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Significant Determiners of Greek Debt Crisis: A Comparative Analysis with Probit and MARS Approaches

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Abstract

The purpose of this study is to determine major indicators of the Greek crisis that started in 2009 and the effects of which can still be observed. In this regard, 8 independent variables were applied so as to fulfill the objective. Besides, the annual data between the years 1984 and 2016 was analyzed with Probit model. As a consequence of this study, it was concluded that inflation and gross savings are the leading meters of Greek crisis based on probit method. On the other hand, according to the MARS results, 3 different variables are identified as the indicators of the debt crisis in Greece. It is concluded that there is a negative relation between financial crisis with saving ratio and current account balance. Additionally, it is also identified that high unemployment ratio leads to financial crisis. While comparisng the results of these two approaches, it is concluded that MARS is much more successful than the probit method to predict the debt crisis in Greece. It is strongly recommended that saving ratio should be increased in Greece. For this purpose, governments should take some actions in order to increase this ratio more than 15.5%. Within this framework, media channels can be used by the government to tell the people about the importance of the savings to have sustainable economic development.

Introduction

The integration of national and international financial markets, which started after the Second World War and gained momentum after 1990, led to the emergence of financial crisis (Selvarajan et al., 2018; Ocampo, 2018). In the period when many developed and developing countries liberalized their financial systems and made their capital account open, there were extraordinary increases in the international movement of capital from one side to the other, and the long-term financial crisis arose (Naqvi, 2018; Özbay et al., 2011; Dinçer et al., 2019f). A new and broader literature has emerged recently in this framework, emphasizing the causes and solutions of these crises in developing countries and developed countries (Jha, 2019; Dinçer, 2015). They mainly tried to understand how to prevent new financial crisis so that people and the companies will not be affected negatively (Ülgen, 2019; Naveed and Mahmood, 2019).

One of the most contagious and destructive financial crises in the recent past without doubt, was in 2007 which started in the US and spread to many developed and developing countries (DesJardine et al., 2019; Helleiner et al., 2018). The economy of some countries was threatened in such a catastrophic way that it took ages and costed fortunes for these countries to overcome this situation. Many different companies went bankrupt and a lot of people have lost their jobs (Armstrong and Read, 2018; Bell and Hindmoor, 2018). This crisis has also affected other regions of the world negatively, such as Europe. In order to overcome the negative effects of this crisis, the government has taken many different actions (Lane and Milesi-Ferretti, 2018; González et al., 2018). For instance, interest rate was lowered in order to increase the trade volume in the market (Zhang and Broadstock, 2018; Steinkamp and Westermann, 2018).

Greece is also a country which suffered from a significant financial crisis after this mortgage crisis. The main point of Greek crisis is that this country declares that it cannot pay its foreign debts. In this framework, the main problem is that Greece borrow money in an uncontrolled manner. Especially after the Euro implementation, all European Union member countries got the opportunity to borrow money at a lower cost. However, most of these countries increased the debt amount in this process without any budgeting control. Greece is an example for these kinds of countries. It is very important to understand the main indicators of this crisis in order to make necessary precautions to prevent a new crisis in the future.

In this study, it is aimed to examine major sources of the financial crisis occurred in Greece using Probit and MARS methods. While it is not possible to evaluate this crisis separately from the global economic crisis that began in the United States in the summer of 2007 and spread to the whole world, it would be a more correct approach to relate the situation predominantly to the economic background and conditions of Greece. As a consequence of this study, the goal is to determine the main indicators of Greek financial crisis. This study is significant and contributes the literature well, being the first study that analyze the Greek financial crisis with probit and MARS methods.

The organization of the paper will be as followed. After the introduction part, brief information regarding similar studies in the literature will be given. The second part will discuss possible causes and outcomes of the Greek crisis. Furthermore, in the third part, the details of the methods used in this study will be given. Moreover, leading indicators of this crisis will be identified in the application part. Last but not least, the conclusion part will consist the results of the analysis.

Literature Review

There are many studies related to financial crisis and their possible indicators in empirical and theoretical literature. Some of them are given in the Table 1.

Table 1: Studies related to financial crisis

Authors	Scope	Method	Result
Avcı and Altay (2013)	Turkey, Argentina, Thailand and England	Signal approach	Interest rate, exchange rate and increase in domestic loans are the main reason of financial crisis in mentioned countries.
Baltas (2013)	Greece	Descriptive Statistic	Volatility in growth performance, high inflation, successive currency devaluations and structural weakness trigger the financial crisis
Broome (2004)	East Asian countries	Monetary Model	Domestic stock and US prices are important factors that cause financial crisis.
Bucevska (2015)	Croatia, Macedonia and Turkey	Logit	Short term external debt and high amount of public spending are leading indicators of the currency crisis for EU candidate countries
Burkarta and Coudert (2002)	15 emerging countries	Linear discriminant analysis	The study suggests that overvaluation resulted from long-term periods, short term debt, inflation and decrease in foreign reserves are leading indicators of financial crisis.
Bustelo et. al. (2000)	Global crisis	Descriptive Statistic	According to the study, there are different causes of each financial crisis. Mexican crisis resulted from overconsumption; however, excessive investment triggered Asian crisis.
Carmassi et. al. (2009)	2007-2008 Global crisis	Descriptive Statistic	Uncontrolled monetary policy is a significant factor that cause financial crisis.
Catullo et. al. (2015)	Japan	Simulation	It is concluded that extraordinary increase in loans leads to financial crisis.
Cebeci (2012)	Turkey	Probit	Inflation, exchange rate, unemployment rate and lower GDP growth result in financial crisis.
Corsetti et. al. (1999)	Asian Countries	Descriptive Statistic	Ineffective political decisions and banking problem are the main determiners of the financial crisis.
Edison (2003)	Global crisis	Descriptive Statistic	As a result of the study, It was found that some of the indicators to determine the financial crisis are too vulnerable. These indicators are real exchange rate, high ratio of short-term debt reserves and declining equity prices. However, early warning system approach is concluded to be a diagnostic tool to predict the crisis.

Firtescu (2012)	Emerging countries	Regression	Exports, domestic credit, lending rate, government expenditure have impact on financial crisis, but FDI does not have a role in this topic.
Frankel and Saravelos (2011)	2008-2009 Global crisis	Linear Regression, Probit/Logit	International reserves and real exchange rate overvaluation are the leading determiners of the crisis.
Glick and Hutchison (2000)	90 industrial and developing countries	Probit	In the study, it was emphasized that bankig crises is assumed to be one of the indicators of currency crisis.
Hana and Al-Ghani (2016)	Jordan	Probit	Volatility in exchange rate, decrease in bank deposit and reserves lead to financial crisis.
Karmakar and Vani (2014)	USA, India and Europe	Probit	Export rate and inflation are major indicators of crisis.
Kaur (2015)	USA	Probit	Short term debt is the most effective indicator of the crisis in USA.
Kruger and Page (1998)	Developing countries	Panel Regression	While the relation between gross savings and financial crisis is positive, relation of current account deficit is inverse. Besides, external debt of a country is not found to be an indicator of crisis.
Lauridsen (2004)	Thailand	Descriptive Statistic	Non-performing loans and current account problems have significant impacts on financial crisis.
Lin (2009)	Taiwan	MDA, logit, probit, ANNs	The study concludes that the models applied in this study, are successful to predict the financial crisis, yet the probit model achieved the most accurate results.
Oktar and Yüksel (2015)	Turkey	MARS	Derivatives with speculative purposes, inflation rates, net profit and short-term foreign debt trigger tfinancial crisis.
Öztürk and Sözdemir (2014)	Greece	Descriptive Statistic	Ineffective economic, political decisions and unreliability of political institutions are important determiners of financial crisis.
Reinhart and Rogoff (2010)	European debt crisis	Descriptive Statistic	In the study it is concluded that local and regional market sentiment accompanied by worsening values of macro fundamental variables and contagion had predominantly significant effect on the origin of the European sovereign debt crisis.
Rodionov (2015)	Russia	Descriptive Statistic	Lack of proper banking control results in financial crisis.

Ruscakova and Semancikova (2016)	Europe	Descriptive Statistic	Uncontrolled fiscal policy and monetary policies lead to financial crisis.
Sztojanov and Stamatescu (2015)	Hungary	Fuzzy Logic	Credit growth, housing prices and GDP lead to crisis.
Sztojanov et. al. (2016)	Romania	Fuzzy Logic	Credit growth and real estate prices are two significant determiners of potential financial crisis.
Wade (1998)	Asian Countries	Descriptive Statistic	Asian capitalist system and debt deflation lead to financial crisis.
Yuksel and Zengin (2016)	2007-2008 Global crisis	Mars and Logit	It was concluded that non-performing loans and bank derivatives lead to crisis according to MARS method, whereas the amount of total assets and non- performing loans are the indicators of crisis based on the logit method

With respect to studies regarding the financial crisis, it is obvious that different indicators have been found for the financial crisis occurred in the past. One of the variables which has been frequently suggested is "exchange rate". Avcı and Altay (2013), Baltas (2013), Cebeci (2012), Frankel and Saravelos (2011), Hana and Al-Ghani (2016), Edison (2003) reached to a conclusion that exchange rate is an important factor for the financial crisis. They used different methods and analyzed different countries in their studies. Another important factor according to the findings of the studies is "inflation". Baltas (2013), Cebeci (2012), Karmakar and Vani (2014), Oktar and Yüksel (2015), Burkarta and Coudert (2002) indicated that inflation is an economy leads to financial crisis applying different methods.

Some of the stıdies given in the table conclude that "total assets" is a significant determiner of the crisis. Although Avcı and Altay (2013), Catullo et. al. (2015), Firtescu (2012), Lauridsen (2004), Yuksel and Zengin (2016), Sztojanov and Stamatescu (2015), Sztojanov et. al. (2016) analyzed different crisis applying divergent methods, they refer ''total loans'' as being the possible cause of the financial crisis. Furthermore, "external debt" is founded to be among the crucial variables of the financial crisis. Bucevska (2015), Kaur (2015), Oktar and Yüksel (2015), Wade (1998) involved this factor in their studies. "GDP growth" has been suggested to be the one of leading indicator of the crisis by Baltas (2013), Cebeci (2012), Sztojanov and Stamatescu (2015). Other important variables are interest rate, public spending, unemployment rate, gross savings, incorrect political decisions, unreliability of political institutions, lack of proper banking control. They are among the major factors which result in the severe financial crisis in the history.

Greece Debt Crisis

Integration process between the European Union and Greece dates back to the year when the free trade agreement was signed in 1961. Until the end of 1970s the EU was the biggest commercial partner of Greece; however, the economic development of Greece was always behind the other countries in the region. In 1981 when Greece joined the Union, per capita GDP was 68% of the EU average, which is the lowest rate after Ireland. Greece was exposed to a high level of competition from the EU countries in the first decade of membership, which combined with local populist policies that hampered efforts to secure macroeconomic stability, lowering the economic performance of the country and opening the economic gap between Greece and other countries (Othelen et. Al, 2003). In the second decade of membership, the economic performance of Greece has increased significantly following a successful macroeconomic stabilization program. Euro-zone membership required to adhere to the EU's approximation criteria for fiscal and monetary policy, and in the 1990s an external discipline was provided for Greece's economic policy. Greece has also been the most important beneficiary of the funds the EU has provided for economic and social cohesion within the framework of regional policies (Rathbun et al., 2019; Othelen et. Al, 2003).

Between 2000 and 2008, Greece's debt stock was around 100% of GDP. During this period, Greece grew by an average of 4% per annum and interest rates remained at low levels. Despite the growth in the Greek economy, fiscal imbalances have remained high for many years. For the last six years, production has increased by 40% in nominal terms and expenditures by the central government by 87%, while tax revenues have increased by only 31% in the same period. In November 2009, the announcement that the new government, which was elected in power in Greece, distorted financial data could be considered the official beginning of Greece's economic crisis (Gogstad et al., 2018; Neaime et al., 2018). The 2008 budget deficit was revised from 5% to 7.5% of GDP. At the same time, the budget deficit foreseen for 2009 was revised to 12.7% from 3.7% of GDP. In April 2010, the European Statistical Office (Eurostat) stated that Greece's 2009 budget deficit was 13.6% of GDP instead of 12.7% of the previously reported GDP, or in other words 32, 4 billion euros. The public debt ratio, estimated at 99.6% of GDP, was also revised to 115.1% of GDP at the end of 2009 (IMF, 2010; Daniel and Peters, 2018; Offe, 2018).

The Greek economy has been at a high growth rate in GDP for more than a decade. However, according to the IMF (2010), this rapid growth has two important characteristics. The first was supported by easy-to-access loans with low interest rates provided to businesses and households, along with the adoption of euro, based on substantial increases in demand. Secondly, the twin has existed with openness, budget deficit and current account deficit emerging together. This points to the lack of willingness to maintain fiscal discipline and the loose fiscal position on the external balance of the economy, accompanied by significantly competitive international competitiveness.

Greece, which is a member of the EU for more than thirty years, has long been a country with a high current account deficit, in other words the net income transfer. The current account deficit / GDP ratio in the Greek economy has remained well above the 5% level, which is considered as a dangerous limit in the literature. In 2008, the current account deficit / GDP ratio reached 16.3% and the historical record broke. Another source of Greece's high current account deficit is the continuing high foreign trade deficits of the country. As the Greek economy grew, imports grew and the gap between exports and imports widened. In the country's economy, the ratio of exports to imports has gradually decreased and the expanding foreign trade deficit has been another factor that increases the current deficit (Trebesch and Zettelmeyer, 2018).

On the other hand, Greek households have become increasingly indebted to over-consumption habits despite increased income on productivity. Loans (housing, consumer and other loans) opened up in the finance sector in Greece seem to have increased rapidly in recent years compared to previous years. The total loan volume opened in 1995 was € 4.82 billion, up 10 times from 2004 to € 51.63 billion (Athanassiou, 2007). Although the annual growth rate of lending has changed, it has generally remained close to 30% on average, and the economy increased by about 40% in 2007 compared to 2007 in the previous year (2008). A similar trend is observed in the household debt ratio. For example, "GDP grew at an average annual rate of 8% in 2000-2004 with current prices, while the household debt rate grew by 29% in the same period." (Athanassiou, 2007: 92-93). It was also influenced by the fact that households borrowed more to buy housing. As a result, they have consumed households above their income and spent more on borrowing more.

The Greek debt crisis and the future of the European Economic and Monetary Union are on the agenda of the world, with Papandreou, the ruling Greek government in October 2009, declaring that the country's public budget deficit to GDP is not actually 6.7% but 12.7% he sat at an important place. In front of the country, there were two basic options for abandoning the European Economic and Monetary Union and the second for international financial support. Greece preferred the second. The economic program for Greece, prepared for exit from the crisis, aims to restore confidence, financial stability and competitiveness and ensure the stability of the financial sector. It is foreseen that all financial and structural policies will be used to get out of the crisis. Measures to be taken within the framework of the financial aid package are mainly aimed at reducing expenditures, increasing incomes and undertaking structural fiscal reforms. As a result, while Greece is struggling to reduce its budget deficit and reduce the debt to GDP ratio, on the other hand, aims to provide the necessary conditions for economic development in the coming years, targeting ongoing structural weaknesses for a long time. Thus, Greece aims to bring new and sustainable growth to its economy by coming from the top of the current crisis (Bekiros et al., 2018).

Models Used in the Study

Probit Model

Probit is a type of regression analysis. In this approach, dependent variable has two different alternatives. Therefore, this approach is accepted very appropriate for financial crisis evaluation. The main reason is that in the crisis studies, the dependent variable is selected as the occurrence of this crisis. This means that this variable can take either 0 (no crisis) or 1 (crisis). In the literature, many different studies considered this methodology, such as Filippini et al. (2018), Meyer et al. (2019), Lacombe and LeSage (2018), Yüksel (2017), Kalkavan and Ersin (2019), Eti (2019).

Multivariate Adaptive Regression Splines (MARS) Model

The MARS method was first developed in 1991 by physicist and statistician Jerome Friedman. This method can be used when there are too many variables. The MARS method offers the best model by selecting from the candidate models. In this way, regression analysis is performed between dependent and independent variables (Friedman, 1991). In view of the above, it is possible to mention the many advantages of the MARS method. In conventional regression models, the independent variable takes place in the model once and takes a single coefficient. However, in the MARS method, these variables may take different coefficients for different conditions. In the MARS method, the ideal model is formed in two stages. First, all possible functions, also called basic functions, are generated using independent variables. The second stage is the stage from the most complex to the best. Yüksel (2016a,b), Oktar and Yüksel (2016), Yüksel et al. (2018), Dinçer et al. (2018a,b), Dinçer et al. (2019), Tunay (2001), Tunay (2011), Yüksel and Zengin (2017), Tunay (2010) and Uzunkaya et al. (2018) are some example studies in the literature in which MARS method was considered.

An Evaluation on Greece Debt Crisis

Data Set and Variables

In this study, the annual data between the years 1984 and 2016 provided from the website of World bank was used. Table 2 presents annual data of growth rate and inflation before and during the crisis.

Table 2: Inflation, GDP deflator (annual %) and Growth Rate of Greece (2003-2016)

Year	Inflation	Growth Rate
2003	3,45	5,79
2004	3,06	5,06
2005	2,24	0,59
2006	3,49	5,65
2007	3,42	3,27
2008	4,34	-0,33
2009	2,56	-4,30
2010	0,67	-5,47
2011	0,79	-9,13
2012	-0,37	-7,30
2013	-2,35	-3,24
2014	-1,83	0,73
2015	-1,02	-0,29
2016	-0,95	-0,24

Source: World Bank

It is clear in table above that the effects of crisis started to be felt in 2009 when there is a sharp decline in inflation, GDP deflator (annual %) and growth rate; however, having analyzed the data, it is also clear that the effects can still be seen in 2016. Thus, it is assumed that the crisis is between the years 2009 and 2016. Based on these findings, dependent value "crisis" takes the value "1" between the years 2009 and 2016, on the other hand, other years until 2009 takes the value of "0". Apart from the dependent variable, 8 independent variables which are supposed to be the major indicators of the crisis in the light of the literature, were analyzed in the study. Table 3 will shed light upon the details of the variables.

Table 3: Independent variables analyzed in the study

The Type of the Variables	The Name of the Variables	Reference
Macroeconomic Variables	Inflation	Baltas (2013), Cebeci (2012), Karmakar and Vani (2014), Oktar and Yüksel (2015), Dinçer et al. (2019a,b,d), Burkarta and Coudert (2002), Nonejad (2019), Fong and Leibrecht (2019), Szyszko et al. (2019)
	GDP Growth Rate	Baltas (2013), Dinçer et al. (2019e), Cebeci (2012), Sztojanov and Stamatescu (2015), Cherp et al. (2016), Dinçer et al. (2018c,d), ERsin and Baş (2019), Leimbach et al. (2017), Feldstein (2017)
	Current Account Deficit	Lauridsen (2004), Abbasoğlu et al. (2019), Ferrero (2015), Gokten and Karatepe (2016), Dinçer et al. (2019c), Fayaz and Kaur (2016), Brumm et al. (2019), Ersin (2018), Zoega (2019), Aliber and Zeoga (2019)
	Household Consumption	Bucevska (2015), Ivanova et al. (2016), Constantinides and Ghosh (2017), Di Maggio et al. (2017), Kumar and Jia (2019), Felix and Caskey (2019)
	Unemployment Rate	Cebeci (2012), Caggiano et al. (2017), Dinçer and Hacıoğlu (2017), Hall (2017), Ergeç and Ersin (2019), Kaufman (2017), Dinçer et al. (2016)
	Exchange Rate	Avcı and Altay (2013), Dinçer et al. (2015), Baltas (2013), Cebeci (2012), Frankel and Saravelos (2011), Dinçer and Hacıoğlu (2015), Hana and Al-Ghani (2016), Hacıoğlu and Dinçer (2013), Dinçer et al. (2016)
	Gross Savings	Kruger and Page (1998), Dinçer et al. (2017), Gruber and Kamin (2015), Dinçer and Yüksel (2018), Wan (2015), Ersin and Eti (2017)

In the study, 8 independent variables were used all of which are macroeconomic variables with the aim of predicting the leading indicators of the Greek crisis. The first variable is the USA crisis since the 2008 financial crisis, originating from the USA, affects the entire financial and real sector, as well as being the country attracting the most foreign capital from international markets, where capital flows have been increasingly liberalized since the 1980s has been transformed into a global crisis by the influence of the size of the economy. (Taylor, 2009). For this reason, it is expected that there is a positive relationship between the USA crisis and the Greek Crisis. Furthermore, the value "1"is given to the years 2008 and 2009, the rest was valued as "0" in the USA crisis data. On the other hand, other variables which is expected to have positive relation with the Greek Crisis are exchange rate, inflation, unemployment and current account deficit. When the values in these variables increases, the crisis is predicted to be more severe. On the contrary, the relation of household consumption, gdp growth rate, gross savings with the crisis is expected to be negative. As the values in these independent variables decrease, the risk of a possible crisis is supposed to increase.

Analysis Results with Probit Method

As it was previously mentioned, 8 variables are used to determine the significant meters of Greek Crisis. Although there was not any multicollinearity problem in the application process, all the variables applied are not significant to explain the dependent variable. All the details regarding the analysis were given in Table 4.

Table 4: The Results of Probit Analysis

Independent Variable	Coefficient	Significance
Exchange Rate	1.25	0.9125
Gross Savings	-0.074	0.0029
Gdp Growth Rate	-0.005	0.9817
Inflation	0.037	0.0027
Household Consumption	-0.007	0.7535
Unemployment	0.024	0.1021
Current Account Deficit	0.018	0.3507
Dependent Variable: Greek crisis		
Adjusted R-squared: 0.88		

In the Table 4, it can be deduced that only 2 variables whose probability values are below "0.05" are statistically important to indicate the financial crisis. Inflation has the most significant value to explain the crisis. Since its coefficient is 0.037, the relation between this variable and the financial crisis is direct. Namely, when the inflation goes up, the economy of that country starts to fluctuate. Moreover, it was seen in the table that "Gross Savings" is an important independent variable that signals the possibility of a financial crisis. The coefficient value of this variable is -0.074, so it proves the inverse relationship between the financial crisis and gross savings. It means, when the gross savings of a country declines, the risk of the financial crisis starts to threaten economies. It can also be assumed that less savings resulted from the high current account deficit and this situation drags the economies into a recession. Additionally, this table also demonstrates that the value of Adjusted R-squared is 0.88. It states that the dependent variable of this study "the Greek financial crisis" can be explained by %88 in this study.

Analysis Results with MARS Method

In the first stage of MARS analysis, all possible models are created by the system. In this circumstance, it is defined that 9 different methods are produced which are given on Table 5.

Table 5: All Possible Models

Basis Functions	Total Variables	Direct Variables	Effective Variables	GCV	GCV R-Square
9	4	4	28.000	0.071	0.636
8	4	4	25.000	0.028	0.856
7	4	4	22.000	0.016	0.920
6	4	4	19.000	0.010	0.949
**5	3	3	16.000	0.008	0.957
4	3	3	13.000	0.010	0.950
3	3	3	10.000	0.009	0.953
2	3	3	7.000	0.015	0.921
1	2	2	4.000	0.021	0.891

Table 5 states that the model that has 5 different basis functions is accepted as the best model. It has 3 different variables, lowest GCV and highest GCV R-Square values. The details of this model are shown on Table 6.

Table 6: The Details of the Best Model

N: 33.000			R-SQUARED: 0.988		
MEAN DEP VAR: 0.242			ADJ R-SQUARED: 0.986		
UNCENTERED R-SQUARED = R-0 SQUARED: 0.991					
PARAMETER		ESTIMATE	S.E.	T-RATIO	P-VALUE
Constant	|	0.002	0.012	0.185	0.855
Basis Function 2	|	0.043	0.010	4.127	.315681E-03
Basis Function 3	|	0.021	0.002	9.194	.835372E-09
Basis Function 5	|	-0.032	0.006	-4.934	.363897E-04
Basis Function 8	|	-0.007	0.001	-6.028	.196282E-05
Basis Function 9	|	0.012	0.003	4.392	.155920E-03
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F-STATISTIC = 443.520			S.E. OF REGRESSION = 0.052		
P-VALUE = .999201E-15			RESIDUAL SUM OF SQUARES = 0.073		
[MDF,NDF] = [5, 27]			REGRESSION SUM OF SQUARES = 5.988		

Table 6 gives information that all 5 different basis functions are significant because their p values are lower than 0.05. Additionally, the p value of F statistic is also lower than 0.05. This situation explains that the model is statistically significant. Another important factor is that adjusted R-Squared value is 0.986. This situation states that this model is so successful that it can explain the debt crisis in Greece 98.6% correct. Table 7 indiates the details of the basis functions.

Table 7: The Details of the Basis Functions

BF2 = max (0, 15.552 - SAVING)
BF3 = max (0, CURRENT ACCOUNT BALANCE+ 14.476) * BF2
BF5 = max (0, - 6.229 - CURRENT ACCOUNT BALANCE)
BF8 = max (0, UNEMPLOYMENT - 7.024) * BF2
BF9 = max (0, UNEMPLOYMENT - 7.024) * BF5

Table 7 gives information that 3 different variables mainly explain the debt crisis in Greece. According to basis function 2, there is negative relationship between saving amount and this debt crisis. This situation mainly shows that when there is uncontrolled consumption, it has a negative influence on the performance of the Greek economy. In order to have more sustainable economy, the saving ratio should be higher than 15.5%. In addition to this variable, basis functions 3 and 5 define that there is also negative relationship between current account balance and debt crisis. In other words, in case of high current account deficit, Greece has an enourmous risk of financial crisis. According to the results of the MARS method, higher current account deficit ratio than 14.47% is accepted as the significant indicator of the financial crisis. Finally, it is determined that unemployment ratio positively affects financial crisis. Table 7 shows that when this ratio exceeds 7.024%, it should be acceoted as a leading indicator of the financial crisis.

Comparison of Probit and MARS Results

The findings of the study show that both probit and MARS approaches underline the importance of different variables for Greek debt crisis. With respect to the adjusted R-Squared ratio, it can be seen that MARS is more successful than the probit to explain this crisis. Graph 1 compares the analysis results of probit and MARS according to Greek debt crisis.
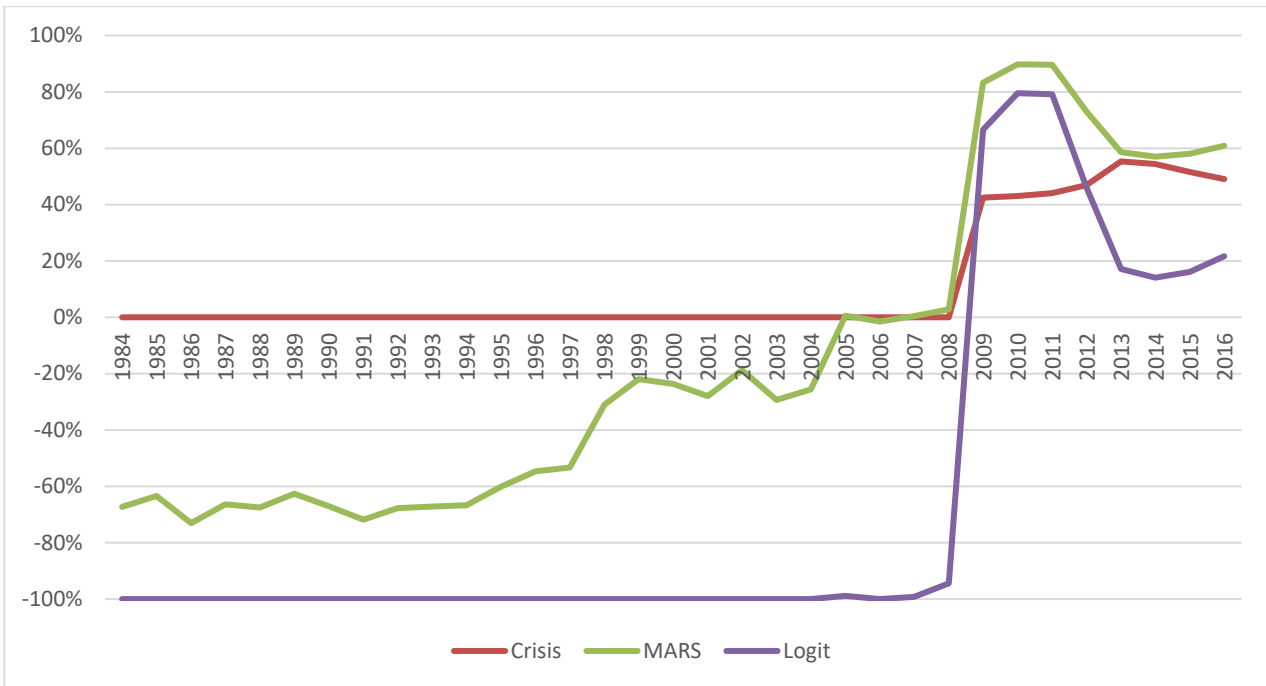
Graph 1: Comparison of MARS and Probit for Greece Debt Crisis

Graph 1 illustrates that MARS method is much more successful than the probit model in order to predict the Greece debt crisis.

Conclusions

The economic crisis in Greece is at risk of spreading to other countries. Since the effect of a particular policy on the budget of a country depends on foreign trade, interest rates and exchange rate it can infect other countries. The fact that most of Greece's public borrowing belongs to foreign creditors strengthens its spreading effect. Actually, Greece, a thirty-year-old EU member, has settled on both the EU and the world agenda with the sovereign debt crisis. Although Greece has a small share in total output, the Greek debt crisis has almost turned into Euro Zone debt crisis. In the literature, the early warning system has been proved to be a beneficial tool to predict the crisis. Therefore, In this study, I tried to find out the leading indicators of the Greek crisis which started in 2009. In order to achieve this objective, 8 variables were utilized. In addition, annual data of Greece between the years 1984 and 2016 were analyzed with Probit and MARS methods.

 As a result of the analysis with Probit method, only 2 variables were found to be meaningful to explain the Greek crisis. The main determiner of the Greek crisis is inflation which occurs as a result of the gap between the amount of money in circulation and sum of goods that can be purchased. The simplest definition is the continuous increase in the general price level and the decline in the value of money, and the fact that the total goods and service offer cannot meet the total demand, in other words, the imbalance can be regarded as the main feature of inflation. Once the inflation starts to increase, the risk of a possible crisis starts to be a threat for the economies. According to the findings, second significant indicator is gross savings that can be defined as the sum of the value of a country's total of goods and services produced for a given year, against a certain currency. Namely, when the value of a country's goods and services declines dramatically, financial crisis gives the alarm in that country.

On the other side, according to the MARS results, 3 different variables are identified as the indicators of the debt crisis in Greece. First of all, saving amount has a negative influence on the financial crisis. That is to say, in case of high and uncontrolled consumption, there is an important risk of the financial crisis for Greece. Another important indicator of this debt crisis is current account deficit. When the ratio of the current account

deficit to GDP exceeds 14.47%, it is accepted as the crucial indicator of the financial crisis. Furthermore, when unemployment is higher than 7.024%, it leads to financial crisis for Greece. By comparison these two different results, it is determined that MARS provide better results than probit to predict this crisis. While considering these results, it can be strongly recommended that saving ratio should be higher. In this circumstance, governments should take some actions in order to increase this ratio more than 15.5%. Media channels can be used by the government to tell the people about the importance of the savings to have sustainable economic development.

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