

The Abstract from Master Thesis_Empirical Analysis done in Stata
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The Impact of Austerity Measures on the Economic Growth in the Eurozone

1. The Research Problem

The concepts for overcoming the crisis in the Eurozone, which has begun with the “trigger” in Greece in 2010, relied on help mechanisms directed toward the most affected countries. In order to get these help packages, a Eurozone country member should have applied a strict austerity measures which were previously defined. There were two such concepts:

- 1) Austerity concept and
- 2) Consumption concept.

The creators of austerity concept and internal devaluation¹ believed that these politics could bring the needed reduction of wages and prices. According to this theory, austerity reduces aggregated demand and increases unemployment. On contrary, it is expected that a higher unemployment would reduce nominal wages. It is also expected that prices will decrease as a result. The goal is to decrease prices in countries with trade deficit (as opposed to the countries with suficit), so their competitiveness would improve.

However, these two politics (austerity measures and internal devaluation) do not have success in the Eurozone countries because of the rigid labour market. Consequently, higher unemployment does not lower nominal wages in expected amount. Furthermore, there is not enough competition in the market of goods of countries with deficits, so the prices do not decrease correspondingly with the fall of nominal wages.

These belt-tightening measures are completely opposite to the theory of John Maynard Keynes. Keynes addressed that increasing the consumption stimulates the economy. He knew that economy could not survive without new employments.² So, the austerity measures and respect of fiscal criteria is contrary to Keynes’s central point that the right time for savings is the time of growth, not the time of crisis. The austerity measures were defined in the first semester of 2010, beginning with the crises in Greece.

2. The Purpose of Research

The aim of this research study is to answer the key question of analysis. Have the fiscal austerity measures impacted a further decrease of GDP in the Eurozone countries, who applied them as

¹Wood R., “Eurozone Macroeconomic Framework: Reducing Internal and External Imbalances”, MPRA Paper No. 53569, (2014), p. 9.

²Stiglic Dž. E., „Slobodan pad“, Budućnost, Novi Sad: Akademska knjiga, (2013), 272. str.

the measures for overcoming the debt crisis? In other words, have these measures caused even higher unemployment rate, which rocketed in 2013 with a level of 12%?

The research purpose is to analyse cross-sectional data and two variables: GDP and budget balance in the Eurozone countries. 16 countries are included in the analysis, out of 19 Eurozone countries in total. (Estonia i Cyprus are omitted due to lack of data, while Litvania has become a Eurozone member on 1st January 2015³).

3. The Definition of Hypothesis

A research hypothesis is a potential solution of the research problem. It is a testing hypothesis, which is defined as “If-Then” form:

H₀: If these is an impact of austerity measures on GDP rates, then these measures would cause further decrease of GDP rates in the Eurozone countires.

By defining the zero hypothesis, we have a clear direction of the study. The purpose is to get the results and conclusions of accepting or declining previously defined testing hypothesis.

4. The Empirical Research

1) The Research Methods, Data and Research Sample

In order to dermine the impact of austerity measures on economic growth rates, the econometric software called Stata⁴ is used, version 13.0. The applied analysis is a cross-sectional data analysis, method of least ordinary squares. There are two chosen variables, the dependent one which refers to GDP rates (accumulated growth GDP rates from 2009 to 2014) and the independent one which is related to structural budget balance (difference between the balance at the end of 2014 and 2019). The focus is on the relation between two variables, or in other words, what kind of impact independent variable has on dependent variable. It is crucial to have in mind the quality of econometric model and for this purpose we use different tests of model specification. In the next table, dependent and independent variables are presented, their way of measure and data sources.

³http://ec.europa.eu/economy_finance/euro/adoption/who_can_join/index_en.htm, 19:21, 20.06.2015.

⁴Stata is software package for statistical data analysis. See more at: <http://www.stata.com>

Table 1 The overview of defined variables, metrics and data resources

Name of Variable	Type of Variable	Unit of Measure	STATA Codification	Metrics	Data resource
Economic Growth	Dependent	% GDP annual growth	GDP	Accumulated % growth of real GDP from 2009 to 2014	International Monetary Fund, World Economic Outlook Database, April 2015
Austerity Measures	Independent	% related to potential GDP	Gov	Difference between structural budget balance at the end of 2014 and at the end of 2009	International Monetary Fund, World Economic Outlook Database, April 2015

Source: Author's work

As the table presents above, applied austerity measures will be quantified as difference between two balance of structural budget, at the end of 2014 versus at the end of 2019. This difference actually represents the change of structural budget balance in the obtained period. The reason for choosing structural budget balance is because it is determined by discrete fiscal policy measures (for example, fiscal rates). A structural budget estimates level of fiscal income, expenses and deficit in conditions of full employment economy. On contrary, a cyclic adjusted budget balance estimates a budget in conditions when real and potential GDPs are equal. So, this indicator is really useful because it enables to extract the component of budget which is the result of previously applied discrete fiscal policy.

In the following table, presented data is used in regression analysis. Although today Eurozone is consisted of 19 countries in total, some are not included in the analysis. The analysis is based on the sample of 16 countries (exception of Estonia and Cyprus due to the lack of data, while Lithuania has become the member on the 1st January 2015).

Table 2 The overview of data used in the regression analysis

Countries	Accumulated % growth of real GDP from 2009 to 2014	Difference between structural budget balance at the end of 2014 and at the end of 2009
Austria	2,6040	2,2540
Belgium	2,9330	1,4420
Finland	-5,5680	-0,7830
France	2,0840	3,0170
Germany	4,4220	1,3520
Greece	-28,4010	20,1230
Irland	0,7700	8,2350
Italy	-8,0680	3,3410
Latvia	-0,6410	0,7490
Luksemburg	7,1600	-0,6540
Malta	12,0970	0,3530
Netherlands	-2,0050	5,0010
Portugal	-7,6360	7,5050
Slovakia	7,6790	4,3580
Slovenia	-6,9640	0,8190
Spain	-6,1070	6,7630

Source: International Monetary Fund, World Economic Outlook Database, April 2015 and Author's calculations

2) The Regression Model

In further steps of analysis, the testing model will be as follows (including variables):

$$GDP = \alpha + \beta * Gov,$$

where *GDP* represents the accumulated GDP growth rates in Eurozone countries, while *Gov* represents the structural budget balance. α i β represents the parameters of the model. The parameter α is actually a parameter of the section of the regression line on the y axis, and represents the value of dependent variable when the independent variable equals zero. On the other hand, the parameter β represents the slope parameter of the regression line and shows the average change of the dependent variable at the unit change of the independent variable, provided that all other factors are constant. The following table shows the rating of this model in Stata software package.

Table 3 Model Evaluation – Impact of austerity measures on accumulated economic growth rates in the Eurozone from 2009 to 2014

Source	SS	df	MS			
Model	750.547737	1	750.547737	Number of obs =	16	
Residual	556.048549	14	39.7177535	F(1, 14) =	18.90	
Total	1306.59629	15	87.1064191	Prob > F =	0.0007	
				R-squared =	0.5744	
				Adj R-squared =	0.5440	
				Root MSE =	6.3022	

GDP	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Gov	-1.377639	.316912	-4.35	0.001	-2.057348	-.6979307
_cons	3.897232	2.020648	1.93	0.074	-.4366279	8.231092

Source: Author’s calculations

The quality of the model is reflected in several indicators. Firstly, the F statistic confirms the validity of the regression analysis. According to the F test, the probability is 0.0007, or the p value is less than 0.01, so at a significance level of 1% it is concluded that the model is statistically significant. Considering the value of the coefficient of determination, it is concluded that the model explains the variations of the dependent variable in the amount of 57.44%, while the rest of 42.56% of the variations are the result factors not included in the model. In the analysis, this means that the austerity measures expressed by changes in the structural budget balance relative to GDP explain 57.44% of the variations in changes in economic growth rates expressed by cumulative GDP growth over the period from 2009 to 2014. The independent variable is statistically significant, so its influence on the dependent variable is highly statistically significant, since the p value according to the t test is 0.001, which is less than 0.01 (1% significance level). When the same reasoning logic is applied to the value of a constant, it is concluded that its p value is 0.074, so we can accept it at a significance level of 0.1, or a significance level of 10%. The estimated parameter with the independent variable is -1.3776, and it shows how much the dependent variable will change on average, with the unit change independent, provided that other factors are constant. Using the corr option, the relationship between the observed variables is calculated. The correlation coefficient ranges from -1 (negative link) to 1 (positive link). Thus, the correlation indicates the strength and direction of the relationship between the variables. The result in Stata suggests that there is a strong negative relationship between the austerity measures and the GDP growth rates since the correlation coefficient is -0.75.

Based on the model evaluation, it would not be correct to conclude that the model is relevant for further interpretation. It is necessary to check that the model specification is consistent with the assumptions of the classical linear regression model, which relate to the following:

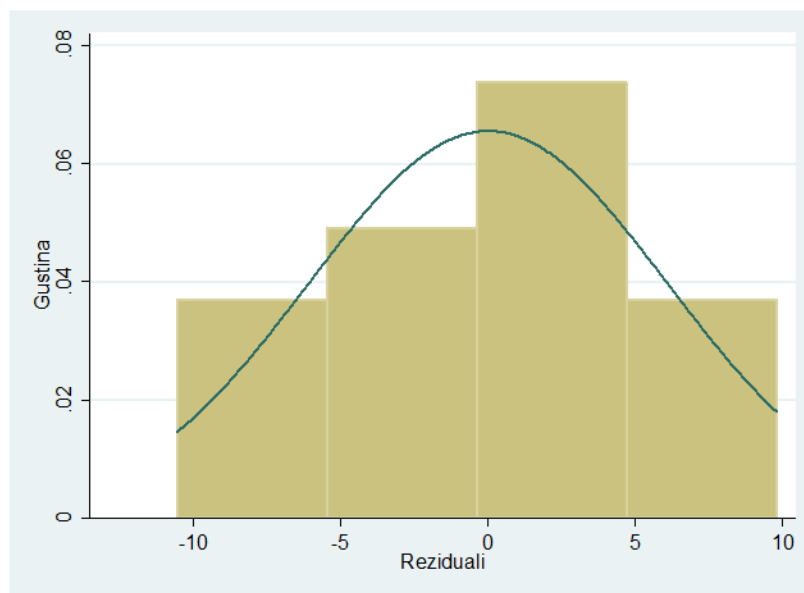
- Normal random error (residual) schedule,
- Absence of autocorrelation and
- Absence of heteroskedasticity.

Appropriate tests are performed to verify that the model meets the defined assumptions. In order for the model to be valid, it is necessary to satisfy every assumption.

- Normal random error (residual) schedule

There are informal and formal tests. Testing the normality of the residual schedule can be done both ways. Firstly, by informal tests, or graphical representations, compared to the normal layout, some discrepancies are observed. However, based on the informal test, it cannot be assured with certainty whether this assumption is satisfied in the model.

Graph 1 The normality of the random error schedule



Source: Author's calculations

Given the relativity of informal tests, a formal test is approached. A Shapiro-Wilk test on the normal random error schedule is conducted. The null hypothesis tested with this test is:

H_0 : There is a normal random error schedule.

Contrary to the zero hypothesis, the alternative hypothesis is:

H_a : Absence of normality of residual schedule.

Table 4 Formal test of normal random error schedule

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
reziduali	16	0.94882	1.037	0.072	0.47128

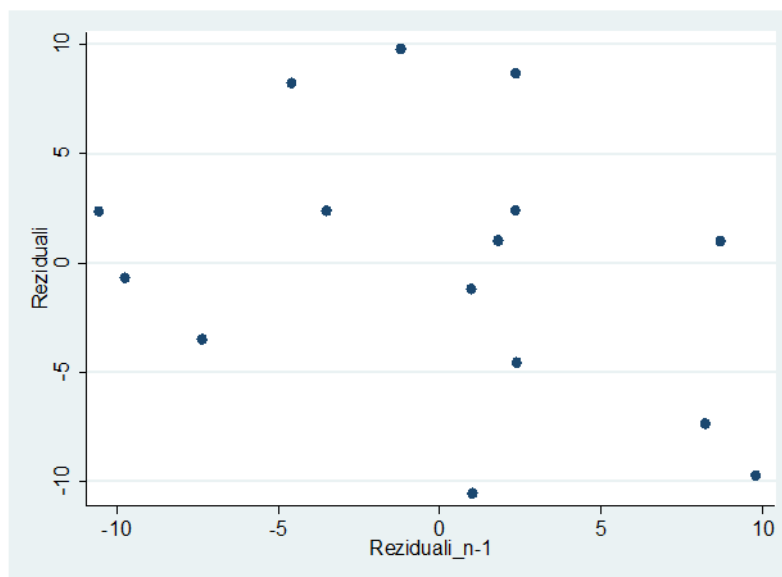
Sources: Author's calculations

Based on the results of the Shapiro-Wilk test, since the calculated p value of 0.47128 is greater than 0.05, it is concluded that the null hypothesis of the normality of the random error schedule is accepted. Thus, the first assumption about the specification of the model is satisfied.

- o Absence of autocorrelation

In order to check the autocorrelation, a series of residuals with a lag time is firstly generated, so, the residual values are translated, and the resulting series is then compared to the original residuals. In other words, it checks if there is a correlation between the current value of the residuals and their value from the previous period. In the absence of autocorrelation between residuals, the current value of the error does not depend on its earlier value.

Graph 2 Graphical check of the existence of autocorrelation between residuals



Source: Author's calculations

Given that the residual values are fairly evenly scattered across all four quadrants in the graph, it is concluded that there is no autocorrelation between them. So the residuals do not show some

behavioral rule in the movement. This is the second assumption of the classical linear model, which the model satisfies. It is necessary to examine whether the last assumption of the absence of heteroskedasticity is also satisfied.

- Absence of heteroskedasticity

Several formal tests are used to test for heteroskedasticity. White's test suggests that homoskedasticity exists because p is 0.6332 greater than 0.05, so the null hypothesis of the absence of heteroskedasticity, is accepted. The same is suggested by the subsequent Breusch-Pagan test, which defines the null or alternative hypothesis in the same way. According to this test, the p value is 0.5603, so the null hypothesis of the residual homoskedasticity is also accepted in this case.

Table 5 White's test of heteroskedasticity

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White's test for Ho: homoskedasticity
      against Ha: unrestricted heteroskedasticity

      chi2(2)      =      0.91
      Prob > chi2  =      0.6332
```

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	0.91	2	0.6332
Skewness	3.14	1	0.0764
Kurtosis	0.56	1	0.4537
Total	4.62	4	0.3291

Source: Author's calculations

Table 6 Breusch-Pagan's test of heteroskedasticity

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Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of GDP

      chi2(1)      =      0.34
      Prob > chi2  =      0.5603
```

Source: Author's calculations

Based on the test results, it is concluded that the assumption of absence of heteroskedasticity is satisfied. However, the remaining test is to test the accuracy of the model in terms of whether

there are omitted variables that would be relevant to the analysis, which should be included in the model. This is a Ramsey test, which gives the following result.

Table 7 Ramsey's test of model specification accuracy

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Ramsey RESET test using powers of the fitted values of GDP
Ho: model has no omitted variables
      F(3, 11) =      0.70
      Prob > F =      0.5721
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Source: Author's calculations

Based on Ramsey's test, the p value is 0.5721, greater than 0.05, so the null hypothesis suggests that there are no omitted factors in the model.

Based on the tests performed, it is concluded that all the assumptions regarding the validity of the model are fulfilled. Further analysis will be based on the results obtained from the research carried out and the response to the originally defined hypothesis of the impact of austerity measures on GDP decline in the Eurozone countries.

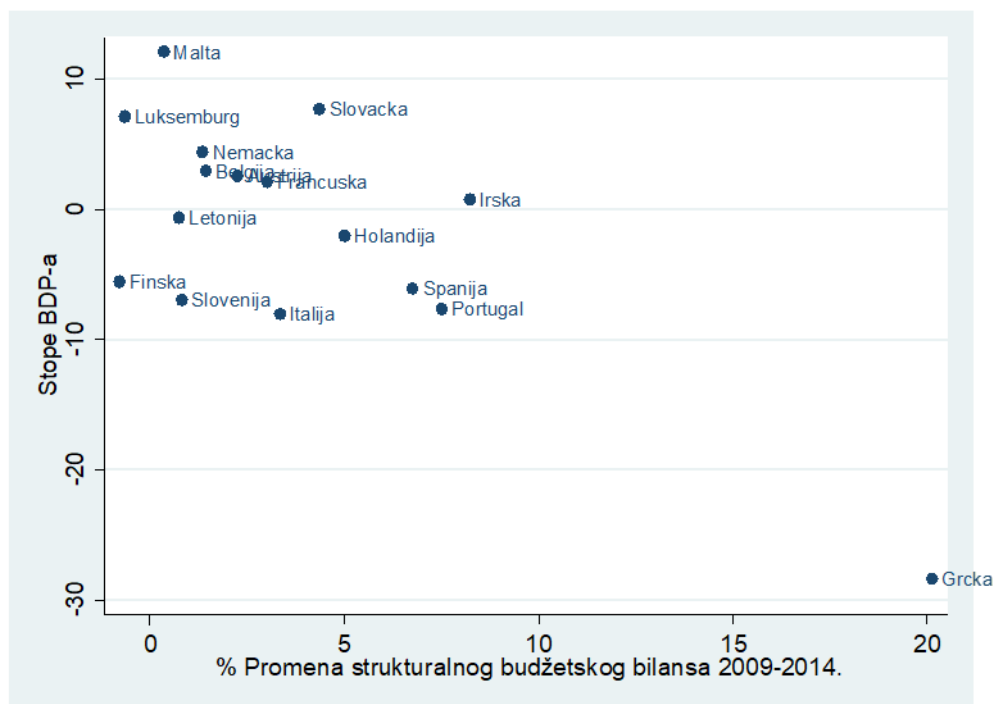
5. The Interpretation of Research results

The analysis began by defining the research problem, that is, a hypothesis that needs to be confirmed or denied based on the research results. The null hypothesis concerned the question:

Did fiscal austerity measures have an additional impact on GDP declines in the Eurozone countries, which were applied as measures to overcome the debt crisis?

After verifying the model specification, the conclusions that can be drawn from the model are considered corroborated by the testimony that has been generated, based on the data collected. Although the analysis is based on a sample of 16 observation units, the results are significant and can be generalized to the total number of units (19 Eurozone Member States).

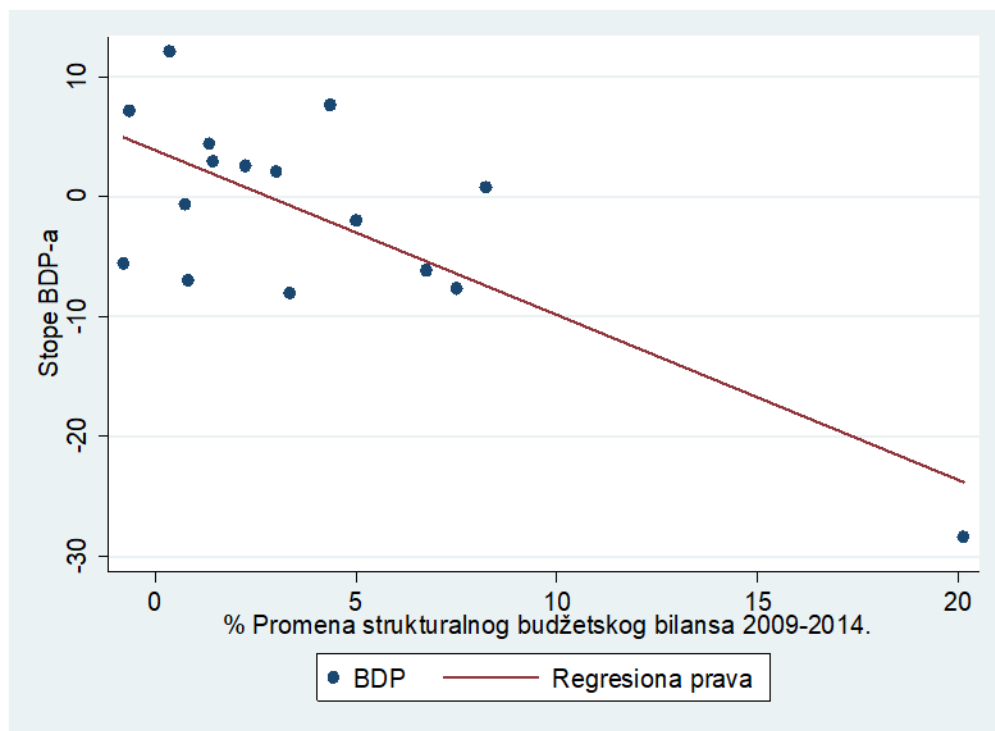
Graph 3 Impact of austerity measures on economic growth - comparative position of Eurozone members 2009 – 2014



Source: International Monetary Fund, World Economic Outlook Database, April 2015 and Author's calculations

Comment: The chart shows the positions of the Eurozone member states in terms of observed economic growth indicators (cumulative GDP growth rates for 2009-2014) and austerity indicators, in the form of a structural budget balance (balance differences at the end of 2014 and balance on end of 2009). Countries that have reduced their structural deficits since the Great Recession have experienced lower growth rates. The position of Greece is significantly different from that of other Eurozone member countries. In order to adequately explain this specific position that Greece has taken on the chart, it is useful to look at the factors which have contributed to the deepening crisis in Greece and to make it one of the Eurozone countries most severely (if not most) affected by the crisis.

Graph 4 The regression line and the impact of austerity measures on economic growth in the Eurozone countries



Source: International Monetary Fund, World Economic Outlook Database, April 2015 and Author's calculations

The final formulation of the regression model⁵:

$$GDP = 3.89 - 1.37 * Gov .$$

$$y = 3.89 - 1.37 * x$$

$$R^2 = 0.5744$$

Comment: Countries that have reduced their structural deficits since the Great Recession have experienced lower growth rates. Thus, countries that "tightened" their fiscal positions, with core growth still weak, achieved lower GDP rates than countries that were prepared to apply shock adjustments through temporary budget spending. Based on the final form of the model, it is clear that movements in GDP rates were strongly influenced by austerity measures. Specifically, the coefficient on the Gov variable (fiscal austerity indicator) is 1.37, with a negative sign indicating that the relationship between the dependent variable GDP (the economic growth indicator) and the independent variable Gov is inversely proportional. The fiscal multiplier⁶, the parameter β

⁵De Grauwe P., Ji Y., "Panic-driven austerity in the Eurozone and its implications", (2013) dostupan na: <http://www.voxeu.org/article/panic-driven-austerity-eurozone-and-its-implications>, 25.06.2015.

⁶„Testimony of Jared Bernstein, Senior Fellow, Before the House Budget Committee“, Center on Budget and Policy Priorities, June 16 (2015), p. 6.

with the independent variable, actually indicates the following: with savings increasing by 1%, GDP growth rates decrease by 1.37% on average, provided that all other factors are constant. Which means that austerity measures were taken and how expensive they were in terms of their contribution to the GDP decline in the countries that implemented them. The position of Greece is specific. The weak Greek economy⁷, which is the first member to be controlled by the Troika⁸, as it sits at the threshold of the 1930s crisis during the Great Depression, looking at a cumulative decline in its GDP, rising to 20% since 2008 (2012 data), is expected to increase to 25% by 2014. The analysis showed that the cumulative GDP decline reached 28% in the period 2009-2014, which means that the Greek economy is more deeply affected by the crisis than predicted (where the percentage would be even higher if taken into account and 2008). According to 2014 data, Greece's public debt has grown to 177.1%⁹ of GDP, as a result of the self-defeating economic concepts imposed by the Troika.

Critics who predicted the collapse of the Eurozone in 2011 and 2012, turned out to be wrong. However, the Eurozone faces three key problems regarding the next indicator. First, growth: there is no recovery, there is still a very high risk of deflation, unemployment remains at an extremely high level, especially for young people, timid policies continue to reduce growth potential. Is continuous stagnation already noticeable? Second, social conditions: the benefits of the common market are reflected through shared prosperity. The debt crisis has led to the introduction of costly, though in the view of many needed, reforms that have put a heavy burden on Southern European countries and have contributed to the creation of a dual Europe. Can "social Europe" survive? Thirdly, convergence: the process of European integration involves both successive crises and overcoming steps that require courageous and approaching positions between Member States, especially France and Germany. However, the driving force of the Eurozone Germany-France seems to be at a standstill today¹⁰. Emphasis is placed on Germany for a reason, although it accounts for less than 30% of Eurozone GDP. Germany is important, though not dominant in Europe. Namely, the Netherlands, Switzerland, Sweden and Norway have surpluses relative to GDP, higher than Germany. Not only do they have more external surpluses, but their surpluses are more stable than Germany¹¹.

⁷Hatgioannides J., Karanassou M. and Sala H., *"Eurozone: The Untold Economics"*, School of Economics and Finance, Queen Mary - University of London, Working Paper No. 699, January 2013, p. 27.

⁸Trojku čine: Evropska komisija, Evropska centralna banka i Međunarodni monetarni fond.

⁹Preuzeto sa: <http://www.tradingeconomics.com/greece/government-debt-to-gdp>, 29.06.2014.

¹⁰Jacques Mistrál, *"Growth, Convergence and Social Conditions: Where is Europe Headed?"*, THINK TANK 20: Growth, Convergence and Income Distribution: The Road from the Brisbane G-20 Summit, November (2014), p. 81.

¹¹Daniel Gros, *"Quantitative Easing and Deflation in a Creditor Economy"*, THINK TANK 20: Growth, Convergence and Income Distribution: The Road from the Brisbane G-20 Summit, November (2014), p. 87.