Is There Any Critical Value of the Government Debt-to-GDP Ratio? The Case of Portugal

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Abstract

The paper finds that real GDP in Portugal has a quadratic relationship with the government debt-to-GDP ratio. The critical value of the debt-to-GDP ratio corresponding to the maximum real GDP is estimated to be 67.02%. The current government-to-debt ratio of 130.4% in 2016.Q4 is way above the critical value of 67.02%. In addition, real GDP has a positive relationship with the real effective exchange rate, the real stock price, lagged German real GDP and a negative relationship with the real lending rate in the euro area, the real crude oil price and the expected inflation rate.

Keywords: Debt-to-GDP ratio, Real effective exchange rate, Monetary policy function, Stock prices, Oil prices

JEL Classification: E62, F41

I. Introduction

In the European Union (EU), several countries have had relatively high government debt-to-GDP ratios. For example, the central government consolidated debt-to-GDP ratio in Portugal increased significantly from 67.5% in 2008.Q3 to 130.4% in 2016.Q4 mainly due to the 2008-2009 global financial crisis. Whether a higher debt-to-GDP ratio would affect real GDP positively or negatively remains inconclusive. If the initial debt-to-GDP ratio is relatively small, an increase in the debt-to-GDP ratio to improve infrastructures may not cause any significant adverse effect. However, if the initial debt-to-GDP ratio is relatively high, a further increase in the debt-to-GDP ratio may reach an unsustainable level, raise the real interest rate, and crowd out consumption and investment expenditures.

This paper focuses on the relationship between real GDP and the government debt-to-GDP ratio in Portugal. Other relevant variables will be considered as well. The IS-MP-AS model is employed in order to incorporate the monetary policy function. The GARCH process is used to estimate the variance and parameters.

II. Literature Survey

Several recent studies have examined the subject of relatively high government debt in Portugal and other related countries. Based on a sample of the OECD during 1988 – 2007, Gruber and Kamin (2012) study the effect of rising government debt on the long-term government bond yield. They find a significant impact of worsening fiscal position on the long-term bond yield. Specifically, a projected deterioration of fiscal standing would increase the U.S. bond yield by 60 basis points by 2015. The impact on other G7 countries is smaller.
Fathi (2014) suggests that in order to reduce the sovereign debt crisis, Portugal needs to limit spending, initiate economic reforms to pursue economic growth, increase productivity, and increase exports relative to imports.

Using a sample of 5 PIIGS countries during 1974-2014, Ferraz and Duarte (2015) reveal that the debt-to-GDP ratio and the growth rate of real GDP exhibit a negative relationship. Specifically, when the growth rate of the debt-to-GDP ratio in Portugal increases by 1 percentage point, the growth rate of real GDP in Portugal would decline by 0.1342 percentage points. For the PIIGS countries as a group, a 1-percentage point increase in the

growth rate of the debt-to-GDP ratio would reduce the growth rate of real GDP by 0.1738 percentage points.

Pereira and Lagoa (2015) find that contagion exists in the bond markets between Greece and Portugal, that during the crises, flight-to-quality from Portugal and Greece to Germany has been observed, and that there is lack of support for decoupling between the Greek and Portuguese bond markets.

Barradas, Lagoa, Leão and Mamede (2015) show that Portugal exhibits financialization, indicating that the financial sector becomes a prominent industry and causes weaknesses in the economy. They reveal that the financial sector plays a significant role in its recent sovereign debt crisis.

In predicting sovereign debt crises based on a sample during 2008-2012, Daniel and Shiamptanis (2015) examine a fiscal limit that a developed country including Portugal would have. They show that Portugal and Greece were in the high-risk category one year before their financial crises and Italy was a high-risk country in 2012 whereas other countries were in the low-risk category.

Applying the Granger-causality test and the logit model, Gómez-Puig and Sosvilla-Rivero (2016) find that contagion incidents are found after the creation of the EMU and occurred before the recent global financial crisis and that both the pure and fundamental-based contagions coexist during the recent sovereign debt crisis.

Gödl and Kleinert (2016) indicate that interest rate spreads in the Eurozone bond market are associated with news on major economic variables such as budget deficit forecasts and growth but do not react to news on austerity measures or fiscal bailouts.

Based on a sample of 93 countries including Portugal during 1999-2010, Guygun, Ozturk and Shaban (2016) show that higher bond ratings would raise the debt level, that there is lack of support for the political business cycle hypothesis, which suggests that following an update of bond ratings, political ambition would result in the worsening of fiscal standing.

III. The Model

Extending Romer (2000), we can express the IS, the monetary policy (MP) and the aggregate supply (AS) functions as:

$$Y = f(Y, T, G, R, S, E, \varepsilon, Y^*) \quad (1)$$
$$R = g(\pi, Y, \varepsilon, R^*) \quad (2)$$
$$\pi = h(\pi^e, Y, E, \varepsilon) \quad (3)$$

where

Y = real GDP in Portugal,
T = real government tax revenue,
G = real government spending,
R = the real interest rate,
S = the real stock price,
E = the real oil price,
ε = the real effective exchange rate (An increase means real appreciation.),
Y^* = world real income,
π = the inflation rate,

R^* = world real interest rate, and
π^e = the expected inflation rate.

Solving for the three endogenous variables, Y, R and π, we can write the equilibrium real GDP as:

$$Y^* = w(D, \varepsilon, R^*, S, Y^*, E, \pi^e) \quad (4)$$

where government debt D replaces government deficits, G – T as the former is the cumulative sum of the latter.

The Jocabian of the three endogenous variables is given by:

$$|J| = [(1 - f_Y) - f_R g_\pi h_Y - f_R g_Y] > 0 \quad (5)$$

Whether real appreciation of the euro would increase or reduce aggregate output depends on its negative and positive impacts on the economy. Real appreciation of the euro tends to reduce imports costs and domestic inflation and attract international capital inflows. On the other hand, real appreciation would hurt exports, increase imports and reduce net exports. The net impact may be estimated by empirical work. Several recent empirical studies show that depreciation of the euro or a currency tends to increase exports (Magnani et al, 2011; Anaraki, 2014; Breuer and Klose, 2015), reduce imports (Magnani et al, 2011), improve the current account or trade as a percent of GDP (Magnani et al, 2011; Artus, 2012), improve the trade balance in the short run but not in the long run (Quarterly Report, 2011), reduce GDP (Artus, 2012), reduce GDP in Portugal, Austria, Hungary, Poland, Switzerland and Turkey but increase GDP in Finland, Germany and Sweden (Kalyoncu, Artan, Tezekici and Ozturk (2008), and has significant exchange rate pass-through (Cheikh and Rault, 2014).

IV. Empirical Results

The data were collected from IMF's *International Financial Statistics*, *Eurostat*, and the U.S. Federal Reserve Bank. Real GDP is measured in million euros. Government debt refers to the central government consolidated debt, and the debt-to-GDP ratio is measured in the percent. The real effective exchange rate is estimated based on the consumer price index, and an increase means an appreciation. The world real interest rate is represented by the real lending rate in the euro area. World real income is represented by the lagged German real GDP. The expected inflation is estimated as the average inflation rate of the past four quarters. The sample runs from 2000.Q1 to 2016.Q4 with 68 observations. The data for the debt-to-GDP ratio before 2000.Q1 is not available.

An analysis of the sample data in Figure 1 shows that there seemed to be a quadratic relationship between real GDP and the government debt-to-GDP ratio. The data for real GDP also exhibits seasonal variations. Hence, a quadratic form for the government debt-to-GDP ratio and seasonal dummy variables are included in the estimated regression:

$$Y^* = w(D, D^2, \varepsilon, R^*, S, Y^*, E, \pi^e, Q2, Q3, Q4) \quad (6)$$

It can be shown that the critical value of the debt-to-GDP ratio (D^*) corresponding to the maximum real GDP is given by:

$$D^* = \beta_1 / 2\beta_2 \quad (7)$$

where β_1 and β_2 are the estimated coefficients of D and D^2. Figure 2 shows that real GDP and the real effective exchange rate seemed to have a positive relationship during the sample period.

The unit root and cointegration tests are performed. We find that each of the time series variables has a unit root in level and is stationary in first difference and that regression residuals are stationary. Thus, these variables are cointegrated.

Table 1 presents empirical results. Approximately 90.87% of the change in real GDP can be explained by the exogenous variables. All the coefficients are significant at the 1% level. Real GDP and the debt-to-GDP ratio have a quadratic relationship, are positively associated with the real effective exchange rate, the real stock price, lagged German real GDP and three seasonal dummy variables, and are negatively influenced by the real lending rate in the euro area, the real crude oil price and the expected inflation rate. Based on equation (7), we estimate the critical value of the debt-to-GDP ratio to be 67.02%. Real GDP and the debt-to-GDP ratio have a positive relationship when the ratio is up to 67.02% and a negative relationship when the ratio is greater than 67.02%. In comparison, the current debt-to-GDP ratio of 130.4% is much greater than the threshold ratio of 67.02%.

V. Summary and Conclusions

This paper has examined the relationship between real GDP, the government debt-to-GDP ratio and other related variables. The IS-MP-AS model is applied. It finds that there is a quadratic relationship between real GDP and the debt-to-GDP ratio, suggesting that there is a critical value of the debt-to-GDP ratio corresponding to the maximum real GDP. The critical value is estimated to be 67.02%. Therefore, the current debt-to-GDP ratio of 130.4% is excessively high and tends to cause real GDP to decline.

In addition, real appreciation of the euro, a lower real lending rate in the euro area, a higher real stock price, a higher German real GDP and a lower expected inflation rate would be conducive to economic growth. Therefore, prudent fiscal policy in the form of less government debt or deficits would increase real GDP. The positive influences of real appreciation of the euro such as lower domestic inflation and more capital inflows would outweigh the negative impacts of fewer exports and more imports.

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Figure 1. Scatter Diagram between Real GDP (REALGDP) and the Debt-to-GDP Ratio (DEBTY)

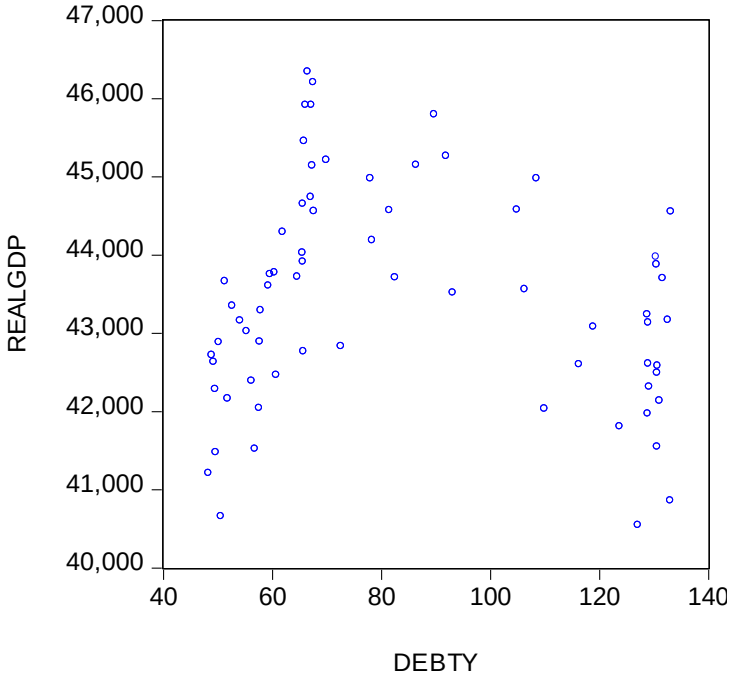

Figure 2. Scatter Diagram between Real GDP (REALGDP) and the Real Effective Exchange Rate (REER)

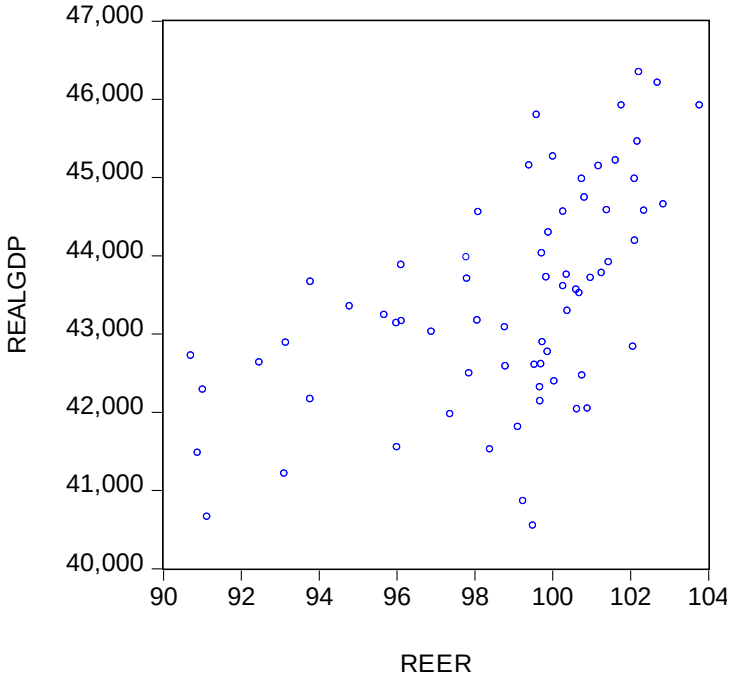

Table I. Estimated Regression of Log(real GDP) in Portugal

Variable	Coefficient	z-Statistic	Probability
C	-1.413924	-80.88509	0.0000
Log(Debt-to-GDP ratio)	1.935418	1579.998	0.0000
Log(Debt-to-GDP ratio)^2	-0.230118	-744.5877	0.0000
Log(Real effective exchange rate)	0.071625	17.97788	0.0000
Real lending rate in the euro area	-0.001708	-3.980667	0.0001
Log(Real stock price)	0.016651	9.246110	0.0000
Log(Lagged German real GDP)	0.575144	1405.121	0.0000
Log(Real crude oil price)	-0.011014	-7.575517	0.0000
Expected inflation rate	-0.006386	-11.75362	0.0000
Q2	0.034034	33.59867	0.0000
Q3	0.045756	30.43326	0.0000
Q4	0.032943	22.84323	0.0000
R-squared	0.908707		
Adjusted R-squared	0.890774		
Akaike information criterion	-6.399988		
Schwarz criterion	-5.943031		
Sample period	2000.Q1-2016.Q4		
Number of observations	68		
MAPE	0.7008%		

Notes: All the coefficients are significant at the 1% level. MAPE stands for the mean absolute percent error. The GARCH process is employed in estimating the parameters and the variance equation.

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