt (bills)	1 st , 2 nd & 3 rd										1 st			2 nd /3 rd	2 nd /3 rd	2 nd
Exports	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd				2 nd	2 nd	2 nd	2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	3 rd		
External debt	1 st , 2 nd & 3 rd	1 st /3 rd	3 rd	3 rd	1 st /2 nd /3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd /3 rd	1 st /2 nd	1 st /2 nd	2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	1 st /3 rd	3 rd	3 rd
Federal funds middle rate	1 st , 2 nd & 3 rd	1 st	1 st	1 st	1 st	1 st	1 st	2 nd	2 nd	2 nd	1 st /3 rd	1 st /3 rd		2 nd	2 nd	2 nd
Federal funds overnight rate	1 st , 2 nd & 3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	2 nd /3 rd	2 nd	2 nd	2 nd /3 rd	2 nd	2 nd	2 nd /3 rd	3 rd	3 rd	2 nd		
Foreign direct investments	1 st , 2 nd & 3 rd							3 rd						1 st		
Gold price	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd	1 st			3 rd			3 rd	3 rd	3 rd	1 st	1 st	1 st
Government consumption	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd				1 st								
Imports	1 st , 2 nd & 3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st	1 st	1 st						
Industrial production	1 st , 2 nd & 3 rd	1 st /2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	1 st /3 rd			3 rd	3 rd	1 st /3 rd	1 st	1 st	1 st	1 st /2 nd	1 st /2 nd	1 st
Inflation	1 st , 2 nd & 3 rd	1 st			1 st /2 nd	2 nd		1 st	1 st	1 st	1 st	1 st	1 st	1 st /2 nd	1 st /2 nd	1 st /2 nd
LIBOR rate	1 st , 2 nd & 3 rd	3 rd			3 rd			3 rd			1 st /3 rd	1 st /3 rd	1 st /3 rd			

Long term interest rates (6 months)	3 rd										3 rd	3 rd	3 rd			
M1	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd	2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	2 nd /3 rd	/3 rd	/3 rd	1 st /3 rd	1 st /3 rd	1 st			
M2	1 st , 2 nd & 3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	1 st /3 rd	3 rd	3 rd	3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd
M3	1 st , 2 nd & 3 rd	2 nd			1 st			2 nd			1 st /2 nd			2 nd /3 rd		
Net foreign assets	3 rd				3 rd	3 rd	3 rd	3 rd			3 rd			3 rd		
Net international reserves	1 st , 2 nd & 3 rd							1 st	1 st	1 st				3 rd	3 rd	3 rd
Nonperforming loans/total loans	3 rd	3 rd														
Oil price	1 st , 2 nd & 3 rd	1 st /2 nd /3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd /3 rd	1 st /2 nd	1 st /2 nd	1 st /2 nd /3 rd	1 st /3 rd	1 st /3 rd	3 rd	3 rd	3 rd	3 rd		
Past due loans	2 nd & 3 rd	3 rd	3 rd	3 rd							2 nd /3 rd	2 nd	2 nd	3 rd		
Portfolio investment	2 nd & 3 rd															
Real effective exchange rate	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd	3 rd			1 st /3 rd			1 st /3 rd	1 st	1 st	3 rd		
Stock price index	1 st , 2 nd & 3 rd	1 st /3 rd	1 st /3 rd	3 rd	2 nd /3 rd			3 rd	3 rd	3 rd	1 st /2 nd			1 st /2 nd	2 nd	
TL to \$	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd				3 rd	3 rd		1 st /2 nd /3 rd	1 st /3 rd	1 st /3 rd	3 rd	3 rd	3 rd
TL to Euro	3 rd	3 rd	3 rd	3 rd							3 rd					

Total credit cards	3 rd							3 rd	3 rd							
Total deposits	2 nd & 3 rd										3 rd			3 rd		
Trade balance	1 st , 2 nd & 3 rd	2 nd	2 nd	2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd	1 st	1 st	2 nd	2 nd	2 nd	1 st /2 nd	1 st /2 nd	1 st /2 nd
Unemployment	1 st , 2 nd & 3 rd	1 st			2 nd	2 nd	2 nd	2 nd	2 nd	2 nd	1 st	1 st	1 st			
US T-bills rate	1 st , 2 nd & 3 rd	3 rd	3 rd	3 rd	1 st /2 nd	1 st /2 nd	2 nd	3 rd			3 rd					

Note: SW stands for stepwise regression, P stands for Probit models, L stands for Logit models, 1st stands for 1994 crisis, 2nd stands for the twin crises of 2000/2001, 3rd stands for 2009 crisis, 0,1,2,3,4 indicates the number of lags of independent variables.