# The Determinants Of Public Debt

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*The study focuses on the identification of the Europeans public debt determinants. For this analysis, we have taken 12 Europeans countries during the 2000 - 2014 period. In order to estimate our model, we used the correlated panels corrected standard errors model. The results confirms the persistence of dependant variable i.e. debt-to-GDP ratio. We also found a positive impact of bank nonperforming loans, military expenditures and imports and a negative influence of GDP growth and bank liquid reserves.*

*Keywords: Public debt, Corrected panels, Europeans countries*
*JEL Classifications: F34, C23*

## I. Introduction

Public debt is one of the main indicators of financial and economic fragility of countries. Indeed, countries tend to borrow money but at limited levels. However, several factors can influence these levels and oblige these countries to excessive debt-to-GDP ratio that sometimes exceeds 100%. The financial crisis of 2008 is an example in which several European countries have known large increases in their debt-

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to-GDP ratio. In this context, several studies have been conducted to know the public debt determinants (Barro (1979), Krugman (1988), Claessens (1990), Warner (1992), Hall and Sargent (2010)). Several variables were used in order to explain changes in public debt i.e. the GDP growth rate, inflation, military spending ...

Our study covers 12 European countries over the period between 2000 and 2014. The subject of our study is to identify the determinants of public debt. In this context, we selected explanatory variables in accordance with the main theoretical studies, namely bank nonperforming loans, exports, imports, inflation, military expenditure, GDP growth and bank liquid reserves. The estimation technique used is the correlated panels corrected standard errors model (PCSE).

In the second section, we presented the review of the scientific literature. In section 3, we described data and research methodology namely variables used, sample, model, etc. In section 4, we specified the empirical results from our model and we compares these of differents studies.

## II. Review of the scientific literature

Several theoretical and empirical studies have focused on the determinants of public debt. Eichengreen and Portes (1986) found a negative correlation between public debt and GDP growth. Sinha et al. (2011) showed that the GDP growth rate is negatively related to the public debt and that it is the most important determinant. Hall and Sargent (2010) indicate that growth reduces the debt-to-GDP ratio in the US. They also showed that over the period 1946-1974, 23% of the debt reduction was due to inflation. This result can be explained by the use of the Government of inflation as a tool to reduce the value of debt.

Aizenman and Marion (2009) also found that inflation reduces the value of debt. In their study, the authors showed that an inflation of 6% will reduce the debt-to-GDP ratio of about 20% over four years.

Bittencourt (2015) emphasized the importance of economic activity in reducing the ratio of public debt in the region. It shows that a 1% increase in the GDP growth rate is associated with a 0.7% decrease in the public debt. It also shows that inflation has negative signs in estimates using debt. This study also allowed to find that the coefficient on the lagged dependent variable is positive and significant, indicating that the debt-to-GDP ratio is a persistent variable.

Other studies have examined the effects of military spending on debt-to-GDP ratio. Using static and dynamic panels, Dunne et al. (2004b) found a positive and significant effect of military spending on external debt in eleven small industrialized economies. The same results were found by Lane (2012), by Smith and Narayan (2009) taking the Middle East country sample and by Ahmad (2012), who studied a group of 25 sub-Saharan countries. Paleologou (2013) was interested in 25 European countries over the 1996-2009 period and also found this positive impact of military spending on debt but also a negative effect of GDP growth.

The financial variables were considered as explanatory factors of public debt. Thus, to study the relationship between financial fragility and debt, several authors have used one of the best indicators, that is "Non Performing Loans". Indeed, Rinaldi and Sanchis Arellano (2006) found a positive and significant correlation between the "Non Performing Loans" and the debt-to-GDP ratio. Makri et al. (2014) also confirmed this result in the economy of the euro area.

## III. Data and methodology

*III.1. Presentation of data*

The data exploited are those that allow us to analyse the determinants of endebtement in in the most indebted European countries. The observations are annual. The data are extracted from database of the World Bank 'World Development Indicators (2015)'[3]. The study

[3] http://data.worldbank.org/.

period extends over fifteen years, from 2000 to 2014. The sample consists of 12 European countries, that is Belgium, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Spain and United Kingdom.

The variables used in this study are: the Central government debt (% of GDP) "DEBT", Bank nonperforming loans to total gross loans (%) "BNL", Exports of goods and services (% of GDP) "EXP", Imports of goods and services (% of GDP) "IMP", Inflation "INF", Military expenditure (% of GDP) "MILIT", GDP growth "GROWTH" and Bank liquid reserves to bank assets ratio (%) "BLR".

Central government debt includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. This variable is used as an endogenous variable in order to define these determinants.

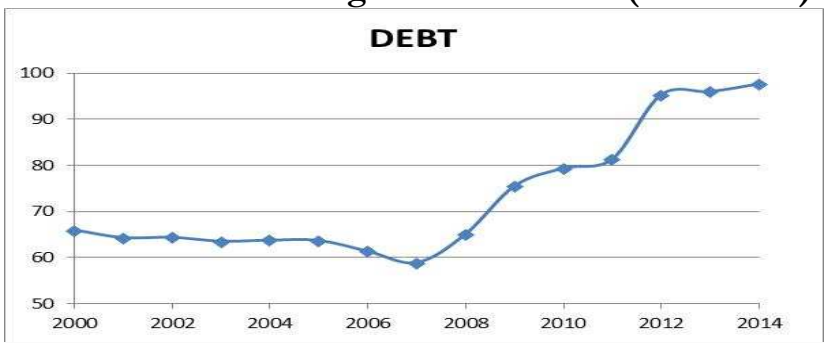
Table 1 (Appendix) presents descriptive statistics for Central government debt concerning the twelve European countries. Considering all countries, we can obviously confirm that 2009 and 2012 are the two years in which debt has significantly increased. Indeed, between 2000 and 2008, the debt ratio fluctuates between 58.894% (2007) and 65.965% (2000). Then the 70% threshold has been exceeded for the first time in 2009 (75.829%). This escalation continued in the rest of period and especially from 2012 (rather than 95% of GDP). The extreme debt ratio recorded is that of Greece in 2012 (166.123%).

We also noticed that the standard deviation has not much increased in recent years compared with the average debt ratio. This shows a small dispersion between the public ratios of countries after 2009, affirming the transmission of debt crisis in this European zone.

Graph 1 visualizes the evolution of debt ratio.

**Graph 1**

**Evolution of Central government debt (% of GDP)**




Source: World Development Indicators (2015)

In order to explain variations in debt, we will use a set of variables that are generally considered in theory as a determinants of public debt. These variables are:

- Bank nonperforming loans to total gross loans (%) (BNL)
- Exports of goods and services (% of GDP) (EXP)
- Imports of goods and services (% of GDP) (IMP)
- Inflation (INF)
- Military expenditure (% of GDP) (MILIT)
- GDP growth (GROWTH)
- Bank liquid reserves to bank assets ratio (%) (BLR).

*III.2. Methodology:*

In order to study the impact of exogenous variables on the public debt ratio, we'll adopted the technique of panel data. Indeed, this method allows us to take into account the variability between countries and also over time. The equation of model can be written as:

$$DEBT_{i,N} = \alpha_0 + \alpha_1 DEBT_{i,N-1} + \alpha_2 BNL_{i,N} + \alpha_3 EXP_{i,N} + \alpha_4 IMP_{i,N} + \alpha_5 \underset{(+)}{INF_{i,N}} + \alpha_6 \underset{(+)}{MILIT_{i,N}} + \alpha_7 \underset{(-)}{GROWTH_{i,N}} + \alpha_8 \underset{(+)}{BLR_{i,N}} + \varepsilon_{i,N} \quad (1)$$

$i = 1,2,...,12$ : Country $i$.
$N = 1,2,...,15$ : Year $N$.

However, before estimating our model (dynamic panel), it is interesting to test the existence of a potential heteroscedasticity. For this, we estimated equation (1) with the "FGLS" method (Feasible Generalized Least Squares). Indeed this method adjusts linear panel data models using feasible generalized least squares. This method is realised by using "xtgls" STATA command to determine the possible presence of heteroscedasticity by comparing between the cross-correlation model and that of the panel. In the case of presence of heteroscedasticity, we will use panels corrected panel method "Linear regression, correlated panels corrected standard errors (PCSE)" estimated by "xtpcse" STATA command. Indeed, this method corrects heteroskedasticity and authorize to estimate equation 1.
Thus, in the first step, we will estimate these two models (heteroskedastic and homoskedastic). Then, we calculate "Likelihood ratio test" which will conclude on the possible existence of heteroscedasticity. Finally, we estimate the determinants of public debt (equation (1)) by correlated panels corrected standard errors model in the case of presence of heteroscedasticity. Results of estimates of both "FGLS" models, Likelihood ratio test and panel corrected model are presented in the following paragraph.

## IV. Results and discussion

We begin by estimating equation (1) by "FGLS" method. The results are shown in Tables 2 and 3.

**Table 2**

**Model estimation with FGLS regression**
**(Panels: heteroskedastic)**

| Cross-sectional time-series FGLS regression | | | Number of obs: 168 | |
|---|---|---|---|---|
| Coefficients: generalized least squares | | | Number of groups: 12 | |
| **Panels: heteroskedastic** | | | Time periods: 14 | |
| Correlation: no autocorrelation | | | Wald chi2(8): 9078.60 | |
| Estimated covariances | | 12 | Prob > chi2: 0.000 | |
| Estimated autocorrelations | | 0 | Log likelihood: - 482.531 | |
| Estimated coefficients | | 9 | | |
| **DEBT** | **Coef** | **Std. Err** | **z** | **P > z** |
| L.DEBT | 0.887 | 0.014 | 60.30 | 0.000 |
| BNL | 0.746 | 0.114 | 6.50 | 0.000 |
| EXP | -0.329 | 0.070 | -4.65 | 0.000 |
| IMP | 0.434 | 0.076 | 5.65 | 0.000 |
| INF | -0.534 | 0.224 | -2.38 | 0.017 |
| MILIT | 3.678 | 0.873 | 4.21 | 0.000 |
| GROWTH | -0.879 | 0.129 | -6.81 | 0.000 |
| LIQ | -0.190 | 0.074 | -2.57 | 0.010 |
| cons | -0.941 | 1.905 | -0.49 | 0.621 |

**Table 3**

**Model estimation with FGLS regression**
**(Panels: homoskedastic)**

| Cross-sectional time-series FGLS regression | | Number of obs: 168 |
|---|---|---|
| Coefficients: generalized least squares | | Number of groups: 12 |
| **Panels: homoskedastic** | | Time periods: 14 |
| Correlation: no autocorrelation | | Wald chi2(8): 3593.55 |
| Estimated covariances | 1 | Prob > chi2: 0.000 |
| Estimated autocorrelations | 0 | Log likelihood: -555.593 |
| Estimated coefficients | 9 | |

| DEBT | Coef | Std. Err | z | P > z |
|---|---|---|---|---|
| L.DEBT | 0.889 | 0.028 | 31.68 | 0.000 |
| BNL | 0.500 | 0.148 | 3.37 | 0.001 |
| EXP | -0.152 | 0.132 | -1.16 | 0.248 |
| IMP | 0.257 | 0.152 | 1.69 | 0.091 |
| INF | -0.434 | 0.394 | -1.10 | 0.271 |
| MILIT | 2.864 | 1.453 | 1.97 | 0.049 |
| GROWTH | -0.971 | 0.221 | -4.39 | 0.000 |
| LIQ | -0.186 | 0.127 | -1.47 | 0.143 |
| cons | 1.003 | 3.271 | 0.31 | 0.759 |

We now present the "Likelihood ratio test" following:
$H_0$ : homoskedastic Panel
$H_1$ : heteroskedastic Panel
Likelihood-ratio test LR chi2(11) = 146.12
Prob > chi2 = 0.000
From this test, we can reject $H_0$ and accept the alternative hypothesis, ie the presence of heteroscedasticity in our panel.
In order to have an effective estimation, we will use panels corrected method "Linear regression, correlated panels corrected standard errors (PCSE)" estimated by "xtpcse" STATA command. The "PCSE" method permits the inclusion of a unit-specific AR1 term in order to obtain a correction for serial correlation, while retaining the unbiased OLS coefficient estimates. Indeed, this method corrects heteroskedasticity and gives a consistent estimate of the "panel-corrected standard errors." The result of the estimation of our dynamic panel is presented in table 4.

**Table 4**

**Linear regression, correlated panels corrected standard errors model (PCSE)**

| **Panels: correlated (balanced)** | | | Number of obs | | 168 | |
|---|---|---|---|---|---|---|
| Autocorrelation: no autocorrelation | | | Number of groups | | 12 | |
| Estimated covariances | 78 | | Obs per grou | min | 14 | |
| Estimated autocorrelations | 0 | | | avg | 14 | |
| Estimated coefficients | 9 | | | max | 14 | |
| R-squared | 0,95 | | Wald chi2(7): 1595.89<br>Prob > chi2: 0.000 | | | |
| | **Panel-corrected** | | | | | |
| **DEBT** | **Coef** | **Std. Err** | **z** | **P > z** | **[95% Conf. Interval]** | |
| L.DEBT | 0.889 | 0.033 | 26.44 | 0.000 | 0.823 | 0.954 |
| BNL | 0.500 | 0.253 | 1.98 | 0.048 | 0.004 | 0.997 |
| EXP | -0.152 | 0.126 | -1.21 | 0.228 | -0.401 | 0.095 |
| IMP | 0.257 | 0.145 | 1.78 | 0.076 | -0.026 | 0.542 |
| INF | -0.434 | 0.329 | -1.32 | 0.187 | -1.080 | 0.210 |
| MILIT | 2.864 | 1.170 | 2.45 | 0.014 | 0.570 | 5.158 |
| GROWTH | -0.971 | 0.343 | -2.83 | 0.005 | -1.644 | -0.299 |
| LIQ | -0.186 | 0.108 | -1.71 | 0.087 | -0.399 | 0.026 |
| cons | 1.003 | 3.036 | 0.33 | 0.741 | -4.948 | 6.956 |

The above table 4 illustrates the results of the impacts of central government debt determinants.

The main results show that our model is globally significant (Chi 2 (7) = 1595.89 (prob = 0.000)). The explanatory power of regression model is large (R-squared = 0.95).

On the other hand, we see excessive significance of the lagged values of central government debt. This shows the high persistence of this

variable. This result is in conformity with Bittencourt (2015) study. Increased levels of Bank nonperforming loans, military expenditures (at the 5% threshold) and also imports (at the 10% threshold) intensificates significtivly central government debt. These results are also in confirmity with the majority of empirical studies finding.
The results of table 4 permits also to confirm that increases in GDP growth and in Bank liquid reserves are significantly decline the level of debt and this respectively at the 5% and 10% threshold.
However, our results can not confirm the hypothesis of reducing the debt ratio by inflaion. Indeed, this variable has a negative sign but is not significant. Similarly, the role of export is not significant.

## V. Conclusion:

The objective of this study is to test the relationship between the debt-to-GDP ratio and its determinants. This study covers 12 Europeans countries during the 2000 - 2014 period. After presenting the differents theoreticals and empiricals works focusing on the determinants of debt, we presented the variables used that is Bank nonperforming loans to total gross loans (%), Exports of goods and services (% of GDP), Imports of goods and services (% of GDP), Inflation, Military expenditure (% of GDP), GDP growth, Bank liquid reserves to bank assets ratio (%). By using Likelihood-ratio test, we detect the presence of heteroscedasticity in our panel. For this purpose, we used the correlated panels corrected standard errors model to estimate our equation. The results show that the dependent variable (debt-to-GDP ratio) is persistent. We also showed that the variables Bank nonperforming loans, military expenditures and also imports have a positive and significant impact on debt-to-GDP ratio. We prove moreover a negative and significant influence of GDP growth and bank liquid reserves on debt-to-GDP ratio. However, we not found a significant impact of inflation.

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## Appendix

**Table 1**

**Descriptive statistics of Central government debt (% of GDP)**

| *Central government debt, total (% of GDP): "DEBT" All countries* | | | | |
|---|---|---|---|---|
| Number of observation 180 | | Average 73.089 | Standard deviation 31.208 | |
| **Year** | **Average** | **Standard** | **Min** | **Max** |
| **2000** | 65.965 | 29.352 | 38.224 | 119.226 |
| **2001** | 64.304 | 30.701 | 35.819 | 121.895 |
| **2002** | 64.376 | 30.046 | 34.116 | 122.351 |
| **2003** | 63.514 | 28.381 | 32.965 | 118.717 |
| **2004** | 63.758 | 28.551 | 31.443 | 121.369 |
| **2005** | 63.685 | 29.430 | 31.629 | 121.502 |
| **2006** | 61.336 | 30.322 | 28.014 | 123.020 |
| **2007** | 58.894 | 30.397 | 24.141 | 120.463 |
| **2008** | 65.125 | 27.013 | 30.789 | 116.862 |
| **2009** | 75.529 | 29.041 | 37.030 | 133.189 |
| **2010** | 79.379 | 26.104 | 41.242 | 127.031 |
| **2011** | 81.410 | 21.592 | 47.969 | 109.078 |
| **2012** | 95.346 | 34.525 | 47.231 | 166.123 |
| **2013** | 96.021 | 31.357 | 47.112 | 144.257 |
| **2014** | 97.690 | 32.601 | 47.256 | 149.365 |

World Development Indicators (2015)