

Effects of the Euro Exchange Rate and Government Debt on Greece's Aggregate Output

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Abstract

This paper finds that aggregate output in Greece is positively influenced by real appreciation of the euro, lagged German output and labor productivity and negatively impacted by government debt as a percent of GDP, the real interest rate, the real oil price and the expected inflation rate. Therefore, recent euro depreciation and high debt/GDP ratio dampen the Greek economic growth whereas recent dramatic oil price decline tends to help the Greek aggregate output. The relatively high explanatory power and low forecast error suggest that the model works reasonable well.

Keywords: Euro Depreciation, Government Debt, Oil Prices, Foreign Income, Labor Productivity

JEL classification: F31, E62

I. Introduction

Greece's recent economic and financial crisis (Vlachopoulou, 2012; Breuss, 2015) has led to renewed interest in determining the impacts of euro depreciation and high government debt on its aggregate output. Euro depreciation is expected to stimulate Greece's exports, create more jobs and income, shift aggregate demand to the right, and increase real GDP (Anaraki, 2014; Breuer and Klose, 2015). On the other hand, euro depreciation tends to raise import prices and domestic inflation and shift short-run aggregate supply to the left. The net effect on aggregate output is unclear. Greece's government debt as a percent of GDP reached 178.6% in 2014 and was the highest among the 28 EU countries. As a result of the inability to pay back huge government sovereign debt in a timely manner (Visvizi, 2012; Frangakis, 2015), it was downgraded to a junk bond status as being highly or extremely speculative or in default with little prospect for recovery. The debt crisis, the banking crisis, capital flight, substantial cuts on pension and other government expenditures, slowdowns in business and economic activities, social unrest, etc. caused real GDP to decline 25.79% during 2007-2014 and the unemployment rate to rise to a high of 26.95% in 2014 (*eurostat*).

This paper focuses on whether real euro depreciation and/or high government debt as a percent of GDP would help or hurt Greece's economy. Other related variables such as the real interest rate, foreign income, the expected inflation rate, etc. will be considered as well.

II. The Model

We can express aggregate demand and short-run aggregate supply as:

$$Y^d = g(\pi, G, T, R, \varepsilon, E, Y^f) \quad (1)$$

$$\pi = h(\pi^e, Y^s, E, P) \quad (2)$$

where

Y^d = aggregate demand.

π = the inflation rate,

G = government spending,

T = government tax revenues.

R = the real interest rate,

ε = the real effective exchange rate,

E = the real oil price,

Y^f = foreign income,

π^e = the expected inflation rate,

Y^s = short-run aggregate supply, and

P = labor productivity.

In equilibrium, aggregate demand equals aggregate supply or $Y^d = Y^s$. We can solve for Y and π simultaneously and express the equilibrium Y as a function of the exogenous variables:

$$Y^* = f(\varepsilon, G - T, R, Y^f, E, P, \pi^e) \quad (3)$$

To measure the impact of government debt on real GDP, government deficit $G - T$ is replaced by D or government debt as a percent of GDP:

$$Y^* = z(\varepsilon, D, R, Y^f, E, P, \pi^e) \quad (4)$$

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The sign beneath each of the right-hand side variables represents the partial derivative of Y^* with respect to each of the exogenous variables.

We expect that the equilibrium real GDP in Greece has a negative relationship with the real interest rate and the expected inflation rate, a positive relationship with foreign income and labor productivity, and an unclear relationship with the real effective exchange rate, government debt as a percent of GDP and the real oil price.

Real euro depreciation is expected to increase exports, reduce imports and shift aggregate demand to the right and increase import costs and domestic inflation and shift short-run

aggregate supply to the left (Cheikh and Rault, 2014). Furthermore, real euro depreciation tends to cause capital outflows and reduce the demand for domestic assets and shift aggregate demand to the left. The net impact is unclear and needs to be verified empirically. Using a sample of 12 countries including Greece, Edwards (1986) reveals that currency devaluations are contractionary in the first year, expansionary in the second year and neutral in the long run. Based on a sample of 23 selected OECD countries, Kalyoncu, Artan, Tezekici and Ozturk (2008) indicate that currency depreciation may be contractionary, expansionary or neutral in the short run or long run. Using a sample of 13 countries including 5 European nations, Kim, An, and Kim (2015) find that currency devaluation tends to be expansionary in developed nations and contractionary in developing economies.

A change in government debt as a percent of GDP may affect real GDP positively or negatively. If the initial debt/GDP level is relatively small, an increase in the debt/GDP ratio to improve infrastructures may not cause too much concern. On the other hand, if the initial debt/GDP ratio is relatively high, a further increase in the debt/GDP ratio may raise the real interest rate and crowd out private spending. Empirical findings are inconclusive. Some studies (McMillin, 1986; Gupta, 1989; Darrat, 1989, 1990; Findlay, 1990; Ostrosky, 1990) maintain that a higher deficit/GDP ratio would not affect the real interest rate whereas other studies (Feldstein, 1982; Hoelscher, 1986; Cebula, 1997; Cebula and Cuellar, 2010; Gruber and Kamin, 2012; Cebula, 2014a, 2014b; Cebula, Angjellari-Dajci, and Foley, 2014) argue that a higher deficit/GDP ratio tends to raise the real interest rate and may reduce private spending and real GDP. Ferraz and Duarte (2015) find that a higher growth rate of public debt reduces the economic growth rate in PIIGS's countries and that the negative impact is slightly lower in Portugal.

A higher real oil price tends to shift short-run aggregate supply to the left and aggregate demand to the left as households are likely to reduce spending on other goods and services and net exports decline. Hence, the net effect tends to reduce real GDP (Hamilton, 1996). However, if a higher real oil price is caused by strong aggregate demand, the short-run effect may be positive whereas the long-run impact may be negative (Kilian, 2008b).

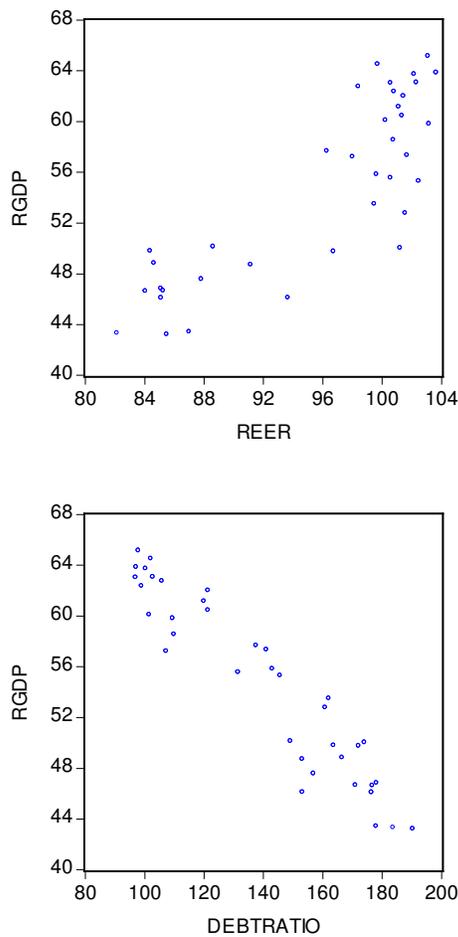
III. Empirical Results

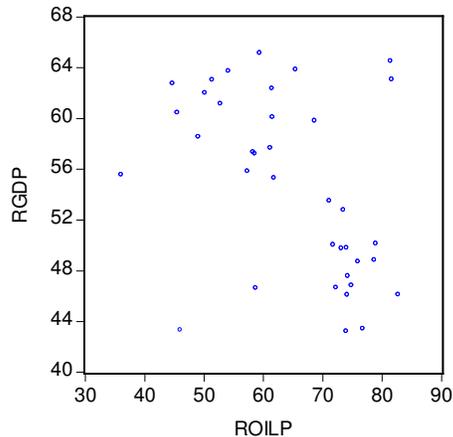
The data were collected from IMF's *International Financial Statistics* and European Commission's *Eurostat*. Real GDP is measured in billion euros. The real effective exchange rate is a trade-weighted exchange rate, and an increase indicates real appreciation of the euro. The real interest rate is represented by the nominal lending rate minus the expected inflation rate. Foreign income is represented by lagged German real GDP measured in billion euros. The real oil price is computed as the nominal oil price times the exchange rate (euros per U.S.

dollar) and deflated by the consumer price index. Labor productivity is defined as total real GDP divided by total employment and is expressed in thousand euros. The expected inflation rate is estimated as the average inflation rate in the last four quarters. The quarterly sample of 2006.Q1 – 2015.Q1 has a total of 37 observations. The data for the lending rate are not available before 2006.Q1.

Figure 1 shows scatter diagrams between real GDP and the real effective exchange rate, government debt as a percent of GDP or the real oil price. As shown, there seem to be a positive relationship between real GDP and the real effective exchange rate and a negative relationship between real GDP and government debt as a percent of GDP or the real oil price. It may suggest that real euro appreciation instead of real euro depreciation would raise real GDP.

Figure 1 Scatter Diagrams





Notes:

RGDP is real GDP in billion euros.

REER is the real effective exchange rate.

DEBTRATIO is the debt/GDP ratio.

ROILP is the real oil price.

An analysis of the data indicates that quarterly real GDP exhibits seasonal effects. Hence, the first quarter is chosen as the base quarter, and three dummy variables representing the second, third and fourth quarters are included in the estimated regression.

In the ADF unit root test, the critical values are -3.6210, -2.9434 and -2.6103 at the 1%, 5% and 10% level. Comparing with the values of the test statistic, we find that each of the time series variables has a unit root at the 5% level. According to the ADF test on the regression residuals, the value of the test statistic is estimated to be -3.6352, which is greater than the critical value of -3.6268 in absolute values at the 1% level. Thus, these time series variables are cointegrated.

Table 1 reports the estimated regression and relevant statistics. Approximately 98.28% of the variation in real GDP can be explained by the right-hand side variables. According to the F-test, the value of the test statistic of 114.4525 suggests that the whole regression is significant at the 1% level. The mean absolute percent error of 1.1003% shows that the forecast error is relatively small. All the coefficients are significant at the 1% level. Real GDP in Greece is positively associated with real appreciation of the euro, lagged German real GDP and labor productivity and is negatively influenced by government debt as a percent of GDP, the real lending rate, the real oil price and the expected inflation rate. The dummy variables for the second, third and fourth seasons have positive and significant coefficients.

Table 1 Estimated Regression of Log(real GDP) in Greece

	Coefficient	z-Statistic
Intercept	-3.491995	-5456.543
Log(real effective exchange rate)	0.862118	3602.596
Log(government debt/GDP ratio)	-0.183164	-923.8581
Real lending rate	-0.024020	-80.60877
Log(lagged German real GDP)	0.408097	69875.44
Log(real oil price)	-0.028844	-142.6884
Log(labor productivity)	0.789574	1413.216
Expected inflation rate	-0.023098	-87.44947
Dummy variable for the 2 nd season	0.012912	10.54404
Dummy variable for the 3 rd season	0.013143	15.82130
Dummy variable for the 4 th season	0.005787	5.692307
R-squared	0.982826	
Adjusted R-squared	0.974238	
Akaike info criterion	-5.706123	
Schwarz criterion	-5.140125	
F-statistic	114.4525	
MAPE	1.1003%	
Sample period	2006.Q1 – 2015.Q1	
Number of observations	37	
Methodology	EGARCH	

In percent terms and absolute values, the real effective exchange rate has the largest impact on real GDP, followed by labor productivity, lagged German real GDP and government debt as a percent of GDP. Specifically, a 1% increase in the real effective exchange rate results in a 0.8621% increase in real GDP. If labor productivity rises 1%, real GDP would increase 0.7896%. When lagged German real GDP increases 1%, real GDP rises 0.4081%. A 1% increase in government debt as a percent of GDP would lead to a 0.1832% decrease in real GDP. If the real oil price rises 1%, real GDP would decline 0.0288%, and vice versa. In viewing of substantial decline of oil prices since June 2014, its positive impact on real GDP would be significant.

Several other variables are considered to test whether regression results may change. If lagged German real GDP is replaced with U.S. real GDP, the value of R-squared is 0.9802. The coefficient of lagged U.S. real GDP is estimated to be -0.1081, which is insignificant at the 10% level. Other results are similar. When both lagged German real GDP and lagged U.S. real GDP are included in the estimated regression, the coefficient of lagged German real GDP is positive and significant at the 1% level whereas the coefficient of lagged U.S. real GDP becomes negative and significant at the 1% level mainly due to a high degree of multicollinearity. If the real exchange rate measured as units of the euro per U.S. dollar times relative prices in the U.S. and the euro area is used, its coefficient of -0.3969 is significant at the 1% level. The value of R-squared is 0.9670. The positive coefficient of lagged German real GDP is marginally significant. The negative coefficient of the real exchange rate is consistent with the result presented in Table 1 that real euro depreciation reduces real GDP in

Greece. In comparison, the trade-weighted real effective exchange rate would be a better measure as Greece has international trade with many countries.

IV. Summary and conclusions

We have examined the impacts of real euro depreciation, high government debt as a percent of GDP and other related variables on aggregate output in Greece. Real euro appreciation, a lower government debt as a percent of GDP, a lower real interest rate, a higher foreign income, a lower real oil price, a higher labor productivity or a lower expected inflation rate tends to increase aggregate output.

Recent euro depreciation, relatively high government debt as a percent of GDP, and relatively high bond yields are the negative factors in affecting aggregate output. On the other hand, rising German output, lower real oil prices and lower expected inflation rates are the positive factors in raising aggregate output. The Greek authorities need to bring down government debt as a percent of GDP at least to the EU average in order to establish credibility for international investors to reconsider investing in Greece.

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