Sustainable debt policies despite the crisis?

Empirical evidence for Iberian economies

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Abstract

This paper studies for the two major Iberian economies, Portugal and Spain, whether they pursue sustainable debt policies based on Bohn (1998)’s idea of a fiscal response mechanism. After presentation and discussion of theoretical reflections on the governmental budget, the empirical estimations are implemented with splines and panel regression. By accounting for time-varying coefficients it is possible to detect how the fiscal response has been modified or developed over time. The outcomes of both methods indicate sustainable fiscal behavior based on past observations of about the last 30 years for Portugal and Spain. However, the administration’s response to increasing debt ratios has weakened over the years in Portugal and, recently, also in Spain.

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1 Introduction

Europe - and many other parts of the world - has been hit hard by the financial and debt crisis and for over four years now the economic downswing with high unemployment, persistent budget deficits and rising public debt ratios troubles the affected economies. This concerns central European countries, like Germany and France, but also economies on the periphery, like Portugal, Ireland, Italy or Spain. The situation is especially severe in Greece: faced with huge deficits and imminent financial problems, a first 'rescue program' was organized for the Greek economy in spring 2010. It was financed mainly bilateral, including also IMF support, and covered 110 billion Euros.\(^1\) Aware of the serious difficulties, the European governments and institutions, namely the especially the European Central Bank (ECB) and the European Commission, agreed upon organization of instruments such as the European Financial Stabilization Mechanism (EFSM), the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM). In return for the financial assistance packages the beneficiaries have to agree to implement rigid austerity programs. Midway through this unpleasant situation are also Portugal and Spain. Both applied for financial assistance, Portugal in spring 2011 and Spain in summer 2012 with regards to its banking sector.

Despite the current crisis, even under 'normal' conditions sound fiscal performance is an important aspect. This especially holds true for monetary union members, such as Eurozone economies in Europe with the European Monetary Union (EMU) for instance, as they commit to one single monetary policy. Concerning Europe this relevance has been recognized by Article 121 of European Union (1997)'s Consolidated Version of the Treaty on European Union, which requires "the sustainability of the government financial position".\(^2\) Therefore, the central research question of this paper considers whether a sustainable fiscal policy can actually be found based on empirical evidence for the Iberian economies.

In fact the Iberian Peninsula consists of the four states of Andorra, Gibraltar (British territory), Portugal and Spain - however, the focus of this analysis is set on the two main

\(^1\) By now, a second package of 130 billions Euros is bundled.

\(^2\) Cf. also Fincke (2012, ch. 1).
economies Portugal and Spain since they represent the majority share of Iberia’s economic power. For instance, in 2008 Spain contributed 86.1 % and Portugal 13.6 % to the GDP of the Iberian Peninsula, while Andorra’s share was only 0.2% and Gibraltar’s of about 0.1 %.\(^3\) Within the European context the latter numbers even diminish, therefore this fiscal sustainability analysis concentrates on the Spanish and Portuguese economies.

A good impression of the recent economic situation and evolution - concerning the public finance perspective - can be gained by studying the interest rate spread development of Portugal and Spain. Here, the difference is based on calculations of the long-run government bond yield of the two Iberian economies compared to Germany.\(^4\)

![Figure 1: Iberian interest rates compared to German bonds (1979-2011) in %.

 Obviously, both economies profited from the proceeding European integration, both entered the EU in 1986, and the preparation of a common currency, with enforced sound fiscal performance, in terms of decreasing interest rates (compared to central European economies). This situation lasted for about the years of the 2000s, until, with the outbreak of the crisis the gaps started to widen again. This development distinctly displays the dynamics of the economics of European integration and accounts for volatility, here,

\(^3\) See Worldbank (2013) and Government of Gibraltar (2013) for the data. Numbers have been converted to US $.

\(^4\) Cf. International Monetary Fund (2013) for the data, author’s calculations. All estimations and plots have been implemented in R 2.9.0.
for the Iberian economies.

While sustainability itself is an old concept rooted in forestry sciences, indeed exactly 300 years old this year if Von Carlowitz (2000)'s "...nachhaltende Nutzung..." [in English: sustainable usage] is the reference, Burger (2003, 2005) claims that also the idea of the solvency of an economy or state has been existing for a long time, even though the term fiscal sustainability arose in the 1970s to 1980s. As regards central empirical literature contributions to fiscal or debt sustainability, certainly the seminal paper of Hamilton and Flavin (1986), who employ time series analysis, matters. Also Hakkio and Rush (1991)'s approach is of relevance, which studies the development of public revenues and expenditures and tests for cointegration. Moreover, Trehan and Walsh (1991) introduce a unit root approach considering the budget deficit. Furthermore, Bohn (1998) presents a test that is less dependent on interest rate assumptions and concentrates on the reaction of the primary surplus to changes in public debt, both relative to GDP. For a more detailed survey on applications of fiscal sustainability tests for Euro area members see Afonso (2005) or in a more recent study by Afonso and Jalles (2012) for instance. Also, a more comprehensive discussion on the terminology and the literature approaches can be found in Fincke (2012, ch. 2).

This paper studies the fiscal policy behavior of Portugal and Spain and whether it may be considered sustainable. The analysis especially focuses on Bohn (1998)'s fiscal response mechanism while also discussing country specific characteristics by utilizing time-varying coefficients in order to detect those circumstances. In order to check for robustness, the country-wise estimation results are supported by pooled regression outcomes. Concerning the technique splines and panel regression are performed. The remainder is organized as follows: section 2 briefly introduces the central theoretical concepts and section 3, first, introduces the methodology and, then, presents the empirical outcomes. Finally, section 4 summarizes the main results and concludes this paper.

\footnote{Cf. for instance Pittel (2002) or Grober (2007).}
2 Theoretical background

From a traditional public finance perspective a government usually decides on its public responsibilities - normally in a democratic way - which provides knowledge about the (expected) expenditures that come along with fulfilling them. Then, the administration has the duty to raise revenues in order to finance these disbursements.\footnote{Even though recent studies indicate that there is empirical evidence that the revenue volume may determine the spending, see for instance Afonso and Jalles (2012).} This signifies, however, that any government has to obey a central economic concept: balancing budgets. Therefore, in order to finance the primary expenditures, $G$, the government has to generate taxes, $T$, of (at least) the same amount. In case the latter are not sufficiently high enough, the government may issue bonds, $B$, with the purpose to fill the liquidity gap (i.e. deficits, $DEF$), this however also means that, once the country is a debtor, a new type of expenditures must be taken into account: interest payments, $rB$. Thus, the governmental budget can be expressed by the subsequent equation:\footnote{Cf. for instance Greiner et al. (2007) for these calculations. The notation refers to continuous and real variables.}

$$\frac{dB(t)}{dt} = G(t) - T(t) + r(t)B(t) = -S(t) + r(t)B(t)$$

with $t$ indicating time and the primary surplus, $S$, consists of $S(t) = T(t) - G(t)$. The solution of equation (1) - in present value terms - leads to the following two central conditions concerning public debt sustainability:\footnote{For a more detailed solution cf. Fincke (2012, ch. 3.1).}

$$B(0) = \int_0^\infty e^{-\int_0^\infty r(\phi)d\phi} S(\mu)d\mu \Leftrightarrow \lim_{t\to\infty} B(t) e^{-\int_0^t r(\mu)d\mu} = 0.$$  

The first part of (2), the present value borrowing constraint, expresses that the present value of upcoming primary surpluses must be equal to the initially existing amount of public debt, i.e. in $t = 0$. Strictly speaking it's expected primary surplus values. The second condition in (2), the No-Ponzi-Game condition, signifies that asymptotically the present value of public debt must converge to zero. A governmental debt policy that fulfills these requirements can be considered sustainable, cf. also Greiner et al. (2007, p. 197).

Now, taking Bohn (1998)'s idea into account, which principally states that the primary surplus to GDP ($s$) ratio is in a way determined by the debt to GDP ratio ($b$), gives:

$$s(t) = \theta b(t) + \omega$$

\begin{eqnarray*}
\end{eqnarray*}
with $\theta$, the parameter of interest, reflecting the reaction of the primary surplus ratio to variations in debt ratio and the constant $\omega$ expressing all other effects, both $\theta, \omega \in \mathbb{R}$. Combining Bohn (1998)'s idea with the governmental budget (1) from above, shows that a significant and positive reaction coefficient $\theta$ indicates sustainability - under certain conditions, see for instance Greiner et al. (2007). Further, if equation (1) is expressed in terms of ratios to GDP, $Y$, such a combination yields:

$$d \left( \frac{B(t)}{Y(t)} \right) = \left( r(t) - \gamma(t) - \theta \right) b(t) - \omega$$

with $\gamma$ denoting the GDP growth rate. Solving (4) for the public debt ratio indicates a more precise sustainability measure. Assuming a positive difference between the interest rate and the economic growth rate, $\tau - \gamma > 0$, here simplified to averages, the public debt ratio will asymptotically only remain bounded, i.e. converge to zero or stay constant for $t \to \infty$, if the reaction coefficient $\theta$ exceeds the positive average interest rate-growth rate gap, $\tau - \gamma$. For these reflections a finite constant upper value for $\omega$ is assumed, i.e. $|\omega| < \infty$, which is economically reasonable since it reflects (all other) effects on the primary surplus ratio. See Fincke (2012) or Fincke and Greiner (2011) for a more detailed analysis. Thus, the central aspect to test for sustainability addresses $\theta$.

Therefore, in order to assess sustainability a positive reaction coefficient is relevant as well as the difference between the interest rate and the growth rate. But despite the convenience, the approach does not come without shortages. For instance, there is a natural limit to Bohn (1998)'s reaction mechanism: since $S$ is financed out of GDP, $s$ cannot be increased without limit. Once that level has been reached the response test may not work anymore, see Fincke and Greiner (2011) for a profound argumentation. Finally, temporarily a country may well pursue a sustainable fiscal policy despite a rising debt ratio, this simply indicates that the positive reaction has not been strong enough to stabilize the debt ratio. Certainly, sooner or later the debt ratio should stabilize.

Nevertheless, Bohn’s approach is a strong test and used in the following section to study whether the Portuguese and Spanish economies implemented a sustainable fiscal policy.

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$^9$ For Iberia this assumption is also empirically reasonable as outlined in chapter 3.
3 Empirics

In order to assess fiscal sustainability according to Bohn (1998)'s approach, i.e. the relationship between the primary surplus ratio and the public debt ratio, first, the relevant assumptions have to be checked and some explanations on the dataset provide insight on the data structure. Then, a short introduction to the estimation technique is given in section 3.1 and, finally, in section 3.2 presents the test results.

Regarding the essential assumption on the interest rate and growth rate gap, the following table 1 summarizes the past empirical observations for Portugal and Spain respectively.\(^{10}\)

\[
(r - \bar{\gamma}) \text{ in } \% \\
\begin{array}{|c|c|c|}
\hline
& 1985-2011 & 1990-2011 \\
\hline
\text{Portugal} & 0.088 & 1.204 \\
\text{Spain} & 0.521 & 0.541 \\
\hline
\end{array}
\]

Table 1: Interest rate and growth rate gap for Portugal and Spain.

Accordingly, this difference is at least positive on average from the middle of the 1980s onwards. Therefore, the central precondition seems to be fulfilled empirically and the approach is applicable to the Portuguese and Spanish fiscal policy situation.

The dataset is mainly based on OECD (2013). Regarding the demarcation of the public sector the general government classification is used here, meaning all subordinated administrative levels and the social security system are included. Public debt is measured as gross financial liabilities, not taking assets into account. Only for the long run interest rate International Monetary Fund (2013)'s data, i.e. bond yields, are used, which are also the basis for the spread or gap calculation in order to capture the volatility and reflect the dynamics of European integration and the crisis development. All data are measured in annual frequency.

The next section briefly introduces the methodology of spline estimation and the merits of time-varying coefficients.

\(^{10}\) See OECD (2013) and International Monetary Fund (2013) for the data, author's calculations.
3.1 Methodology

For estimating the relationship between two - or eventually more - empirical variables regression analysis models are the most common approach, mainly performed in a parametric manner, i.e. OLS. A more flexible estimation technique with fewer assumptions can for instance be implemented by utilizing splines. They basically describe the systematic link between the variables by a flexible function, which is only required to be continuous and appropriately differentiable. For an introduction see for example Ruppert et al. (2003), Keele (2008), Kauermann (2006) or Greiner (2009).

Applied to the research questions of this paper, the relationship between the dependent variable, the primary surplus ratio $s$, and the explanatory variable, public debt ratio $b$, for both Iberian economies is to be estimated. The following graphics illustrate the initial situation for both countries: Portugal (1978-2011, solid lines), and Spain (1980-2011, dashed lines).\footnote{Cf. OECD (2013) for the data.}

Concentrating on the Spanish case for illustrative reasons, the subsequent plot 4 presents the central relationship between the primary surplus and debt, both relative to GDP.\footnote{Here the series has been extended to 2012 in order to include an additional crisis observation.}

Figure 2: Primary surplus to GDP ratio for Portugal and Spain.\hspace{2cm} Figure 3: Debt to GDP ratio for Portugal and Spain.
Figure 4: Primary surplus and debt to GDP ratio for Spain (1980-2012).

Obviously, no clear pattern is observable. The observations are mainly clustered around 60% debt ratio with varying primary balances. Maybe, another explanatory variable modifies this original relationship. Since Spain is an EMU economy, which has been shaped by European integration and recently by the crisis, as already visualized by the spreads in figure 1, an evidently modifying variable is 'time'. Thus, figure 5 shows the primary surplus to GDP ratio relationship from above conditioned on time. Here, decades have been chosen with the last plot containing the crisis observations.

Figure 5: Primary surplus and debt ratio for Spain (1980-2012) separated by decades.

Apparently, the relationship between the Spanish primary surplus ratio and its debt ratio
changes over the years. While there is an increasing pattern in the 1980s and 1990s (enforcing a sound fiscal position), stabilization can be observed in the 2000s with primary balances around 2.5% and debt ratio values around 55% - before the situation is plummeting due to the crisis.\footnote{Cf. also Fincke (2012, sec. 4.1.1) for a similar methodology motivation.}

Accordingly, an appropriate regression equation to capture this type of relationship is:

\[ s = f(t)b + \epsilon, \]  
\[ (5) \]

with \( \epsilon \) for the errors, being i.i.d \( N(0,\sigma^2) \). Including additional control variables the full estimation model is described by:

\[ s(t) = \omega_0 + \theta(t)b(t-1) + \omega_1Y_{Gap}(t) + \omega_2G_{Gap}(t) + \epsilon(t), \]  
\[ (6) \]

estimated separately for each economy. To account for business cycle influences, the output gap \( Y_{Gap} \) has been included, which is calculated as \( Y_{Gap} = \frac{Y-Y^*}{Y^*} \), with \( Y^* \) being the trend obtained from the Hodrick-Prescott filter. Similarly, an expenditure gap has been included \( G_{Gap} = \frac{GG-GG^*}{GG^*} \) with \( GG \) expressing the overall outlays of the government.

In order to back up these estimation outcomes, a panel regression using the standard linear model is additionally implemented, which combines time series analysis with cross sectional approaches. Meaning the whole (pooled) data set can be used to study the overall relationship between the Iberian primary surplus ratio and debt ratio. It also allows to control for country specific effects. Needless to say, then, the reaction coefficient in (6) becomes \( \theta \), while the rest of the model remains unchanged. See for instance Kleiber and Zeileis (2008) for details.

3.2 Estimation results

Using the Iberian data to estimate the fiscal response mechanism according to Bohn (1998), this chapter will, first, present the outcome of the spline estimation of equation (6). Subsequently, the panel data analysis result provides additional information.

Regarding the sign of the coefficients, a positive reaction coefficient is expected for the debt ratio corresponding to the theoretical reflections from above. For the business cycle
variable $Y_{Gap}$ a positive sign indicates counter-cyclical policy behavior and for the expenditure gap $G_{Gap}$ a negative sign can be expected, meaning in times of higher spending than usual, the primary surplus ratio will be affected negatively. Separate estimation of the regression equation (6) for Portugal (1978-2011) and Spain (1980-2011) yield the following results: \[14\]

| Variable | Coefficient | Std. Error | t-stat | P>|t| |
|----------|-------------|------------|--------|------|
| $Y_{Gap}$ | 0.30 | 0.097 | 3.11 | 0.004 |
| $G_{Gap}$ | -0.22 | 0.068 | -3.27 | 0.003 |

Table 2: Estimation results Portugal.

Both results show a significant and positive reaction coefficient, indicating sustainable debt policies, for Portugal and Spain. Moreover, the other parameters all show the expected signs and are statistically significant. The diagnostics suggest a suitable fit of the model. The interesting part is the time-dependent smooth term, $sm$, which is also statistically significant and indicates changes in the fiscal behavior over time. The plots of these smooth terms are depicted in figures 6 and 7 below. Please note, the plots are centered around the average value - thus, zero in the figures corresponds to the reaction coefficient values of table 2 and 3 respectively.

For Portugal, the graph shows a constantly decreasing shape. Economically, this run displays a declining emphasis of the Portuguese government on debt stabilization. Meaning, despite a positive reaction coefficient, the lack of the administration’s willingness or ability to put more effort on correcting the trend resulted in the increasing debt ratio, which has been illustrated in figure 3. Thus, this development plus facing the crisis finally helps to partially explain Portugal’s application for financial assistance in 2011.

Corresponding to the decomposition by decades in figure 5, figure 7 now mainly displays the reaction coefficient development over time: a more or less increasing trend until the middle of the 2000s, which has been turned around afterwards and deteriorated with the

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14 See OECD (2013) for the data. Initially, the regressions also included the interest rate gap, which however didn’t yield significant effects. Estimations performed with package mgcv.
crisis. Obviously, the time-varying coefficient estimation presents a good approximation of the underlying relationship.

However, the separate estimations included only about 30 observations. For a more robust analysis a panel estimation, which pools the data, has been estimated. The regression can either be conducted ’manually’, that is by Dummy variables for instance, or by using a package, for example `plm` as suggested by Kleiber and Zeileis (2008, ch. 3.6). Since accounting for country specific (fixed) effects did not render significant differences across the two economies, the overall (pooled) model is presented here. Table 4 summarizes the results.\footnote{Again, cf. OECD (2013) for the data. For symmetry reasons the years 1980-2011 are used for both countries, i.e. 64 observations.}

The panel estimation results confirm the significantly positive reaction coefficient, indicating fiscal sustainability for the Iberian economies based on past fiscal behavior over the last thirty years. This outcome, however, does not state, that this situation is automatically given for the future. Moreover, the applications for fiscal programs underline this point: stronger fiscal effort is essential for turning the negative trend of the response around.
Table 4: Panel estimation results (1980-2011).

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Stand. error (t-stat)</th>
<th>Pr(&gt;t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.048</td>
<td>0.011 (-4.246)</td>
<td>7.68 \cdot 10^{-5}</td>
</tr>
<tr>
<td>( b(t-1) )</td>
<td>0.052</td>
<td>0.019 (2.729)</td>
<td>0.008</td>
</tr>
<tr>
<td>( YGap(t) )</td>
<td>0.588</td>
<td>0.117 (5.010)</td>
<td>5.09 \cdot 10^{-6}</td>
</tr>
<tr>
<td>( GGap(t) )</td>
<td>-0.405</td>
<td>0.088 (-4.610)</td>
<td>2.16 \cdot 10^{-5}</td>
</tr>
</tbody>
</table>

\[ R^2(\text{adj}): 0.38 \quad \text{AIC: -290.78} \]

F Test (for ind. effects): \( F = 0.234 \ (df_1 = 1, df_2 = 59) \) \ p-value: 0.63

All in all, the tests suggest fiscal sustainability for Portugal and Spain despite the rising debt ratios.

4 Summary

The analysis of this paper has studied sustainability of public debt according to Bohn (1998)'s fiscal response mechanism. Accordingly, a fiscal policy is regarded as sustainable once the primary balance relative to GDP is enhanced in response to increasing debt ratios - like a corrective activity. Subsequently, based on the theoretical background, the concept has been transferred to the empirical methods of spline estimation and panel regression.

Empirically, such a sustainable fiscal behavior can be observed for both large Iberian economies, Portugal and Spain, based on data for about the last 30 years. This outcome is based on country specific semi-parametric estimations allowing for time-varying parameters and standard panel model estimation. However, the response has not been strong enough to turn the increasing trend of the debt ratio around. This also becomes clear in the development of the reaction (coefficient) over time: for both countries the response is languishing, especially severe recently with the proceeding of the crisis. Summing up, as a result the Portuguese and Spanish administration should enhance their effort concerning debt stabilization.
References


