Who dominates who within the euro area?
An empirical study of the Theory of the Price Level

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September 27, 2011

Abstract

The traditional view of inflation as a purely monetary phenomenon is challenged by the recent development of the Fiscal Theory of the Price Level in which the price level is determined by the government budget constraint. I take the theory to the data by studying whether fiscal policy has been of a Ricardian or non-Ricardian regime. I use a panel data set compromising eleven countries that adopted the euro in 2002 to test the presence of a non-Ricardian regime. I find no evidence that supports such an interpretation. On the contrary, the results suggest that the regime has been predominately Ricardian during the sample period.

Keywords: Fiscal Theory of the Price Level, EMU, Panel data analysis

*Comments and guidance during the writing process from Anna Larsson is gratefully acknowledged.
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1 Introduction

By signing the Treaty of Maastricht in 1992, political leaders around Europe marked the end of a three decades-long pursuit to establish a monetary union. It would also lay down the formal foundations of what would later become the common currency, the euro.

The unprecedented mission of unifying twelve economies with wildly different macroeconomic situations under one common currency called for a set of convergence criteria to be met by each member before adhesion to the monetary union. The convergence criteria originated from concerns raised by some members (foremost Germany) about the ability of other members to sustain the required monetary discipline. Five criteria were outlined in total and placed restrictions on inflation, long-term interest rates, exchange rates, budget deficits and public debt. With the completion of these criteria, and the subsequent adoption of the euro, each economy was effectively giving up one of its macroeconomic tools, the monetary policy. Moreover, constraints were also placed on each countries use of the other macroeconomic tool, fiscal policy. These constraints came in the form of the Stability and Growth Pact (SGP) which was adopted in 1997 (Baldwin and Wyplosz, 2004). Although the formulation of the Maastricht treaty and the SGP was to a large extent a political process, they were influenced by research on economic integration and macroeconomic policy.

Three authors; Woodford (1994); Sims (1994); Leeper (1991) have contributed to the understanding on the role of the fiscal policy in price determination. The theory, known as the Fiscal Theory of the Price Level (FTPL), explains how fiscal policy via the government budget constraint

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1 One interpretation is that the first three criteria dealt with the inflation since both long-term interest rates and stable exchange rates are only attainable under a low inflation-regime.
may affect the price level. Hence, could the theoretical predictions be verified, this would have important implications for the design of the monetary and fiscal regimes. This is generally true, but of the utmost importance in the European Monetary Union, in which the European Central Bank has been entrusted a single monetary policy regime while the 17 member states are pursuing their own independent fiscal policies.

The purpose of this thesis is to empirically identify the dominant regime within the countries that initially introduced the euro in 2002. As will be explained in the theoretical section, an empirical test of the FTPL is a test of whether fiscal policy has been Ricardian or non-Ricardian. In the former case, the price level is determined through the control of the monetary stock whereas in the latter case, the price level is determined by the government budget constraint.

The findings of this thesis are in favor of a Ricardian interpretation of the data. I do not find any evidence that supports that the fiscal policy has been of a non-Ricardian kind.

The results of this thesis are in line with previous contributions to the empirical literature on the FTPL. Perhaps the most well known are those by Canzoneri et al. (1998) and Bohn (1998). Canzoneri et al. (1998) estimate a VAR-model with liabilities and surpluses as per cent of GDP on data from the US. They find that a positive shock in surpluses reduces the outstanding debt in the next period. This seems to correspond to what one would expect from a Ricardian regime. Bohn (1998) adopts a similar approach but uses OLS. The debt-ratio is found to be positively correlated with the surplus for a large variety of specifications, including a business cycle indicator which suggests that U.S. policy makers react to unsustainably high debt by running surpluses. Studies on European data comprise the works of Creel and Bihan (2006) and Afonso (2002). Creel and Bihan (2006) study the primary and cyclical surplus together with the debt ratio
in very much the same fashion as Canzoneri et al. (1998). The countries of the study include Germany, France, Italy, the UK and the US. Bivariate VAR:s are estimated for each individual country. Afonso (2002) use a panel with fifteen members of the European Union, EU-15. None of the two studies find any support for the FTPL.

The rest of the paper is organized as follows. I present the theory as it is outlined in Woodford (1995) in section two. In section 3, I draw upon the theory to derive an empirically testable hypothesis on the FTPL. Moreover, in this section I also present the econometric methodology to be used in this thesis along with the sources and definitions of the data. Section 4 outlines the results and section 5 concludes.

2 Theoretical framework

2.1 Constraint or equality?

The aim of this section is to explain the Fiscal Theory of the Price Level as it is outlined in Woodford (1995). As opposed to the monetarist approach, in which the rate of inflation is fully determined by the growth rate of the money supply, Woodford shows in his paper that even if a central bank is fully committed to price stability, fiscal policy may still cause macroeconomic instability.

The very essence of the FTPL stems from a simple equation which states that the real value of outstanding debt must equal the present value of future surpluses and can be written as in equation 2.1.

\[
\frac{\text{Nominal debt}}{\text{Price level}} = \text{The present value of future surpluses} \quad (2.1)
\]

How should one interpret this equation? Obviously, debt must be repaid at some point. Therefore, it is logical that the real value of today’s debt
must equal the discounted value of future flows of surpluses. This assumes that today’s debt will eventually be repaid.

Some of the controversy over the FTPL also originates from this equation. Adherents of the FTPL consider it as an equilibrium condition, while opponents regard it as a constraint for policy makers to adhere to in setting fiscal policy. By regarding equation 2.1 as a constraint, policy makers, find themselves obliged to adjust expenditures and revenues in such a way that 2.1 holds with equality. However, advocates of the FTPL argue that the equation should not be regarded as a restriction on fiscal policy, but rather seen as an equilibrium condition. Therefore, when something threatens to violate 2.1, equilibrium may well be maintained by adjustments of the price level rather than adjustments of fiscal variables.

2.2 The Fiscal Theory of the Price Level

In this section, it is shown how fiscal policy can affect the price level in a closed economy with identical infinite-lived households. Throughout this section, uppercase letters denote nominal values while lowercase letters denote real values, deflated by the price level denoted \( p \). Households derive utility from consumption \( c_t \) and real money holdings \( M_t/p_t \), and maximize:

\[
\sum_{t=0}^{\infty} \beta^t U(C_t/p_t, M_t/p_t) \quad (2.2)
\]

where \( 0 < \beta < 1 \) is a discount factor. The utility function is increasing in its two arguments. Obviously, consumption, \( c_t/p_t \), increases utility. \( M_t/p_t \) represents the convenience of holding money for transactions. Households chose their level of consumption and monetary holdings subject to their budget constraint

\[
C_t + M_t + B_t \leq W_t + Y_t - T_t \quad (2.3)
\]
where $W_t$ stands for financial wealth. $T_t$ is a lump-sum tax levied on the households. $Y_t$ represents income and is thought of as an amount of consumption goods with which each household is endowed. Holdings of bonds, $B_t$ and money, $M_t$ will evolve according to:

$$W_{t+1} = M_t R^m_t + B_t R^b_t$$  \hspace{1cm} (2.4)

Household can choose between two forms of holding their wealth, nominal money and bonds. Holding wealth in money yields a return of $R^m_t$, which in this model will be assumed to be equal to 1. Bonds, on the other hand yield a return of $R^b_t$, assumed to be greater than 1.

Finally, households are required in every time period to chose a strict positive amount of consumption and nominal money holdings, $C_t, M_t \geq 0$. Moreover, households are bound by a borrowing limit, which implicates that they cannot borrow more than the present value of their lifetime production, according to:

$$W_t \geq -\sum_{j=0}^{\infty} \frac{Y_{t+j} - T_{t+j}}{\prod_{s=0}^{j-1} R^b_{t+s}}$$  \hspace{1cm} (2.5)

Households will hence plan their consumption path and monetary holdings according to 2.2 and 2.3 while meeting the non-negativity constraint of $C_t$ and $M_t$ and the borrowing limit as stipulated by 2.5.

The economy will be in equilibrium if the money holdings demanded by the representative household equal the money supplied by the government. Likewise, bonds demanded must equal the quantity of bonds issued by government and finally, purchases, both public and private must equal real income, the economy’s real endowments.

$$c_t + g_t = y_t$$  \hspace{1cm} (2.6)

where $g_t$ represents public consumption and is financed by taxes, seigniorage or newly issued debt. The financing constraint facing the government
will therefore take the following form:

\[ g_t = T_t + (M_t - M_{t-1}R_t^{m} - 1) + (B_t - B_{t-1}R_t^{b} - 1) \]  

(2.7)

At this point, it is useful to note that the government can only specify three of the variables \( M_t, R_{t-1}^{m}, B_t \) and \( R_{t-1}^{b} \). If the government decides to specify the quantity of \( B_t \) to issue, the price of it will be determined by the market. Similarly, if it sets the prices, e.g. specify \( R_{t-1}^{b} \) and \( R_{t-1}^{m} \), it must let the market allocate its desired share between the two assets.

For the above specified paths of consumption, savings and government purchases to represent a perfect foresight equilibrium, the present value of households consumption and money holdings cannot exceed the present value of net income plus initial wealth, \( W_0 \).

\[
\sum_{t=0}^{\infty} C_t + \Delta_t M_t \leq \sum_{t=0}^{\infty} Y_t - T_t + W_0
\]  

(2.8)

The paths of the household is then optimal if, and only if, the first-order conditions

\[
\frac{u_m(c_t, m_t)}{u_c(c_t, m_t)} = \Delta_t
\]  

(2.9)

\[
\frac{u_c(c_t, m_t)}{u_c(c_{t+1}, m_{t+1})} = \beta(1 + r_t^{b})
\]  

(2.10)

hold, where \( \Delta_t = \frac{(R_t^{b} - R_t^{m})}{R_t^{b}} \). Hence, \( \Delta_t \) can be seen as the ”price” of holding money. In 2.9, \( u_m \) and \( u_c \) are both normal goods, so that \( u_m/u_c \) is decreasing in \( m \) and increasing in \( c \). Then, this equation can be inverted to yield the liquidity demand function.

\[
m_t = L(c_t, \Delta_t)
\]  

(2.11)

This is the demand for liquidity as an increasing function of \( c_t \) and a decreasing function of \( \Delta_t \). Here, demand for liquidity only depends on pri-
vate purchases and to further illustrate this, equation 2.6 is substituted into 2.11 to yield

\[ m_t = L(y_t - g_t, \Delta_t) \]  

(2.12)

The second first-order condition represents the intertemporal consumption decisions taken by households. This equation can also be modified in order to obtain an IS equation. Substituting 2.6 and 2.12 into 2.10 yields

\[ \lambda(y_t - g_t, \Delta_t) = \beta(1 + r_{bt})\lambda(y_{t+1} - g_{t+1}, \Delta_{t+1}) \]  

(2.13)

By substituting 2.6 into 2.8 and dividing by \( p_t \) yields:

\[ \frac{W_0}{p_0} = \sum_{t=0}^{\infty} \left( \tau_t - g_t \right) + \Delta_t m_t \prod_{j=0}^{t-1}(1 + r_j) \]  

(2.14)

The optimizing household exhausts their budget constraint, implying that the budget constraint of the government must also hold. According to the budget constraint of the government, outlined in equation 2.14, the present value of future revenues must equal the real value of current liabilities. This equation is nothing less than equation 2.1 stated in the beginning of this section. This type of reasoning can, of course, be extended to any time period and equation 2.14 can hence be written as

\[ \frac{W_t}{p_t} = \sum_{s=t}^{\infty} \left( \tau_s - g_s \right) + \Delta_s m_s \prod_{j=t}^{s-1}(1 + r_j) \]  

(2.15)

This equation then implies that predetermined values of the nominal liabilities of the government, \( W_t \), and expectations regarding the future surpluses determine the price level. In this sense, prices will adjust to fiscal variables, and not the other way around. A decrease of the government surplus at some future date will make the RHS of equation 2.15 smaller than the LHS, assuming constant prices. Moreover, the reduction of future surpluses will expand the private budget constraint as described in
equation 2.3. This will enable households to increase consumption both at the current time period as well as planning for higher consumption in the future. This additional demand will result in inflationary pressure and, as a result, the price level will increase until it has reached such a level that household demand is in line with what the economy can supply and equation 2.15 is once again in equilibrium.

The mechanism in the model and the equilibrium forces at work within this framework suggest that the government budget constraint is a sensible starting point for price determination.

2.3 Ricardian or Non-Ricardian Regimes

Equation 2.15 suggests that fiscal factors are key when determining the price level. This stand in contrast to the monetarist approach, according to which equation 2.11 together with the money supply is key. However, until now, one important assumption has been excluded from the theoretical setup: that of the dominant regime. The findings of the previous section are not valid in one particular case. Imagine that tax collections are determined by a feedback rule of the following type.

\[
T_t = G_t - [M_t - R^m_{t-1}] + \gamma R^b_{t-1} B_{t-1}
\]  

(2.16)

Under this rule, the government collects taxes each date in order to cover its purchases less the savings on the outstanding monetary base, on which it does not have to pay any interest rate, plus a fraction of outstanding debt that it wishes to repay. Let \(\gamma\) be a parameter between 0 and 1. Government debt will evolve according to:

\[
B_t = (1 - \gamma) R^b_{t-1} B_{t-1}
\]

(2.17)

Equation 2.17 suggests that the government eventually will repay all
its debt, regardless of the price level or interest rates. This turns out to be a necessary and sufficient condition so that paths of $p_t$ and $R^b_t$ describe a perfect foresight equilibrium if they jointly satisfy 2.12 and 2.13. None of these conditions involve the initial level or debt, nor does the evolution of tax collection matter. Taken together, 2.16 suggests that the price level will evolve independently of any fiscal policy. If 2.16 holds, the economy will be in what Woodford calls a *Ricardian regime of monetary dominance*.

### 3 Methodology and Data

#### 3.1 Methodology

From the discussion in section 2.2, it is tempting to solve for $p_t$ in equation 2.15 and then estimate this equation empirically. However, such an empirical setup would be premature since, as outlined in section 2.3, the theoretical plausibility of the FTPL relies on the absence of a tax-collection rule like the one in equation 2.16. Therefore, to test the FTPL empirically, the focus has been on establishing whether fiscal policy has been conducted according to such a rule or not. Unfortunately, this approach is by no means simple to implement due to what has become be known within the literature as the observational equivalence (Canzoneri et al., 1998). The notion of observational equivalence stems from the fact that data on equation 2.15 are only observable in equilibrium. From equilibrium observations, however, one simply does not know if prices or fiscal variables adjust to ensure equilibrium. Imagine that there is a positive correlation between debt levels and surpluses, which in fact we observe in the data as pictured in Figure 1.

It would be tentative to draw the conclusion that this should be interpreted as a Ricardian regime by arguing that high levels of debt induce
fiscal policy makers to run large surpluses which would be used to reduce the debt burden. However, such a conclusion is premature since the FTPL provides an equally plausible explanation to the positive correlation. A non-Ricardian interpretation of the data would be that the order of causality goes in the reverse direction. Therefore, large surpluses make the RHS of equation 2.15 larger than the LHS. For the LHS to increase, the price level or nominal income would have to decrease, leaving the debt to GDP ratio inflated. Therefore, contemporaneous correlation can not be viewed as evidence in favor of the FTPL.

Generally speaking, in the literature, one can observe two distinct approaches to empirically test the FTPL. The first one is the backward-looking approach in which increases in the level of debt would lead to a less expansionary fiscal policy and, hence, positive surpluses. The other approach, called the forward-looking approach in which positive surpluses will reduce debt in the next period.² These two approaches can be summarized

²The labels, backward and forward are used by some authors, like Bajo-Rubio et al.
as follows:

Backward-looking:  \( \Delta b_t > 0 \rightarrow \Delta s_{t+1} > 0 \)

Forward-looking:  \( \Delta s_t > 0 \rightarrow \Delta b_{t+1} < 0 \)

A rejection of any of these hypotheses would indicate the presence of a non-Ricardian regime in which fiscal policy could potentially determine the price level.

The theory and the discussion presented above on how surpluses could, or could not, pass into lower debt, provide some possible guidelines on how to validate the FTPL empirically. For the backward-looking approach, the tax-collection rule presents us with a possible regime interpretation of the data. High debt in the previous period should induce governments to run surpluses in the current period. In this sense, \( \gamma \) may be interpreted as a parameter of political pressure or institutional arrangements such as the Maastricht treaty or the Stability and Growth Pact.

The forward-looking approach, which I will apply in this thesis, may be expressed as follows:

\[
Debt_{i,t} = \alpha_i + \gamma Debt_{i,t-1} + \delta Surplus_{i,t-1} + \beta Interest\ rate_{i,t} + \epsilon_{i,t} \tag{3.1}
\]

where \( Debt_{i,t} \) is country \( i \)’s net-financial liabilities as share of nominal GDP, \( \alpha_i \) is a country-specific unobserved effect, assumed to be constant over time, \( Surplus_{i,t-1} \) is the primary surplus as a share of nominal GDP in country \( i \) lagged one period and \( Interest\ rate_{i,t} \) is the long term interest rate on government bonds. The inclusion of the lagged dependent variable \( Debt_{i,t-1} \) as an explanatory variable is not in line with the theory but rather a tool to get rid of potential autocorrelation. Therefore, in most specification, \( \gamma \) will be allowed to differ from zero, i.e. the autoregressive

\[\text{(2009) but seem not to be a standard terminology.}\]
term will be included. The interest rate surely affects the debt since, given the surplus, a higher interest rate calls for each country to issue new debt just to cope with the interest payments on the outstanding debt. A higher interest rate will increase this burden and $\beta$ is expected to be positive. However, to some extent, interest rates may also reflect the debt situation of the country in question. A high debt induces creditors to demand higher interest rates in order to cover for the increased risk of default, the risk premium. Therefore, there might be a problem of endogeneity in which interest rates are not exogenously given but rather affected by the size of the debt, the endogenous variable. To assure that this does not affect the results, Interest rate_{i,t} will be omitted in some specifications as a part of a sensitivity analysis.

In a Ricardian-regime, surpluses are expected to reduce debt in the next period and we expect $\delta$ to be negative. On the other hand, in a non-Ricardian regime, we would expect changes in today’s surplus to be uncorrelated with the size of the debt in next periods, i.e. $\delta = 0$. However, such an interpretation of the data rests on the assumption that surpluses are not autocorrelated. If the reverse were to be true, $\text{Surplus}_{i,t-1}$ would be a good predictor of $\text{Surplus}_{i,t}$ and we would expect $\delta$ to be positive since a positive change of surpluses would cause the nominal income to decrease, in line with the theory. There is, however, one remaining case which must be addressed. According to the reasoning above, a negative $\delta$ is consistent with a Ricardian interpretation of the data. Such an interpretation may however not be valid if surpluses are found to be negatively autocorrelated. Then, in fact even a negative sign of $\delta$ is in line with a non-Ricardian regime. Therefore, if $\text{Surplus}_t$ were found to be negatively autocorrelated, any reliable conclusion on which regime has been dominant would be impossible to draw from the previous hypothesis. To rule out the possibility of negative autocorrelation, an autocorrelation function
will be used to test whether $Surplus_{i,t}$ is positively autocorrelated.

The backward-looking approach might appear a more convincing route since it is directly derived from the tax-collection rule which effectively rules out the possibility of a non-Ricardian regime, if tax collection is based on such a rule. However, by applying the forward-looking approach, I depart from the foundations of the FTPL by assuming that the fiscal policy tool is the surplus, not debt. Therefore, surpluses can be regarded as exogenous to debt since the real value of debt will evolve according to the path of the surpluses. This does not mean that authorities set fiscal policy without considering current debt, nor is this implied by the FTPL. Where the FTPL differs is the process (by price-level adjustments) by which government solvency is obtained, i.e. price-level adjustments (Christiano and Fitzgerald, 2000).

### 3.2 Econometric considerations

With access to time-series over almost 20 years, covering eleven countries, one approach is to estimate a model for each country, i.e. a pure time-series approach. Alternatively, the sample could be organized as a panel-data set and estimated by estimators designed to handle the particular structure of panel data. The two most frequently used estimators in panel data analysis are the **fixed effects model** and the **random effects model**. The common feature of these two estimators is their capacity to handle unobserved effects, denoted $\alpha_i$ in equation 3.1. This term is assumed to be constant over time but may vary across countries. In a macroeconomic model, this term may correspond to elements such as institutions and political culture. These factors can of course change over time but may be slow in doing so and it is therefore possible to treat them as time-invariant. The choice between the fixed and the random-effects model depends on the assumptions regarding the correlation between this unobserved effect,
\( \alpha_i \) and other explanatory variables, such as Surplus_{i,t}. If it is assumed that \( \text{corr}(\text{Surplus}_{i,t}, \alpha_i) \neq 0 \), one should pick the fixed effects model. However, if \( \text{corr}(\text{Surplus}_{i,t}, \alpha_i) = 0 \) holds, the random effects model should be used. In this context, there are two arguments why fixed effects may be preferred instead of random effects. First of all, in a random effects model, we think of the sample as being randomly drawn from a larger population. The sample studied in this thesis can hardly be considered randomly drawn. On the contrary, it has been drawn due to the adoption of the euro in 1999. Moreover, unobserved effects, such as institutions will probably affect how fiscal policy is handled within the economy. I therefore expect unobserved effects to be correlated with the explanatory variable, surplus, an assumption that would favor the use of the fixed effect model. However, it is quite common to report both estimates and also include the OLS-estimator since this can shed light on the country specific variation within the data. The OLS-estimator ignores the panel data structure altogether.

Before one can proceed to estimate a specification like the one stipulated in 3.1, one has to deal with some of the properties of the data. Two of these stem from the time-dimension of the sample. As always, one has to verify that the series are stationary. Each variable from each panel will therefore be tested for a unit root using the Augmented Dickey Fuller (ADF) test. Moreover, even if a series does not contain a unit root, it might still be highly persistent. A failure to take this into account will render autocorrelated residuals which in turn can reduce the estimated variance. Therefore, appropriate tests will be conducted in an attempt to detect the presence of autocorrelation. I follow the method proposed by Wooldridge to test for autocorrelation in the fixed effects model and the OLS (Wooldridge, 2002) and use the Breusch and Pagan Lagrange Multiplier test to detect potential autocorrelation in the random effects model (Breusch and Pagan, 1980).
The inclusion of the lagged dependent variable as an explanatory variable may solve the problem of autocorrelation. However, it creates another problem since the lagged dependent variable by assumption is correlated with the error term. One estimator which deals with this problem is the Arellano-Bond estimator (Arellano and Bond, 1991). This estimator starts by taking the first difference of the model. This does not solve the problem but instead of using the first difference of the lagged variable, it uses an instrument, the first difference lagged two periods. In this way, the correlation between the error term and the lagged dependent variable is eliminated and one can obtain an unbiased estimate of the model (Green, 2002).

3.3 Data

I use a panel-data set of the initial eleven countries adopting the euro at the launch of the monetary union. These countries are Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain. The data-set ranges from 1992 to 2010 and includes three macroeconomic variables; net-financial liabilities as a share of nominal GDP, the primary surplus as a share of nominal GDP and the long-term interest rate on government bonds. All the data are annual, rendering a total of 20 time-series observations for each variable and country. All of the variables are taken from the OECD Economic Outlook No 89. In Greece’s case, data are missing between 1991 to 1994 for all three variables. Irish data on liabilities are missing from 1991 up until 1997. Portuguese data on liabilities are missing from 1991 up until 1994.

Net-financial liabilities include debt and other liabilities (i.e. obligations) that the government sector has, both on a short- and long-term ba-

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3Greece was forced to postpone its adoption of the euro due to failure to comply with the convergence criteria. Luxembourg was excluded from the sample due to lack of data.
Table 1: Mean of debt and surplus as share of GDP and the inflation rate

<table>
<thead>
<tr>
<th>Country</th>
<th>Debt</th>
<th>Surplus</th>
<th>CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>36.13511</td>
<td>-.0751152</td>
<td>2.061833</td>
</tr>
<tr>
<td>Belgium</td>
<td>95.8943</td>
<td>3.568835</td>
<td>2.008758</td>
</tr>
<tr>
<td>Finland</td>
<td>-36.9918</td>
<td>.2787892</td>
<td>1.55603</td>
</tr>
<tr>
<td>France</td>
<td>38.90243</td>
<td>-1.167281</td>
<td>1.638173</td>
</tr>
<tr>
<td>Germany</td>
<td>36.8201</td>
<td>-.1100512</td>
<td>1.886953</td>
</tr>
<tr>
<td>Greece</td>
<td>87.30695</td>
<td>-.7257031</td>
<td>5.659275</td>
</tr>
<tr>
<td>Ireland</td>
<td>18.21186</td>
<td>.1739244</td>
<td>2.48716</td>
</tr>
<tr>
<td>Italy</td>
<td>97.27682</td>
<td>2.420754</td>
<td>2.793404</td>
</tr>
<tr>
<td>Netherlands</td>
<td>38.69503</td>
<td>.8359753</td>
<td>2.176362</td>
</tr>
<tr>
<td>Portugal</td>
<td>40.30267</td>
<td>-1.00389</td>
<td>3.350431</td>
</tr>
<tr>
<td>Spain</td>
<td>39.73781</td>
<td>-.3699203</td>
<td>3.209842</td>
</tr>
<tr>
<td>Total</td>
<td>44.9819</td>
<td>.3634813</td>
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</tr>
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</table>

sis. The proper government assets, deposits or holdings in private sector companies have been subtracted from gross-financial liabilities in order to obtain the net-value. The surplus of a government budget is revenues less expenditures. I use the primary surplus, i.e. the surplus net of expenses due to interest-payments on outstanding debt. In this sense, the variable captures the changes in the fiscal stance in the current year. The long-term interest rate on government bonds is the average of the daily rates on the yield of government bonds. For most countries in the sample, they refer to bonds with a maturity of ten years.
3.4 Data Description

The focus of this thesis is to empirically validate the FTPL by testing a set of hypothesis econometrically. While econometric tools may be very useful, a simple descriptive analysis of the data may also provide insightful conclusions. Therefore, this section will thus briefly outline some of the main features of the data.

Table 1 provides the mean of the two fiscal variables used in this thesis along with the mean of the annual inflation rate. The debt has been positive for all countries except Finland. In fact, all countries except Finland have had a positive debt, i.e. have been indebted, in every single year between 1992 and 2010. As can be verified by Figure 2, great heterogeneity exists among the EMU countries with respect to both the evolution and the size of the debt. The debt has been increasing in France, Germany, Greece and Portugal, whereas Belgium, Netherlands and, to some extent Ireland and Spain, have managed to reduce their debt, albeit it has increased dramatically in the two former countries in 2009 and 2010. Three countries (Belgium, Greece and Italy) stand out for their high level of debt (an average of 95 per cent), while the rest of the countries have had more moderate levels (an average of 27 per cent).
Figure 2: Debt as % of GDP, by country
Figure 3: Surpluses and inflation rate, by country
Table 2: Autocorrelation of $Surplus_t$

<table>
<thead>
<tr>
<th>Country</th>
<th>Autocorrelation</th>
<th>Q</th>
<th>Prob&gt;Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.4207</td>
<td>3.923</td>
<td>0.0476</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.6587</td>
<td>9.619</td>
<td>0.0019</td>
</tr>
<tr>
<td>Finland</td>
<td>0.7631</td>
<td>12.907</td>
<td>0.0003</td>
</tr>
<tr>
<td>France</td>
<td>0.6209</td>
<td>8.5445</td>
<td>0.0035</td>
</tr>
<tr>
<td>Germany</td>
<td>0.2094</td>
<td>0.97231</td>
<td>0.3241</td>
</tr>
<tr>
<td>Greece</td>
<td>0.7489</td>
<td>10.769</td>
<td>0.0010</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.4895</td>
<td>5.3108</td>
<td>0.0212</td>
</tr>
<tr>
<td>Italy</td>
<td>0.6572</td>
<td>9.5731</td>
<td>0.0020</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.3596</td>
<td>2.8659</td>
<td>0.0905</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.3665</td>
<td>2.9779</td>
<td>0.0844</td>
</tr>
<tr>
<td>Spain</td>
<td>0.6621</td>
<td>9.7172</td>
<td>0.0018</td>
</tr>
</tbody>
</table>

Figure 3 plots surpluses together with the inflation rate. According to the theory, positive surpluses should translate into a lower price level. Any conclusion is of course difficult to draw due to the complexity of the data. Anyhow, Figure 3 together with Table 1 reveal some interesting features. The overall average of the surplus has been a mere 0.36 per cent. However, the averages in Austria, France, Germany, Greece, Portugal and Spain have been negative, indicating deficits. Hence, three of the EU-4 have had a negative primary surpluses.  

4 This bleak picture of the public accounts should be considered in light of the last years’ economic turmoil during which several countries have incurred large deficits. If the last two years are disregarded, the overall average of the surplus is 1.17 per cent. The inflation rate has varied across countries but one, if any, common feature may be detected. Starting in the mid nineties, the inflation rate seems to

---

4France, Germany, Italy and Spain have come to be known as the EU-4 due to the size of their economy.
have converged towards two per cent. In some countries, like Greece and Portugal, this convergence has been evident but a similar pattern is also visible in the case of Austria, Italy and Spain.

Given the discussion in 3.2, one could not distinguish between a Ricardian and a non-Ricardian regime if $\text{Surplus}_t$ were found to be negative autocorrelated, that is a positive surplus in one period is followed by a negative surplus in the next period. Table 2 provides the Q-statistics from the autocorrelation function of $\text{Surplus}_t$ for each country. There is no evidence suggesting that $\text{Surplus}_t$ may be negatively autocorrelated. Hence, we may conclude that a negative and significant sign of $\delta$ may be viewed as evidence in favor of a Ricardian regime.

4 Results

This section presents the empirical results from estimating the model as it is specified in equation 3.1. Four different estimators will be used: fixed effects (FE), random effects (RE), OLS and the Arellano-Bond (A-Bond) estimator.

In an initial specification, lagged debt is excluded. These estimates are presented in the first three columns in Table 3. The estimates of the FE ($-1.520$) and RE ($-1.498$) model are both significant and negative. In the third estimation, where OLS has been used, the coefficient is positive ($1.555$) but insignificant. From these results, only the OLS-estimate provides some support for a non-Ricardian interpretation of the data whereas both the FE and RE model suggest a Ricardian interpretation. The estimated effect of $\text{Interest rate}_t$ is positive but only significant using the OLS estimator.

However, the residuals from all three estimations in columns (1) - (3) are autocorrelated and therefore, the variance is probably overestimated.
Moreover, given the contemporaneous positive correlation between *Surplus* and *Debt*, the omission of the latter is likely to bias upwards the estimate of the former. In fact, the size of the coefficients does not make economic sense even if the data is interpreted from a Ricardian point of view. Autocorrelation can arise for several reasons. Such factors include sluggishness of economic time series, the omission of an significant explanatory variable or the existence of pure autocorrelation (Gujarati, 2003). In this case, the autocorrelation detected in the three first columns is likely a result of not taking into account the persistence of the variable *Debt*$_t$, as discussed in section 3.2.

In order to eliminate the autocorrelation detected in columns (1) - (3), *Debt* lagged one period, *Debt*$_{t-1}$ is included as an explanatory variable in columns (4) - (7). None of these estimations are plagued by autocorrelation in the residuals and it is hence possible to draw more reliable conclusions from this set of estimations. As expected, both the coefficients and the variance are lower (in absolute values) in all specifications in which *Debt*$_{t-1}$ has been included. All estimates of *Surplus*$_{t-1}$ are negative and significant and can be interpreted as evidence against the FTPL. Given that, independent of estimator, the coefficient ($\delta$), is close to unity - in fact their upper 95 per cent-confidence intervals all include unity - it is tempting to draw the conclusion that surpluses are used one by one to reduce outstanding debt. The random effects estimator and the OLS estimator are equal for all variables, implying that the country specific variation is relatively unimportant.\(^5\) Moreover, the Arellano-Bond estimator is almost identical to the fixed effects-estimator. With the inclusion of *Debt*$_{t-1}$, *Interest rate*$_t$ becomes significant in all specifications.

\(^5\)This is a good example of how the estimation of a random effects model provides insightful information even if the researcher believe that the “correct” model is one of fixed effects.
Table 3: Estimates of equation 3.1 - Dependent variable: $Debt_t$

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FE</td>
<td>RE</td>
<td>OLS</td>
<td>FE</td>
<td>RE</td>
<td>OLS</td>
<td>A-Bond</td>
<td>FE</td>
<td>RE</td>
<td>OLS</td>
<td>A-Bond</td>
</tr>
<tr>
<td>$Surplus_{t-1}$</td>
<td>-1.520***</td>
<td>-1.498***</td>
<td>1.555</td>
<td>-0.994***</td>
<td>-0.865***</td>
<td>-0.865***</td>
<td>-0.996***</td>
<td>-1.073***</td>
<td>-0.923***</td>
<td>-0.923***</td>
<td>-1.067***</td>
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<tr>
<td></td>
<td>(0.396)</td>
<td>(0.333)</td>
<td>(1.062)</td>
<td>(0.293)</td>
<td>(0.204)</td>
<td>(0.204)</td>
<td>(0.292)</td>
<td>(0.269)</td>
<td>(0.198)</td>
<td>(0.198)</td>
<td>(0.276)</td>
</tr>
<tr>
<td>$Interest\ rate_t$</td>
<td>0.667</td>
<td>0.686</td>
<td>3.142**</td>
<td>0.579**</td>
<td>0.478***</td>
<td>0.478***</td>
<td>0.597**</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.966)</td>
<td>(0.419)</td>
<td>(1.288)</td>
<td>(0.246)</td>
<td>(0.157)</td>
<td>(0.157)</td>
<td>(0.283)</td>
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</tr>
<tr>
<td>$Debt_{t-1}$</td>
<td>0.845***</td>
<td>1.005***</td>
<td>1.005***</td>
<td>0.812***</td>
<td>0.850***</td>
<td>1.009***</td>
<td>1.009***</td>
<td>0.824***</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>(0.0178)</td>
<td>(0.0437)</td>
<td>(0.0497)</td>
<td>(0.0179)</td>
<td>(0.0179)</td>
<td>(0.0467)</td>
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<td></td>
<td></td>
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<tr>
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<td>196</td>
<td>196</td>
<td>194</td>
<td>194</td>
<td>183</td>
<td>194</td>
<td>194</td>
<td>194</td>
<td>183</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.157</td>
<td>0.037</td>
<td>0.802</td>
<td>0.979</td>
<td>0.793</td>
<td>0.978</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Number of id</td>
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<td>11</td>
<td>11</td>
<td>11</td>
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<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>$\beta = 0$</td>
<td>$\beta = 0$</td>
<td>$\beta = 0$</td>
<td>$\beta = 0$</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 4: Estimates of equation 3.1 - Dependent variable: $\Delta Debt_t$

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta Surplus_{t-1}$</td>
<td>-1.035***</td>
<td>-1.037***</td>
<td>-1.037***</td>
<td>-0.978**</td>
<td>-0.985***</td>
<td>-0.987***</td>
<td>-0.951**</td>
<td>-0.985***</td>
<td>-0.959***</td>
</tr>
<tr>
<td></td>
<td>(0.323)</td>
<td>(0.251)</td>
<td>(0.255)</td>
<td>(0.336)</td>
<td>(0.259)</td>
<td>(0.262)</td>
<td>(0.342)</td>
<td>(0.258)</td>
<td>(0.260)</td>
</tr>
<tr>
<td>Interest rate$_t$</td>
<td>1.012***</td>
<td>0.946***</td>
<td>0.917***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.275)</td>
<td>(0.263)</td>
<td>(0.260)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta Interest rate_{t}$</td>
<td></td>
<td></td>
<td>-0.443</td>
<td>-0.424</td>
<td>-0.415</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td>(0.688)</td>
<td>(0.476)</td>
<td>(0.475)</td>
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<td></td>
</tr>
<tr>
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<td>185</td>
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</tr>
<tr>
<td>R-squared</td>
<td>0.176</td>
<td>0.163</td>
<td>0.111</td>
<td>0.185</td>
<td>0.185</td>
<td>0.185</td>
<td>0.185</td>
<td>0.185</td>
<td>0.185</td>
</tr>
<tr>
<td>Number of id</td>
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<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Restrictions</td>
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<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
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<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
</tr>
<tr>
<td></td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
<td>$\gamma = 0$</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
In the remaining four specification, interest rate, has been excluded due to the potential problem of endogeneity discussed in section 3.1. As can be verified in column (1) - (7), the estimates of \( \beta \) are positive but this could hence be a result of reversed causality. The omission does not alter the overall results. \( Surplus_{t-1} \) remains negative and significant in all specifications. The coefficients are slightly higher while the standard errors are slightly lower. More importantly, the conclusion from the previous estimations remains valid; the data suggest a Ricardian interpretation of the fiscal policy conducted in the EMU countries between 1992 and 2010.

The close to unity estimates of the effects of \( Debt_{t-1} \) raise the concern that these series, rather than being stationary as assumed until now, contain a unit root. Indeed, the results from ADF-tests presented in Table A1 indicate that \( Debt_t \) contains a unit root for some countries (Belgium, Finland, Ireland and Portugal). \( Surplus_t \) also contains a unit root for some of the countries (Belgium, Finland, France and Ireland) whereas \( Interest rate_t \) is stationary for all countries. As is well known, regressions using non-stationary data may produce false results. Significant results may appear where in reality there are none. Therefore, equation 3.1 will also be estimated with debt and surplus in first differences. The results are presented in table 4. The interpretations of the coefficients do not change: a negative sign of \( Surplus_{t-1} \) still indicates a Ricardian regime of monetary dominance whereas an insignificant or positive sign suggest a non-Ricardian regime. Table 4 presents the results. Independent of estimator, the coefficients of \( Surplus_{t-1} \) are similar and close to unity, regardless of whether \( interest rate_t \) is estimated in levels (columns (1) - (3)), in first differences (columns (4) - (6)) or excluded (columns (7) - (9)). These results further strengthen the case for a Ricardian interpretation of the data. Since \( Interest rate_t \) is stationary, a priori there is no need to estimate this variable in first differences. However, a more homogenous approach is ob-
tained by estimating the entire model in first differences, albeit at the cost of losing some variation in Interest rate_t.

4.1 Robustness and sensitive analysis

In equation 3.1, I have implicitly assumed homogenous effects by not indexing δ. It is however possible that some countries’ fiscal policies have been Ricardian while others’ have not. Moreover, the type of regime may have shifted over time. In order to investigate these possibilities, this section seeks to test the robustness of the above found results. The robustness test will take two dimensions. First, the sample-period will be divided into two periods; one before 2002 when each country had their own currency and one after 2002 when these countries shared a common currency. This is the time dimension of the robustness test. Second, I will divide the countries into two groups with respect to the size of their respective economy. The first subgroup will contain the already mentioned EU-4, France, Germany, Italy and Spain. The second group naturally contains the rest of the sample, Austria, Belgium, Finland, Greece, Ireland, Netherlands and Portugal. This is the country dimension. This type of analysis adds to the credibility of the results presented so far and provides a more complete picture. One drawback of the robustness test is however the limitations it imposes on the number of observations available. The sample I use in this thesis is already limited, compromising eleven countries over 20 years. Studying a sub-period or a subset of countries reduces an already small sample. This can affect the properties of the estimators.

With this in mind, Table 5 presents the results from the time dimension of the robustness test. The OLS estimator has been left out since it coincides with the random effects model. Estimations in columns (1) - (3) are based solely on observation prior to the introduction of the euro whereas the results in columns (4) - (6) are based on observations post 2002. The
Table 5: Time dimension - Dependent variable: $Debt_t$

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FE</td>
<td>RE</td>
<td>A-Bond</td>
<td>FE</td>
<td>RE</td>
<td>A-Bond</td>
</tr>
<tr>
<td>$Surplus_{t-1}$</td>
<td>-1.000**</td>
<td>-0.443</td>
<td>-1.033**</td>
<td>-1.086***</td>
<td>-0.989***</td>
<td>-0.991***</td>
</tr>
<tr>
<td></td>
<td>(0.382)</td>
<td>(0.373)</td>
<td>(0.449)</td>
<td>(0.334)</td>
<td>(0.233)</td>
<td>(0.302)</td>
</tr>
<tr>
<td>$Interest\ rate_t$</td>
<td>-0.0983</td>
<td>0.833***</td>
<td>-0.189</td>
<td>2.799**</td>
<td>2.161**</td>
<td>2.798***</td>
</tr>
<tr>
<td></td>
<td>(0.424)</td>
<td>(0.252)</td>
<td>(0.467)</td>
<td>(1.082)</td>
<td>(0.881)</td>
<td>(0.972)</td>
</tr>
<tr>
<td>$Debt_{t-1}$</td>
<td>0.579***</td>
<td>0.995***</td>
<td>0.506***</td>
<td>0.767***</td>
<td>0.991***</td>
<td>0.823***</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.0373)</td>
<td>(0.135)</td>
<td>(0.0442)</td>
<td>(0.0230)</td>
<td>(0.0418)</td>
</tr>
</tbody>
</table>

Observations        | 95          | 95          | 84          | 99          | 99          | 99          |
R-squared            | 0.542       |             |             | 0.727       |             |             |
Number of id         | 11          | 11          | 11          | 11          | 11          | 11          |
Restrictions         | Sample from 1992 to 2001 | Sample from 2002 to 2010 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

results suggest that fiscal policy has been of a Ricardian type, both before 2002 and after. The sign of $Surplus_{t-1}$ is negative and significant in all six estimations except for the random effects model in column (2). Besides column (2) then, the estimates of $\delta$ are close to unity and hence similar to those in Table 3. Thus, the fiscal policy in the sample seem to have been Ricardian, independent of the time period studied.

The results from the country dimension of the robustness test is presented in Table 6. Again, the OLS estimator coincides with the random effects model and has therefore been omitted. The three first columns, (1)
Table 6: Country dimension - Dependent variable: $Debt_t$

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surplus$_{t-1}$</td>
<td>-0.568</td>
<td>-0.490***</td>
<td>-0.564**</td>
<td>-1.143**</td>
<td>-0.951***</td>
<td>-1.145***</td>
</tr>
<tr>
<td></td>
<td>(0.280)</td>
<td>(0.172)</td>
<td>(0.238)</td>
<td>(0.371)</td>
<td>(0.250)</td>
<td>(0.343)</td>
</tr>
<tr>
<td>Interest rate$_t$</td>
<td>0.418**</td>
<td>0.500**</td>
<td>0.424***</td>
<td>0.902</td>
<td>0.486**</td>
<td>0.937*</td>
</tr>
<tr>
<td></td>
<td>(0.121)</td>
<td>(0.210)</td>
<td>(0.130)</td>
<td>(0.534)</td>
<td>(0.232)</td>
<td>(0.515)</td>
</tr>
<tr>
<td>Debt$_{t-1}$</td>
<td>0.869***</td>
<td>0.983***</td>
<td>0.859***</td>
<td>0.808***</td>
<td>1.007***</td>
<td>0.802***</td>
</tr>
<tr>
<td></td>
<td>(0.0274)</td>
<td>(0.0193)</td>
<td>(0.0297)</td>
<td>(0.0761)</td>
<td>(0.0208)</td>
<td>(0.0683)</td>
</tr>
<tr>
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<td>76</td>
<td>72</td>
<td>118</td>
<td>118</td>
<td>111</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.827</td>
<td></td>
<td></td>
<td></td>
<td>0.803</td>
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<td>Sample with EU-4 excluded</td>
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</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

- (3) present the estimation based only on observations from the EU-4. The picture of a Ricardian regime is not as convincing as in previous specifications. The fixed effect model is negative but with a much lower coefficient ($-0.568$) than in previous specifications using the fixed effect model.
More importantly, it is not significant which thus would indicate that the fiscal policy in these countries has been of a non-Ricardian type. However, such a conclusion may be premature if the results of the two other models (RE and A-Bond) are considered. In particular, the Arellano-Bond estimator which in previous specifications has been similar to the fixed effects
model produces a negative and significant estimate of $\delta$. The coefficient is almost identical ($-0.564$ compared to $-0.568$) while the standard errors are slightly lower ($0.238$ compared to $0.280$). The random effects model is negative and significant but only at the 10 per cent level. Taken together, these results suggest that the insignificance of the fixed effects model may be due to the reduced sample size rather than to the true regime in these countries.

If the results were somewhat fuzzy in the estimates based solely on the EU-4, those in columns (4) - (6) where the EU-4 have been excluded from the full sample are again convincing. All estimates of $\delta$, independent of estimator, are negative and significant. The coefficient produced by the fixed effects estimator ($-1.143$) is again almost identical to the Arellano-Bond estimator ($-1.145$) whereas the standard errors are slightly higher ($0.371$ compared to $0.343$). Thus, one can reaffirm that the fiscal policy in these countries has been of a Ricardian type.

5 Conclusions

This thesis sheds light on the fiscal policy conducted in the EMU countries that introduced the euro as their common currency in 2002. The theoretical point of departure is the Fiscal Theory of the Price Level, i.e. a framework where the price level is determined by fiscal policy rather than monetary policy. The purpose of this thesis has been to empirically test whether the framework necessary for fiscal policy to determine the price level has been in place in the EMU countries, i.e. has fiscal policy in these countries been of a Ricardian or non-Ricardian kind? To answer this question I use an econometric model in which fiscal variables (debt and surplus as share of GDP) have been studied over a time-period of almost 20 years (1992 - 2010). I use four different models have been used; fixed
effects, random effects, OLS and the Arellano-Bond estimator.

The results are unambiguous. Independent of specification, all estimates suggest that the fiscal policy conducted in the EMU over the studied period has been of a Ricardian kind. The estimates of $\delta$, the coefficient of $\text{Surplus}_{t-1}$ is close to unity, suggesting that surpluses have been used one by one to reduce debt. And even if it has not been tested directly in this thesis, it is then unlikely that the fiscal policy has determined the price level. The results are robust to the time period studied and to the composition of countries. It is however important to stress that these findings do not invalidate the theory in itself. Nevertheless, it provides strong evidence that the framework required for fiscal policy to determine the price level has not been in place in these countries during the time-period studied in this thesis.

The use of panel data approach is atypical in the empirical literature regarding the FTPL which has mostly relied on the use of VAR-models to test for the dominant regime. The most obvious advantage of using panel data analysis is that it allows the researcher to control for unobserved effects. Furthermore, the aim in this thesis has been to study the fiscal policy in a set of economies which have shared a common policy framework in the form of the convergence criteria, the Stability and Growth Pact and later a common monetary policy. From this perspective, it is natural to assess these countries in a panel analysis rather than individually using time-series. The recent development of reliable estimation techniques, such as the Arellano-Bond estimator further provides the necessary tools for panel data study with emphasis on the time-dimension of the data.

A natural extension of the thesis would be to study the dominant regime using the backward-looking approach. A similar discussion as in section 3.1 could generate a testable hypothesis. However, given the rich array of econometric toolkits available, there are several methods that remain
unexplored but that would shed light on the dynamics of the government budget constraint. One approach would be to use of an error correction model. If surpluses were to react to a high level of debt and therefore decreasing the debt level, this would indicate a Ricardian regime. Since cointegration tests for panel data structures have now been developed, it would be possible to estimate such an error-correction model without having to sacrifice the advantage that the panel-data approach entails.
References


## Appendix

Table A1: Does the serie contain a unit root?

<table>
<thead>
<tr>
<th>Country</th>
<th>Debt</th>
<th>Surplus</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Belgium</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Finland</td>
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<tr>
<td>France</td>
<td>No</td>
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</tr>
<tr>
<td>Germany</td>
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<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Greece</td>
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<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ireland</td>
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</tr>
<tr>
<td>Italy</td>
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<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Netherlands</td>
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<td>No</td>
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</tr>
<tr>
<td>Portugal</td>
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</tr>
<tr>
<td>Spain</td>
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<td>No</td>
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