THE EFFECT OF INDUSTRIAL PRODUCTION AND TRADE BALANCE ON NATIONAL DEBT LEVELS: EVIDENCE FROM THE EUROPEAN ECONOMY

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Abstract

The goal of the current research is to examine structural determinants of national debt levels. Mainstream economic theory holds public spending as the major cause of budget deficits and the accumulation of national debt. This paper adopts a somehow different approach, considering industrial production and trade balance as major causes of a country’s debt. In order to test the validity of this hypothesis, it examines the relationship between national debt, industrial production and trade balance in an econometric model. The data used come from Eurostat and they concern GDP, debt, trade balance and industrial production for 26 European economies.

Keywords: National debt determinants, trade balance, industrial production, panel data analysis

JEL Classification: E23, H62, H63

1. Introduction

The goal of the current research is to examine structural determinants of national debt levels. Mainstream economic theory holds public spending as the major cause of budget deficits and the accumulation of national debt. This paper adopts a somehow different approach, considering industrial production and trade balance as major causes of a country’s debt. In order to test the validity of this hypothesis, it examines the relationship between national debt, industrial production, trade balance and government expenditures in an econometric model using data from 26 European economies.

The main motive for this research lies in the intense deficit and debt problem faced by the Greek economy. The Greek yearly deficit grew from 5 € billion in 2000, to 36 € billion in 2009 (7fold), while the value of the country’s GDP grew from 137 € billion in 2000, to 235 € billion in 2009 (2fold). As a result the value of the country’s public debt grew from 140 € billion (103.4% of GDP) in 2000, to 298 € billion (126.8% of GDP) in 2009. Faced with a huge deficit and debt problem, the Greek economy has a hard time convincing capital markets about its ability to repay loans. This is translated in higher interest rates, which inflate the lending cost and undermine the country’s long term financial and political stability.

The balance of government revenues and expenditures is considered as the primary factor for the creation of budget deficits and the accumulation of public debt. When government expenditures outweigh revenues, the government has to face the deficit problem by turning to capital markets for borrowing funds. The height of the Greek governments’ expenditures as % of GDP, lies between 44% in 2000 and 53% in 2009. The average value of government expenditures for the 26 countries examined was 44.7%. By this observation we can conclude that the height of Greek government expenditures as % of GDP is not significantly higher than the rest of the countries examined. The highest % of GDP for government expenditures is observed in Sweden, 58% in 1998 and 55% in 2009, but this country is not faced with an intense debt problem (69% of GDP in 1998 to 41.9% in 2009). This observation provides the motive for examining other factors that may affect yearly deficit and public debt levels, which are often overlooked by domestic economists.

Greece has a very low industrial production value as percentage of GDP - only 20%, which is the lowest form the 26 countries examined. The value of the goods and services
produced in 2009 was only 47 € billions. The 20% percentage is far from the 26 countries’ average industrial production value as percentage of GDP, which is 60%. The maximum value is met in Czech Republic, were industrial production value reached 120% of GDP in 2009. Moreover Greece’s low industrial production has a declining rate since 2003 (from 26% of GDP to 20% in 2009). This can also be observed by the country’s Index of Industrial Production (2005=100) (Table 1).

Table 1: Greek Index of Industrial Production 2000-2010

<table>
<thead>
<tr>
<th>Year</th>
<th>I.I.P. (2005=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>83.88</td>
</tr>
<tr>
<td>2009</td>
<td>89.86</td>
</tr>
<tr>
<td>2008</td>
<td>98.72</td>
</tr>
<tr>
<td>2007</td>
<td>103.21</td>
</tr>
<tr>
<td>2006</td>
<td>100.91</td>
</tr>
<tr>
<td>2005</td>
<td>100.02</td>
</tr>
<tr>
<td>2004</td>
<td>101.65</td>
</tr>
<tr>
<td>2003</td>
<td>101.09</td>
</tr>
<tr>
<td>2002</td>
<td>100.46</td>
</tr>
<tr>
<td>2001</td>
<td>100.34</td>
</tr>
<tr>
<td>2000</td>
<td>103.77</td>
</tr>
</tbody>
</table>

Source: Eurostat

The values of the Index present a steady yearly decline, particularly during the last 3 years, with a decrease of 17% from the 2005 value.

The trade gap is another structural problem of the Greek economy which is related with the decline in industrial production. Because domestic industrial production is so low, the country has to turn to imports in order to satisfy the needs of the domestic market. This, in combination with the fact that the country’s exports are very low, creates a large trade deficit. This was -17 € billion in 1998 and -28 € billion in 2009 (reaching -48 € billion in 2008). As % of GDP the trade deficit average value for the 12 years examined (1998-2009) was -15.5%. The average value of trade balance for the 26 countries examined was -5% of GDP, with a minimum value of -35% of GDP (Cyprus for the year 2008) and a maximum of 17% (Norway for year 2008).

The question that arises from these observations is the following: is there a connection between public debt, industrial production and trade balance? In order to answer this question the current research applies a multiple regression model with debt as the dependant variable and trade balance, industrial production and government expenditures as the independent ones.

2. Literature review

According to the Keynesian view, public debt is thought to have a positive impact on economic activity for a country, through the mechanism of public expenditure multiplier. Some keynesians also argue that budget deficit and government debt increase national production, which makes private agents perceive the future economic situation more optimistic and increase their investments. On the other hand there is the neo-classical approach. They claim that budget deficits and public debt can have harmful effects for economic growth. In an attempt to justify their point of view, neoclassicals analyse consumption expenditure of households during their entire life cycle and consider that the government with budget deficit moves the tax burden on future generations, which leads to a
rise of current consumption. In assuming full employment, representatives of the neoclassical school argue that increasing consumption means decreasing savings. So the level of interest rates must increase in order to restore equilibrium on the capital market which in turn decreases the size of private investment. The relationship of the above views and the current research lies in the fact that interest rates affect private and public investment decisions in general and industrial production in particular. Investment may as well result in industrial production rise, since a low level of interest rates lead to higher investment levels and, therefore, higher production output.

Empirical studies concerning public debt

The current economic crisis gave an incentive to the shift the focus of the literature on the topic of public or government debt. A quite interesting attempt was made by Neck R. and Sturm J.E. (2008) who edited a book that questions the public debt’s sustainability in relationship with a growing public sector. Research sample were EU countries and the USA, and the main goal was to find out whether the development of public debt in the United States and six EU countries was sustainable--that is, whether fiscal policies in these countries can be continued without creating the potential for government bankruptcy. The sustainability of public debt should be dealt with as a challenge not only to public policy design but also to economic theory. Findings showed that, apart from Italy, the rest of the sample countries could control their sustainable public debt and were able to return to a sustainable path after a period of unsustainability.

The problem of managing public debt was analysed by Nadim Hanif M. (2002) focusing on the public debt of Pakistan. Similarities with the Greek case can be found in the fact that, instead of applying fiscal measures, the government of Pakistan resorted to borrowing in order to finance the deficit. Therefore, there was an increase in liabilities which, in combination with poor debt management, resulted in a serious economic problem. The researcher believes that public debt is not so much a big problem per se, but it is its management that counts, in order to make it sustainable.

Another major topic is that of economic growth in countries affected by the economic crisis. Presbitero A. F. (2010) focuses on the current economic crisis and he tries to investigate the impact of public debt on growth in advanced and emerging countries. His results show that, on a panel of low- and middle-income countries over the period 1990-2007, public debt has a negative impact on output growth up to a threshold of 90 percent of GDP, beyond which its effect becomes irrelevant. This non-linear effect can be explained by country-specific factors since debt overhang is a growth constraint only in countries with sound macroeconomic policies and stable institutions. A similar focus was on the study of Creel J. and Saraceno F. (2009), who they use Barron’s production function and Blanchard-type consumers to assess fiscal sustainability and the determinants of long-run (or potential) growth, in presence of productive capital services and of public debt. In this way they try to prove that, provided public spending is not too high, it will be growth-enhancing. More particularly, their theoretical model showed that there has been used as a benchmark for assessing the efficiency of public spending, and in the cases of France, UK and US, it has first been shown that the actual level of general government gross fixed capital formation was below its optimal level. Another interesting research was made by Misztral P. (2010) who investigates the relationship among public debt, GDP and economic growth in the EU, including reasons and factors determining these relationships. Using the VAR approach, he found that one of the factors that determined GDP growth in the EU in the period 2000–2010 were changes in public debt. On the other hand, one of the factors which determined the size of public debt in the EU in the same period was changes in GDP. Secondly, he found that elasticity coefficients of public debt to economic growth and economic growth to public debt
significantly differed in the individual EU member countries. Finally, the highest, positive impact of public debt on GDP took place in the EU member countries, where the share of public debt in GDP was close to 65%.

In the case of the EU, Koukouritakis M. (2003) attempted to estimate the effects on Greek trade balance due to the EU accession. He used a full trade model, since Greece relies on imported inputs for export production. After the accession, the country had to liberalize its trade by abolishing all barriers, such as tariffs, quotas, financial stringencies, indirect taxes on imports and export subsidies. The study notes that after the accession, the country had to liberalize its trade by abolishing all barriers, such as tariffs, quotas, financial stringencies, indirect taxes on imports and export subsidies. The gradual abolition of all protective and promoted measures on trade after the EU accession increased the trade deficit. As far exporting is concerned, the effects due to the abolition of export subsidies were quite small. After the EU accession, imports substituted for a large part of the country’s domestic production, an effect that implies trade creation and improvement in terms of static welfare.

3. Methodology

Model Specification

The model used has the following form:

\[
\text{DEBT} = f(\text{TRDBAL}, \text{INDPRO}, \text{GOVEXP})
\]  

The model’s basic assumption is that a country’s general government debt (DEBT) is affected by the value of its trade balance (TRDBAL), industrial production (INDPRO) and government expenditures (GOVEXP). Trade balance and industrial production are expected to be negatively correlated with debt, while government expenditures are expected to be positively correlated.

Data Sources

All the data used come from the European Statistical Agency’s (Eurostat) statistical database. The data used concern the following 26 European economies: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom and Norway and they regard 12 consequent years, from 1998 to 2009. Missing values were treated by using the average value for in-between missing values and the value of the previous or following year for the rest. Percentage of missing values was 2.3% (29 values out of 1248), and most of them were met in the industrial sector production values (manufacturing, mining and quarrying and electricity, gas and water supply) than had to be added in order to calculate total production value for each country.

Variable Specification

\text{DEBT (DEBT)}

Debt was measured by each country’s consolidated general government gross debt at nominal value outstanding at the end of the year, as percentage of its Gross Domestic Product. In Eurostat the general government sector comprises central government, state government, local government, and social security funds. Debt is valued at nominal value and foreign currency debt is converted into national currency using end-year market exchange rates. GDP used as a denominator is the gross domestic product at current market prices.
GDP is the basic measure of a country's overall economic health and it is equal to the sum of the gross value-added of all resident institutional units (i.e. industries) engaged in production, plus any taxes, and minus any subsidies, on products not included in the value of their outputs.

**TRADE BALANCE (TRDBAL)**

Trade balance for each country was measured as the value of its trade balance (positive or negative) (in millions of Euros) as percentage of its GDP. The balance of trade is the difference between the monetary value of exports and imports of output in an economy over a certain period. A positive balance is known as a trade surplus if it consists of exporting more than is imported; a negative balance is referred to as a trade deficit or, informally, a trade gap. The value of trade balance used includes both goods and services.

**INDUSTRIAL PRODUCTION (INDPRO)**

Industrial production was measured by each country’s value of industrial production as percentage of its GDP. Industrial production value was calculated as the sum of the values generated by 3 industrial production sectors: manufacturing, mining and quarrying and electricity, gas and water supply. As the total industrial production value was not available in the Eurostat website, the values of the three sectors had to be added in order to calculate it. These 3 sectors are also used by Eurostat for the calculation of the Index of Industrial Production. However, the values from the Eurostat database for the 3 sectors’ production value were available until 2007. In order to calculate the production value for the missing years (2008, 2009) the sum of the 3 sectors was multiplied by the percentage change of the Index of Industrial production (2005=100), which was available from EUROSTAT.

**GOVERNMENT EXPENDITURES (GOVEXP)**

The government expenditures variable was measured by each country’s total general government expenditure as percentage of its GDP. Total general government expenditure refers to all the money spent by a country’s government.

**Descriptive Statistics**

Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>DEBT</th>
<th>TRDBAL</th>
<th>INDPRO</th>
<th>GOVEXP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Years</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Observations</td>
<td>312</td>
<td>312</td>
<td>312</td>
<td>312</td>
</tr>
<tr>
<td>Min</td>
<td>3,7</td>
<td>-35,4</td>
<td>17,7</td>
<td>33,2</td>
</tr>
<tr>
<td>Max</td>
<td>126,8</td>
<td>4,31</td>
<td>120,6</td>
<td>58,8</td>
</tr>
<tr>
<td>Mean</td>
<td>48,4</td>
<td>-9,5</td>
<td>60,6</td>
<td>44,7</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>27,7</td>
<td>8,19</td>
<td>18,5</td>
<td>5,9</td>
</tr>
</tbody>
</table>

**Description**

- General government debt as % of GDP
- Value of trade balance as % of GDP
- Industrial production value as % of GDP
- Total government expenditures as % of GDP

**Data Source**

Eurostat database  Eurostat database  Eurostat database  Eurostat database
4. Results

The regression results were as follows:

Table 3: Regression Results

<table>
<thead>
<tr>
<th>Estimated results</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standardized Coefficients</td>
<td>t values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>constant c</td>
<td></td>
<td>-68.435</td>
<td>-4.396***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trade balance %</td>
<td></td>
<td>-0.062</td>
<td>-0.906</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>industrial production %</td>
<td></td>
<td>-0.054</td>
<td>-1.008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>government expenditure %</td>
<td></td>
<td>0.586</td>
<td>9.445***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
<td>0.552</td>
<td>0.298</td>
<td>23.02</td>
<td>0.198</td>
<td>44.949</td>
</tr>
<tr>
<td>R square adjusted</td>
<td></td>
<td>0.552</td>
<td>0.298</td>
<td>23.02</td>
<td>0.198</td>
<td>44.949</td>
</tr>
<tr>
<td>St. error of the estimate</td>
<td></td>
<td>23.02</td>
<td>0.198</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DW statistic</td>
<td></td>
<td></td>
<td></td>
<td>0.198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F statistic</td>
<td></td>
<td></td>
<td>44.949</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

By substituting the results of our panel analysis we get:

\[ Debt_t = c + b_1 trbal + b_2 indpro + b_3 goexp \]
\[ \Rightarrow Debt_t = -68.435 - 0.168 trbal - 0.08 indpro + 2.701 goexp \]  \hspace{1cm} (2)

Firstly we notice that the econometric evaluation of the results imply that there is a satisfactory level of goodness of fit (R square), while the F statistic denotes an overall significance of the regression. Secondly, we notice that standard errors are quite small. Bearing in mind that the standard errors measure the statistical reliability of the coefficient estimates, and that the larger the standard errors, the more statistical noise in the estimates, the results are acceptable.

The estimates of trade balance and industrial production seem to have a weak negative effect on government debt, while government expenditure a positive one (as expected). Since our sample consists of countries with both positive and negative trade balance, the representative variable denotes an overall impact on government debt. More specifically, the more the trade balance rises (i.e. exports increase and/or imports decrease) there is a negative effect on government debt.

By observing the regressions residuals plot we notice that there is no heteroskedasticity problem, and by looking at the VIFs (Variance Inflation Factors) we can conclude that there is no multicollinearity problem. However, our concern for autocorrelation signs is verified by the low DW statistic of 0.198. According to the upper and lower critical values for the DW test which are 1.643 and 1.704 respectively, there seems to be a strong sign of positive autocorrelation among the residuals \( \hat{u}_t \). These residuals act as proxies for the actual residuals \( u_t \) and are used by the DW methodology testing. Autocorrelation is a problem frequently met in time series models, created by the lack of stagnation in the data and can also be verified by the fact the R square is higher than the DW value (Chalkos, 2006).

The proposed remedy for this problem is the use of the first differences. This means that the 1st observation of the dependent variable will be \( \Delta Y = Y_t - Y_{t-1} \), while for the
dependent variables will be $\Delta X = X_t - X_{t-1}$, the 2\textsuperscript{nd} observation $\Delta X = X_{t-1} - X_{t-2}$, and so on. In its general form, our model will be:

$$Debt_t = Debt_{t-1} = c + \beta_2(trbal_t - trbal_{t-1}) + \beta_3(impro_t - impro_{t-1}) + \beta_4(govexp_t - govexp_{t-1}) + (u_t - u_{t-1})$$

(3)

The results of the regression using the first difference method are:

**Table 4: Regression results using first differences**

<table>
<thead>
<tr>
<th>Estimated results</th>
<th>Standardized Coefficients</th>
<th>t values</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant $c$</td>
<td>-2.232</td>
<td>-4.18</td>
</tr>
<tr>
<td>trade balance %</td>
<td>0.113</td>
<td>2.108**</td>
</tr>
<tr>
<td>industrial production %</td>
<td>-0.101</td>
<td>-1.947**</td>
</tr>
<tr>
<td>government expenditure %</td>
<td>0.455</td>
<td>8.307***</td>
</tr>
</tbody>
</table>

R adjusted = 0.535, R square = 0.279, St. error of the estimate = -

2.078, 40.945, 0

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

Firstly, our econometric tests improve dramatically, focusing on the DW statistic and the F statistic. Since the danger of autocorrelation and heteroscedasticity is eliminated, we can carry on with the results’ explanation.

We notice that the government expenditures variable retains its positive relationship with public debt, as expected. Assuming that the public sector consumes and invests more than it receives from taxation, budget deficits will add up and inflate the accumulated public debt. Therefore, the ‘vicious circle’ of borrowing in order to pay for past and future expenses carries on. On the other hand, industrial production still has a weak effect (-0.1), which implies that a rise in industrial production value can decrease public debt. In the second regression, the sign of trade balance has changed, which means that the negative correlation with debt that was observed in the first regression cannot be verified. In the second regression, trade balance has a weak positive correlation with debt, meaning that an increase in trade balance will increase public debt.

**Robustness of the Results**

The results of the regression were checked for multicollinearity, heteroskedasticity and autocorrelation problems. The autocorrelation problem noticed in the first regression was corrected by applying the first differences method. The lack of multicollinearity can be verified by the low VIFs (Variance Inflation factors), which are all under 2. The lack of heteroskedasticity can be verified by the regression’s residuals plots. Appendix 1 presents the residuals distribution, and as it can be seen from the graph the residuals are distributed normally. Appendix 2 presents the relationship between the dependent variable (DEBT) and the residuals. Appendix 3 is the residuals scatter plot diagram, from which it can be observed that the residuals are indeed distributed randomly around 0.
5. Conclusions

The goal of the current study was to test the effect of trade balance, industrial production and government expenditures on public debt levels. The conclusions of the study can be drawn from the regressions’ results. Industrial production was found to have a weak negative effect on public debt, meaning that an increase in industrial production value can lower public debt levels. Government expenditures were found to have a strong positive effect on public debt levels, meaning that an increase in government expenditures can also increase public debt. Trade balance was expected to have a negative effect on public debt, however this hypothesis cannot be verified form the regression results. In the first regression trade balance had a weak negative correlation with public debt, but this relationship was not verified in the second regression. In the second regression trade balance was found to have a weak positive effect on public debt. Perhaps the reason that the signs of the trade balance coefficient were not stable lies in the fact that some countries have a negative and some positive trade balance. In any case, the effect of trade balance on public debt needs further testing.

References

Appendices

Appendix 1: Residuals distribution histogram

Histogram

Dependent Variable: debt

Regression Standardized Residual

Mean = -7.81E-18
Std. Dev. = 0.995
N = 311
Appendix 2: Regression’s standardized residuals diagram

Normal P-P Plot of Regression Standardized Residual

Dependent Variable: debt

Expected Cum Prob

Observed Cum Prob
Appendix 3: Residual dispersion diagram

Scatterplot

Dependent Variable: debt

Regression Standardized Residual

Regression Standardized Predicted Value