Determinants of Debt Crisis in EU and the Recovery Efforts

Öztürk, Mustafa and Aras, Osman Nuri and Kadı, Filiz

2012

DETERMINANTS OF DEBT CRISIS IN EU AND THE RECOVERY EFFORTS

Mustafa ÖZTÜRK
Dr., Fatih University
Fatih Üniversitesi 34500 Büyükçekmece/İstanbul
mozturk@fatih.edu.tr

Osman Nuri ARAS
Associate Professor, Fatih University
Fatih Üniversitesi 34500 Büyükçekmece/İstanbul
onaras@fatih.edu.tr

Filiz Salih KADI
Dr., Fatih University
Fatih Üniversitesi 34500 Büyükçekmece/İstanbul
mozturk@fatih.edu.tr

Abstract

European Union has taken economic and financial measures to cope with the debt crises erupted in 2009. These measures can be summarized as putting in place a bail-out mechanism and austerity measures, strengthening economic policy coordination, setting up "Stability and Growth Pact III" and the establishment of a system of macro-economic surveillance, introducing the "Euro Plus Pact" for closer economic coordination of euro-zone countries and the establishment of a permanent European Stability Mechanism (ESM).

Will the European Union be able to master the debt crises? To answer this question, we will examine the economic and financial determinants of the crises. Moreover we will discuss how effective the economic and financial measures taken for the recovery of EU countries.

Key Words: Debt, Debt Crisis, Managing the crisis, European Union, Member States, Macroeconomic Stabilisation

JEL Classification: E62, E630, F550, H630

1. INTRODUCTION

Global financial crisis which was erupted in the US mortgage market has spilled over to the European Union. Some countries such as Greece, Spain, Italy, and Portuguese were very fragile because of heavy debt stock. These countries couldn't have coped with the global financial shrinkage and stuck in a deep debt

crisis. The crisis in European Union started in Greece in 2009 and spilled over to the Ireland, Portugal and Spain (Constâncio: 2012). Policy makers had to take measures to prevent the crisis ruin the real sector of these countries and to suppress further spreading. The rescue package which is 110 billion euros in size put in application for Greece in may 2009 and the European stabilisation mechanism was established and 750 billion euros was alloted for bailing out the countries likely to fall in insolvency. Aiming to safeguard financial stability in Europe by providing financial assistance to euro area Member States, European Financial Stability Facility (EFSF) created by the euro area member countries. However this mechanism do not provide an adequate basis for dealing with any possible future debt crises in the euro area.(EFSF, 2012) In October 2011 and February 2012, additional measures taken to prevent the collapse of member economies. 53.5% of Greek debt owed to private creditors deleted. EFSF increased to about €1 trillion, to restore confidence in Europe(Grinkevich:2012). A part of the Treaty on Stability, Coordination and Governance (TSCG) European Fiscal Compact aiming the member countries implement new budget rules was accepted. The European Central Bank has lowered interest rates and provided cheap loans amounted more than one trillion Euros to the weaker banks (European Comission). To cope with debpt crisis Greece, the Republic of Ireland and Portugal have all received massive bailouts from the EU and International Monetary Fund. The EU member states aim to cut deficits to a maximum of 3% of GDP by the financial year 2014-15 (BBC:2012).

Although there have been some measures taken by the member countries and the European Central Bank, the recovery does not seem in the near future. Structural reforms are needed for the conclusive solutions. Member states should focuse on main factors causing the government's borrowing. (Marshall: 2012) But the structural reforms are painful and the results can be obtained in the long run. On this way this study aimed to analyze macro economic factors that affect the debt stock of the member countries.

2. Data Set and Method

Although there was some kind of recovery efforts, the countries in the debt crisis couldn't have found effective and applicable solution. It seems that the recovery is painful and takes the time. The first step for revival is to determine the proper economic measures to reduce the debt stock. With this aim, the years between 2000 and 2012 have been analysed in three-month segments and government debt stock has been analysed with macro economic indicators of euro zone. After detecting the data affects the debt stock whether the data are influential on

reducing the debt stock have been searched for. Analyses eviews 6.0 packet programmes and VAR model were used for that.

Table. 3. 1 Macro Economic Variables Used in the Model

Variables	Code of Variable	Type	Definition
Government Debt (as a percent of GDP)	govdebt1sa	Endogenous	Seasonal Adjusted Stationary
GDP (economic growth)	gdp	Endogenous	Seasonal Adjusted Stationary
Industrial Production Index	industprod1	Endogenous	Seasonal Adjusted Stationary
İmport	import1	Endogenous	Seasonal Adjusted Stationary
Export	export1	Endogenous	Seasonal Adjusted Stationary
Inflation	Inflationsa	Endogenous	Seasonal Adjusted Stationary
Unimployment Rate	Unimploymentsa1	Endogenous	Seasonal Adjusted Stationary
Labour Productuvity	Laborproduct	Endogenous	Seasonal Adjusted Stationary

The series in the model have been selected as quarter periods from European Central Bank data warehouse and they include the periods between the first quarter of 2000 (2000Q1) and the second quarter of 2012(2012Q2). All series that are subject to analyse have been composed of precise periodic values. In the first step, it was analysed if the series contains unit root or not by the help of Augmented Dickey Fuller and Dickey Puntola tests. The unit roots ones are bowdlerized of root. After that, by using seasonal dummy it was deseasonalized. In the third phase, optimal lag values for the model have been determined with information criteria. In the fourth step, relations between series and their directions were detected by Granger causality test. In the fifth phase, VAR (Vector Auto Regressive) model was formed for the forecast of relations of government debt stock and reel macro economic data. In the sixth phase, relations between variables were analysed by establishing cause and effect functions.

3. Model Determination and Analyses

3.1. VAR (Vector Auto Regressive) Model

Description and analyses of engagements between macro economical variables, forecasting the future is significant. However, engagements are mostly mixed and multi dimensional. The direction of the relation between variables, detection of dependent and independent variables may be difficult. For this reason, simultaneous equation systems are required. VAR Model (Vector Auto Regressive) is a model in which many variables are included in the analyses with their past values and each equation is settled out by the method of least-square method (Gujarati 2009:747). They have been developed for analyses of simultaneous equation system. In this type of models, there are no boundries of

in-out division. This model puts all variables under operation at the same time and analyses in integrity. Variables can be used even if they are not stabile at the same level. It is a cause of choice in time series analyses for the reason that there are no restraints and it allows analyses of dynamic relations. The fact that laged values of dependant variables are included in the model paves the way to strong anticipations of the future (Baltagi 2008:360-361). Based on two endogenous variables, namely Y1 and Y2, VAR Model can be formulated as following general equation (Agung, 2009:323-324):

$$Y1_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1j} Y1_{t-j} + \sum_{j=1}^{k} \delta_{1j} Y2_{t-j} + \mu_{1t} \qquad Y2_t = \alpha_2 + \sum_{j=1}^{k} \beta_{2j} Y1_{t-j} + \sum_{j=1}^{k} \delta_{2j} Y2_{t-j} + \mu_{2t}$$

In the model, α is constant term, k is lag length, μ is error term. In VAR model the average of error terms is zero. Covarians with laged values is zero. Variances are constant. They are in normal distribution and stochastic. It is assumed that there is no relation between errors and their laged values but this doesn't mean a restraint to the model. Otocorelation problem may be eliminated by increasing lag length of variables. However, in the condition of errors' being in relation to each other (the correlation between them is different from zero), change in one of the errors affects the other in a certain amount of time. There is no relation between error terms and variables on the right of the model. On the right handside of the model, there are laged values of inner varibles and there isn't the problem of simultaneouty. This allows the equations in the model to be settled out with least squares method.

3.2. Stationarity

Stationarity is a variable's avarage, variance and otocovariance's being stationary in time. Serie's stationarity is important in time series which follows a stocastic period. In stationary series, possible fluctiations will be temporary. The impact of fluctiations will decrease gradually and serie will be back to long term avarage level. In nonstationary series, there will be no long term avarage that the serie can go back after the flucitations. Series' stationarity is determined by unit root test. Expanded Dickey Fuller (ADF) tests are used for this.

$$\Delta X_t = a + \alpha X_{t-1} + \beta \sum_{i=1}^{m} \Delta X_{t-i} + e_t \qquad (1)$$

$$\Delta X_t = a + bt + \alpha X_{t-1} + \beta \sum_{i=1}^{m} \Delta X_{t-i} + e_t \qquad (2)$$

Equations numbered (1) and (2) are the regression equations which are used for Dickey Fuller test. Number (1) is an equation with a stationariy but without a trend, and number (2) is an equation with both a stationariy and a trend. In number (1) equation H_0: α =0 hypothesis and in number (2) equation H_0: b =0

hypothesis is tested for unit root test. If H_0 is rejected, X_t serie is stationary, if not rejected it is not stationary (Bozkurt 2007:27–45). Acoording to the results of ADF unit root test, series are analysed to see if they have unit root on peg and this is done looking at %1, %5 and %10 significance levels. Once the unit root is found, difference is taken and evaluated out of the unit root (Sevuktekin 2010:305-315).

Table. 3.2. Stationarity of Variables

Code of variable	Without trend				With trend			
	τ	%1	%5	%10	τ	%1	%5	%10
govdebt1sa	-7,50	-2,62	-1,95	-1,61	-7,41	-4,17	-3,50	-3,18
gdp	-3,50	-2,61	-1,95	-1,61	-4,22	-4,16	-3,51	-3,18
industprod1	-3,49	-2,61	-1,95	-1,61	-3,41	-4,16	-3,50	-3,18
import1	-3,45	-2,61	-1,95	-1,61	-3,59	-4,16	-3,51	-3,18
export1	-3,18	-2,61	-1,95	-1,61	-3,37	-4,16	-3,51	-3,18
Inflationsa	-3,68	-2,61	-1,95	-1,61	-3,64	-4,16	-3,51	-3,18
Unimploymentsa1	-5,73	-2,61	-1,95	-1,61	-5,63	-4,16	-3,51	-3,18
Laborproduct	-3,88	-2,61	-1,95	-1,61	-4,24	-4,16	-3,51	-3,18
Number 1 in codes of variable shows that the first level difference of that serie is taken.								

Dickey Fuller Test was tested on %5 significance level with variables subjected to analysis. While the test was being carried out, it was tested automatically using Schwarz Info Criterion option since it was unknown if the error term was with autocorrelation. First differences of nonstationary ones were differed from the unit root by taking I(1).

3.3. Lag for VAR Analysis

Lag lengths for VAR analysis were specified being dependent on LR, FPE, AIC, HQ, SC criteria in table 3.3 and via autocorrelation LM, heteroscedasticity White and normal distribution Jargue-Bera tests. The smallest lag level, where there is no autocorrelation (as LM probability values more than 0,05), no heteroscedasticity (as White test Joint probability value more than 0,05) and there is normal distribution (as normality probability values more than 0,05), is 1 according to LR, FPE, HQ, SC critical value.

Table. 3.3. VAR Lag Order Selection Criteria

Endogenous variables: GOVDEBT1SA GDP INFLATIONSA LABORPRODUCT INDUSTPROD1 EXPORT1 IMPORT1 UNIMPLOYMENTSA1						
Exogenous variables: C DVU			Sample: 2000Q1 2012Q2		Included observations: 45	
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-338.6976	NA	0.000970	15.76434	16.40671	16.00381

1	-133.6229	319.0052*	1.95e-06*	9.494349	12.70619*	10.69169*
2	-66.40324	80.66354	2.32e-06	9.351255	15.13258	11.50647
3	10.24527	64.72541	3.33e-06	8.789099*	17.13989	11.90219
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error AIC: Akaike information criterion. SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

3.4. Causality Test

While the relations between variables are studied, two things are aimed at: one is whether there is a connection between variables and if yes, in which direction; two is on which length of lag the connection might be taking place. Granger (1969) causality test is a test done for this purpose (Gujarati 2009, 699-702).

$$y_t = \alpha_0 + \sum_{i=1}^{n} \beta_i x_{t-i} + \sum_{i=1}^{n} \gamma_i y_{t-i} + u_i \qquad (3)$$

$$x_t = \alpha'_0 + \sum_{i=1}^{n} \theta_i y_{t-i} + \sum_{i=1}^{n} \lambda_i x_{t-i} + u_i \qquad (4)$$

Through the causality test symbolised with the equations numbered (3) and (4), how the variables x and y affect each other is found. With the components of x added to the model, it gets clearer if x causes changes on the future values of variable y. The same is applied for y with a parallel reason. It is necessary that the variables x and y are stationary or to be made stationary to conduct the Granger causality test. If the variables are not stationary, a false causality will be observed. The causality which appears as a result of fake regression is a sign of simultaneous correlation.

Granger Causatility Test was conducted for the reasons such as testing the correlation between Government Debt Stock and macro economic data, and identifying which variables affected each other in what direction. Import, export, gross domestic product, labour productivity, industrial production and unemployment rate have a one-way influnce on the government debt stock. Inflation unilaterally affects government debt stock.

Table. 3.4. Granger Causality Test for Government Debt Stock and Macroeconomic Indicators

Sample: 2000Q1 2012Q2 Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
IMPORT1 does not Granger Cause GOVDEBT1SA	46	5.16605	0.0100
GOVDEBT1SA does not Granger Cause IMPORT1		0.51447	0.6016
INFLATIONSA does not Granger Cause GOVDEBT1SA	46	3.93912	0.0272
GOVDEBT1SA does not Granger Cause INFLATIONSA		3.37896	0.0438
EXPORT1 does not Granger Cause GOVDEBT1SA	46	5.72104	0.0064
GOVDEBT1SA does not Granger Cause EXPORT1		0.50287	0.6085
GDP does not Granger Cause GOVDEBT1SA	46	4.48728	0.0173
GOVDEBT1SA does not Granger Cause GDP		0.68486	0.5098
LABORPRODUCT does not Granger Cause GOVDEBT1SA	46	1.96419	0.1532
GOVDEBT1SA does not Granger Cause LABORPRODUCT		0.69554	0.5046
INDUSTPROD1 does not Granger Cause GOVDEBT1SA	46	6.41907	0.0038
GOVDEBT1SA does not Granger Cause INDUSTPROD1		0.91485	0.4086
GOVDEBT1SA does not Granger Cause UNIMPLOYMENTSA1	46	2.08566	0.1372
UNIMPLOYMENTSA1 does not Granger Cause GOVDEBT1SA		3.80782	0.0304

3.5. Rating of Variables

Rating the variables used in VAR method is applied for impulse-response functions which are used to specify the reactions of the variables to shocks. Rating should be from exogenous to endogenous. Assigning the correlation between exogenous and endogenous is done in connection with the reactions that variables give to temporary shocks. Whereas the most exogenous doesn't react against the shocks stemmimg from other variables, the most endogenous reacts against shocks both from others and the ones coming from itself. Rating the variables is mostly decided through Granger Causation Analysis. In Cholesky decomposition, impulse-response functions may change when the variables are rated differently (Güloğlu 2010:3). A correct rating must take place if the aim is a successful analysis of the reactions of variables to shocks. In this study, variables are rated from exogenous to endogenous using Granger Causation Test. Rating of variables is as follows; import, export, gross domestic product, labour productivity, industrial production and unemployment.

3.6. Impulse-Response Functions

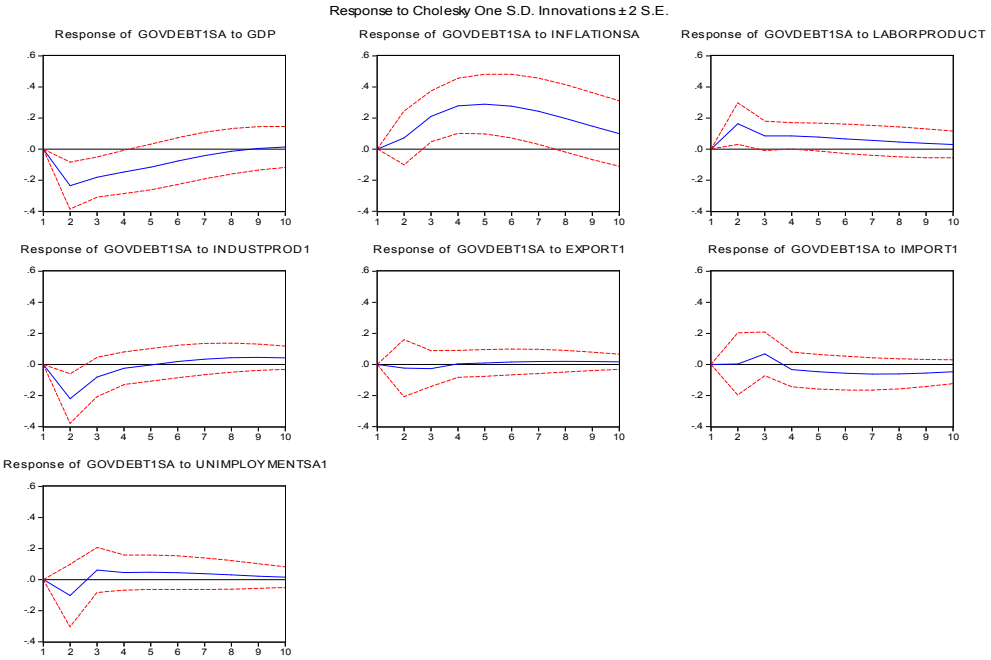
Impulse-Response functions show how effective a standard deviation shock seen in one of the random error terms of VAR model findings might be both in the present and future values of endogenous variables. This decides whether the most effective variable could be used as a political tool or not. Cholesky decomposition is one of the common methods used in defining impulse-response coefficients, verticalising errors and diagonalising the acquired variance-covariance matrix

(Phillips, Tzavalis 2007: 356-357). Moving average method is one of the useful ways to analyse the mutual interactions between x_t and y_t series. ϕi coefficients are used to generalize the impacts of shocks in ε_{xt} and ε_{yt} on the series of x_t and y_t. Four elements of ϕjk (0) matris are influence values (Bozkurt 2007:94-98).

$$\begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} \overline{y}_t \\ \overline{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{xt-i} \\ \varepsilon_{yt-i} \end{bmatrix}$$

For instance, ϕ_{12} (0) shows the impact of a unit shock in ε_{yt} on x_t serie. Again, it shows, respectively of ϕ_{11} (1) ve ϕ_{12} (1), the impact of a unit shock in ε_{xt-1} and ε_{yt-1} on x_t serie. Cumulative actions of ε_{xt} and/or ε_{yt} term are acquired through impulse-response functions' sum of coefficients that their indexes match. For instance, it should be known that the item ϕ_{12} (n) is the result of the impact of ε_{yt} variation on x_{t+n} after an n term. Therefore, the total of cumulative actions of the term ε_{yt} on x_t serie after an n term is $\sum_{i=0}^{n} \phi_{12}(i)$. Long term influence value is acquired when n stretches into infinity. Since the series x_t and y_t are accepted static, the sum of $\sum_{i=0}^{n} \phi_{jk}^2(i)$ for all j ank k conditions is finite. Impulse-response function is the name given to ϕ_{11} (i), ϕ_{12} (i), ϕ_{21} (i) and ϕ_{22} (i) coefficients. Whether macroeconomic variables have an impact on government debt stock was analysed through causation test in previous part. In this section, on the other hand, disposability of government debt stock as a political tool was tried to test using the impulse-response analysis. Vector Moving Average (VMA) display format was used in order to show the possible reactions of data to a standard deviation shock which may take place in government debt stock through impulse-response analysis. Results were shown in figures 3.1. In the graphics of impulse-response analysis, centerline shows point estimates and bottom and over lines show confidence interval of a standard error. In figure 3.1. reaction shown by government debt stock to a shock of standard deviation in import, export, gross domestic product, labour productivity, and industrial production and unemployment indexes is shown. Reactions given could be outlined as follows;

Figure 3.1. Impulse-Response Function



GDP negatively affected the government debt stock until the end of the second term. However, after the second term it couldn't put a recognizable impact.

Inflation positively affected the government debt stock from the beginning of third term to the end of the seventh term. However, after the seventh term it couldn't put a recognizable impact

Labour productivity positively affected the government debt stock until the end of the second term. But, after the second term it couldn't put a recognizable impact.

Industrial production index negatively affected the debt stock until the end of the second term. However, after the second term it couldn't put a recognizable impact.

No significant connection between export and debt stock could be identified.

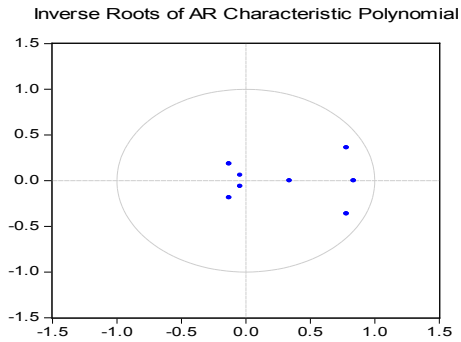
No significant connection between import and debt stock could be identified.

No significant connection between unemployment rate and debt stock identified.

3.7. Stablity Test of VAR Model

Stablity should be tested after the model is set up. Stablity of the model depends on eigenvalues of coefficient matrix. System gets stationary once all eigenvalues of coefficient matrix exist within unit circle. When the eigenvalues of coefficient matrix exist outside the unit circle, then the system is not stationary. This means that it is because of the facts that since all the eigenvalues of coefficient matrix are in the circle unit that the model is stationary.

Figure 3.2 Stablity Test for VAR Model



3.8. Autocorrelation Test of VAR Model

Table. 3.3. VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h					
Sample: 2000Q1 2012Q2			Included observations: 47		
Lags	LM-Stat	Prob	Lags	LM-Stat	Prob
1	79.55361	0.0910	7	59.57657	0.6335
2	71.16970	0.2515	8	62.61215	0.5257
3	82.95807	0.0557	9	49.46807	0.9094
4	98.98526	0.0633	10	46.43124	0.9518
5	70.60298	0.2666	11	51.11752	0.8781
6	58.73616	0.6625	12	66.32131	0.3968
Probs from chi-square with 64 df.					

In order to testify whether VAR model involved a problem in structural meaning, Autocorrelation Test – LM was conducted. The test, which was applied to specify whether the error terms found in VAR model were connected, reveals that there is no autocorrelation for 12 lags.

3.9. Heteroscedasticity Test

Chi-Square value shows there is no heteroscedasticity problem in the model predicted. In other words, it reveals the fact that error term variance is the same for all observations. It can be seen that there is no heteroscedasticity according to the results of white heteroscedasticity test.

Table. 3.4. Government Debt Stock and White Test for Macro Economic Variables

Chi-sq	df	Prob.
605.5662	576	0.1905

3.10. Structural Break Test

Conducting Chow Breakpoint test, it was attempted to study whether there was a structural break in the model and break was identified in first quarter of 2010. Dummy variable for breakpoint inserted to the model.

CONCLUSION

In the analysis, negative relationship between government debt stock and GDP and industrial production index determined. The increase in industrial production and GDP has an effect on reduction of the government debt stock. Increase in industrial production and national income ensures the growth of tax base and thus allows for an increase in tax revenues. However, the policy being implemented at the moment is to increase fiscal discipline more. Countries in debt crisis were insufficient and failed to take fiscal measures. Reactions from the public are very high. The measures taken restrict the economy and increase the unemployment. In these circumstances although there were attempts to fix the budget deficit and to reduce the debt stock, economic recession will cause to the reduction in tax revenues and led to a debt crisis become inextricable.

There is a pozitive relationship between inflation and public debt. In this case, an increase in inflation will adversely affect the debt stock. In inflationary conditions borrowing costs will increase and the debt stock of the countries that have to borrow will gradually grow. However, monetary expansion in the euro zone seems to escalate inflation in the medium term. If the current monetary and fiscal policies fail to provide economic recovery, possibility of inflation risk in euro zone will be negatively reflected to the crisis. Economies which plan to reduce the debt stock should also realize healthy and sustainable growth. And also they should fight inflation and provide price stability.

BIBLIOGRAPHY

Agung I Gusti N. (2009) Tıme Series Data Analysis Using Eviews, Singapore:Wiley

Baltagi Badi H. (2008). Econometrics, Berlin: Springer.

BBC (2012). EU austerity drive country by country, http://www.bbc.co.uk/news/10162176[12.08.2012]

Bozkurt, H. (2007). Zaman Serileri Analizi, İstanbul: Ekin Kitabevi

Constâncio, V. (2012). Contagion and the European debt crisis, Public Debt, Monetary Policy And Financial Stability, Financial Stability Review, No. 16, http://www.banque-france.fr/fileadmin/user_upload/banque_de_france/publications/Revue_de_la_stabilite_financiere/2012/rsf-avril-2012/FSR16-article-10.pdf [25.09.2012]

European Financial Stability Facility, (2012), http://www.efsf.europa.eu/attachments/faq_en.pdf[23.08.2012]

Gujarati D. N. (2009). Temel Ekonometri, İstanbul: Literatür Yayıncılık.

Güloğlu, B. Vektör Otoregresif Modellerin Etki Tepki Fonksiyonlarının Güven Aralıklarının Güvenirliliği, http://www.ekonometridernegi.org/bildiriler/o15s1.pdf s.3 [18.08.2010]

Marshall, A. G. (2012) Austerity, Adjustment, and Social Genocide: Political Language and the European Debt Crisis, http://andrewgavinmarshall.com/2012/07/24/austerity-adjustment-and-social-genocide-political-language-and-the-european-debt-crisis/ [26.09.2012]

Phillips Garry D. A. Tzavalis E. (2007). The Refinement of Econometric Estimation and Test Procedure, Cambridge University Press

Sevüktekin M. Nargeleçekenler M. (2010). Ekonometrik Zaman Serileri Analizi, Ankara: Nobel Yayın Dağıtım.

Six-pack? Two-pack? Fiscal compact? A short guide to the new EU fiscal governance, Economic and Financial Affairs, European Comission, http://ec.europa.eu/economy_finance/articles/governance/2012-03-14_six_pack_en.htm[10.09.2012]

Vlad Grinkevich(2012), Europe's Financial Pill Won't Cure Greece, Ria Novosti , http://en.rian.ru/analysis/20120222/171450607.html[12.09.2012]