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The Impact of the Income Inequality on the Sovereign Credit Risk

A panel approach for 26 European Countries during 2005-2010

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by

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ABSTRACT

The aftermath of the financial crisis that had its beginning in 2007 has put to the fore the increase of the public debt in OECD countries. Global economic recessions and public bailouts of banks have resulted in a significant concern about the sovereign default risk mainly on the Eurozone countries facing structural economic imbalances. Using Credit Default Swaps (CDS) as a measure of sovereign credit risk, the purpose of this study is to analyze the link between sovereign default risk and income inequality for a broad panel of 26 European countries over the years 2005 to 2010. Applying the System GMM techniques the findings support the hypothesis that income inequality is a significant predictor of the sovereign credit risk. The empirical results also show that income inequality has more impact on the dynamics of the CDS spreads in times of economic downturns.

Key words: Sovereign Credit Risk, Credit Default Spreads, Income Inequality, Fixed Effects, Arellano-Bond GMM estimator

RESUMO

A recente crise financeira que teve origem no início de 2007 expôs o aumento da dívida pública em alguns países da OCDE. Os desequilíbrios macroeconómicos e a vulnerabilidade do sistema financeiro global estão associados ao risco de falência soberano principalmente nos países da Zona Euro desprovidos de mecanismos autónomos de política monetária. O objetivo deste estudo é analisar a relação existente entre o risco de falência soberano medido através dos *spreads* dos CDS e a desigualdade de rendimento para um painel de 26 países Europeus ao longo do período de 2005 a 2010. Utilizando o estimador *GMM-System* como metodologia econométrica, os resultados do trabalho empírico suportam a hipótese de partida de que a desigualdade de rendimento constitui um importante determinante no risco de crédito soberano. Como principal evidência empírica a retirar deste estudo, sublinha-se que a desigualdade de rendimento tem maior impacto na dinâmica dos *CDS* em períodos de recessão económica.

Palavras-chave: Risco Soverano, Credit Default Spreads, Desigualdade de Rendimento, Modelo de Efeitos Fixos, Estimador GMM Arellano-Bond

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List of Abbreviations

%	percent
CDS	Credit Default Swaps
EAMS	Euro-area Member States
ECHP	European Community Household Panel
EU- EMU	Members States of the European Monetary Union
EU-SILC	Statistics on Income and Living Conditions
FE	Fixed Effects
i.e.	idest (that is)
ISDA	International Swaps and Derivatives Association
GDP	Gross Domestic Product
GIIPS	Group of peripheral European Countries (Greece, Italy, Ireland, Portugal and Spain)
GMM	Generalized Method of Moments
LDC	Less Developed Countries
LSDV	Least Squares Dummy Variable Model
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
R^2	R-square (coefficient of determination)
S&P 500	Standard & Poor's 500 (Stock Market Index)
VAT	Value Added Tax
VIX index	Volatility Index Market (Chicago Board Options Exchange)
WDI	World Development Indicators

I. Introduction

The financial crisis that began in 2007 has brought to the surface a considerable number of issues and turned into the worst economic crisis since the Great Depression. In the light of this economic turmoil OECD countries faced growing public debt, while at the same time some European countries have severely violated the criteria drawn up in the Maastricht Treaty, which stipulates a threshold for the public debt of 60% of the national GDP. By 2010, the attention was on the heterogeneity of the sovereign risk perceived, and the challenges faced by the GIIPS group (Greece, Ireland, Italy, Portugal, and Spain) in adjusting their fiscal budgets in the context of a sovereign debt crisis (Caceres et al., 2010).

This study seeks to exploit explanations and causes for the European countries sovereign debt or credit risk based not only in financial indicators but also in structural features of the economies such as the income inequality. The motivation of this research is in line with Berg and Sachs (1988) empirical evidence, which states that *"countries with high income inequality had a significant greater likelihood, ceteris paribus, of having rescheduled their debts than did countries with low income inequality*". By considering the recent European economic context which put into the fore economic issues as the sovereign debt and sovereign credit risk, it is formulated the following research question: is income inequality a significant determinant of the sovereign credit risk of European countries? This thesis turn to be an important research topic since it exploits an innovative view regarding the determinants of the sovereign credit risk alternative to the financial or macroeconomic indicators. The selection of the explanatory variable income inequality as a channel of influence of the sovereign credit risk provides an important link between the measure of sovereign risk and a social and political indicator. Therefore, given this assumption it is assessed whether income inequality constrains the mechanism through which policymakers take their policies towards attaining fiscal sustainability in the context of high government indebtedness and sovereign credit crisis.

From a theoretical viewpoint, inequality and the resulting distributive policies may affect economic growth, contribute to inflationary crises, and lead to massive capital flight (Berg and Sachs, 1988). The main argument of the thesis is hypothesized by Alesina and Rodrik (1994) and Person and Tabellini (1994) stating that higher income inequality creates a greater political demand for redistributive policies, and politicians influenced by the (relatively poorer) median voter opt for (short-sighted) distortionary policies. Given this assumption, McColliste and Karayalçin (1994) developed a theoretical framework assuming that in unequal societies the redistributive policies are partially financed by foreign borrowing as government tends to respond to the voters pressures for redistribution. This in turn may lead to an increasing of default risk as international lenders limit the credit extent to these countries leading borrowing countries to invest less and grow at a slower pace**.** Following the same approach, Kim (2008) finds evidence supporting the hypothesis that the sovereign's willingness to pay is highly influenced by the level of inequality of a country.

In contrast to these studies which focus on the linkage of the external debt crisis and income inequality of developing countries, this research seeks to exploit the recent economic context of developed countries which face increasing sovereign debts and evaluate the impact of income inequality as a determinant of the sovereign credit risk. The most common indicator to assess the income inequality derives from the "equivalised disposable income" (eg. Niehues, 2008; Stiglitz et al., 2009). Nonetheless, the introduction of the gross component adjusted by an equivalent scale enables to depict the role of the government redistribution on income. Therefore, I use in this analysis the "equivalised gross income" as main explanatory variable. This indicator is calculated from the EU Statistics on Income and Living Conditions (EU-SILC) enabling the construction of different inequality indexes based on microdata of European Countries. Another important difference is the adoption of a sample of countries encompassing different historical, political and economic realities such as the ex-USRR countries. Additionally, this study contributes for the literature by adding the credit derivatives contracts – Credit Default Swaps (CDS) – as an indicator of sovereign risk default.

The validity of the hypothesis that income inequality influences the size of a country sovereign debt and credit risk is tested by using a dynamic panel approach with 26 European countries and a time period from 2005 until 2010. As in Fontana and Scheicher (2010) study, the indicator adopted to represent the sovereign debt is the sovereign CDS spreads. On the other hand, the explanatory variable addressing income inequality is given by the Gini and Theil coefficients. Additionally, variables related with the macroeconomic considerations such as public debt, inflation, GDP and GDP growth are included in the analysis control variables. The econometric methodology starts with OLS models. Even though this method displays limitations in panel studies, it serves as a clear starting point. In a further approach, fixed-effects models are used in order to control for all time-invariant differences between the countries. Additionally, the Arellano-Bond Generalized Method of Moments (GMM) estimator is used to deal with the issue of reverse causality in a dynamic panel design. This specification enables to evaluate the impact of income inequality on the sovereign credit risk by considering the explanatory variables income inequality and debt to GDP as endogenous variables.

The empirical results provided by the GMM estimator support the main hypothesis that income inequality plays a significant influence on the sovereign CDS euro spreads whereby the results are statistically and economically significant. However, results are sensitive to the choice of the inequality indicator.

The remainder of this thesis is organized as follows. Chapter 2 presents an overview of the available literature on sovereign credit risk and also on income inequality. Furthermore, this section describes the literature review based on the link between income inequality and sovereign default risk. The chapter concludes with the description of the development of the European economy focusing on the macroeconomic implications of the recent sovereign debt crisis and the main findings which attempt to assess the influence of the debt crisis on income distribution. Chapter 3 outlines the econometric methodology used in the regression analysis along with the approach to deal with possible econometric issues as heterogeneity and endogeneity of the explanatory variables. The second part of this chapter provides an overview of the data used in the empirical models and a statistical analysis of the variables. Chapter 4 presents the results of the analysis derived from different econometric specifications. The discussion of the results and the concluding remarks can be found in the Chapter 5, while it is also presented directions for further research on this topic.

II. Literature Review

This section intends to identify the appropriate academic and professional fields of literature followed by the description of the main themes that are important for this study. It is worth to highlight that there has been yet not much published research on the interplay of debt sovereign with inequality income indicators.

2.1 Income Inequality

2.1.1 Income Inequality and Sovereign Credit Risk

Political economic literature has traditionally focused on studying income distribution as a consequence of macroeconomic performance and government policies (Barro, 2000). However, in the recent literature many empirical findings are indeed concerned with the reverse causality, i.e., how income inequality can explain macroeconomic performance. Although the present issue is not extensively studied in the literature, there are nevertheless some empirical studies that focus on the causality from income inequality to risk sovereign debt. Hence, the core of this issue dates back to the debt crisis in the 70´s and 80´s in Latin American countries where these countries faced huge external deficits while at the same time displayed a highly skewed income distribution. Berg and Sachs (1988) were the pioneers to state this issue, analyzing the association of the debt rescheduling of less developed countries (LDC) and the structural variables of the economy. This relationship is empirically tested by employing a cross-section probit model, based on a sample of 35 countries over the period 1977-1985 whose dependent variable relies upon the probability of rescheduling and non-rescheduling of debt of the countries. The intent of the model is to relate this variable with the degree of openness of the economy and social variables (level of income inequality, share of agriculture in GDP and the level of *GDP per capita*). Further, the authors also aim at explaining the value of the debt in the secondary markets in the year of 1987 in order to put forward this variable as an indicator of the credibility of the financial sector. The results from their models show that all the variables considered display a positive effect on debt rescheduling of the countries. Furthermore, their findings provide evidence that higher income inequality, as well as political and social instability is considered significant predictors of a higher probability of debt rescheduling in the context of external financial crisis. This situation arises because income inequality decreases credibility of political stability, which is crucial for a successful macroeconomic management.

Also McColliste and Karayalçin (2004) developed a political-economic model based on the sovereign debt in the frame of the median voter theorem[1]. The central idea of this theorem concerns with the assumption that distributional policies affect the preferences of the majority of population, and thereby, influences political decisions (Alesina and Rodrik, 1994). This model states that foreign borrowing can be reallocated for two purposes: either public investments or transfers to the population. Governments take their decisions according to the population preferences. Hence, it is hypothesized that in more unequal societies, governments face higher demand for redistribution coming from popular pressures of agents with less than average incomes - the median voters - as they prefer redistribution policies rather than an increase of taxes proportional to income. The impact of pronounced demands for redistribution implies less investment as governments will use foreign debt to finance redistribution of income (higher current transfers) at the expense of lower public investment. On the other hand, countries with unequal distributions of income tend to redistribute more and, as a consequence, invest less because governments will tend to use the foreign loans to redistribute income rather than to invest in the public domain lowering the future income. In case a government opts to default, lending countries will impose a fraction of the countries income as a penalty. The sanctions or the repayment of debt required by the creditors' countries is collected by leaving a proportional income tax. As the majority of population in countries with more unequal distributions of income prefers to receive higher transfers payments rather than paying a proportional tax, there will be more redistribution and less public investment leading to less income in the future. Therefore, governments which face less income in the future decrease the cost of sanctions that foreign creditors require in case of default as the creditors punishment will be lower due to lower levels of income. This effect will in turn increase the probability of default since creditors might anticipate that borrowing countries with less income will opt to default instead of paying its external debts. Following this assumption, international lenders impose credit ceilings leading the sovereign borrowers again to invest less and as consequence to grow slower.

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[1] Following the assumptions of Alesina and Rodrik (1994), the application of the median voter theorem should be interpreted as a *proxy* of the political process itself instead of considering all its assumptions literally.

These ideas are further examined by Kim (2008), whose findings rely on the demonstration of the influence of the sovereign default of a country and it relationship with the "willingness-to-pay" of a government and income inequality. The author uses the framework development by Meltzer and Richard (1981) stating that agents with lower income in relation to the average incomes, i.e., median income agents, will prefer that governments invest less and redistribute more. As external borrowing has to be repaid with future income taxes, median income agents will prefer that government incurs in default and redistribute rather than to pay future income taxes in order to pay the external debt. Therefore, given this, in economies with skewed income distribution, agents demand for default is subsequently higher resulting in a higher probability of default risk. Empirically findings are reached through a panel data model based on random-effects logistic regression to assess the effect of income inequality on the probability of default occurrence in 51 developing countries over the period of 1971 and 2003. Accordingly, his findings provide strong evidence that the probability of a country default follows an inverted U-relationship in which highly unequal democracies are less likely to "actually" default. Under this assumption, the author stresses that countries with more skewed income distribution are more likely to have denied access to foreign loans (and so they are less likely to default). Indeed, in more unequal countries, the risk of default is higher which in turn implies a higher probability of the borrowing country do not honor with its promise to repay the credit. Thus, through a simple model game the author asserts that rational creditors do not have the incentive to lend to countries with structural problems (corruption, inefficiency, irresponsibility). On the other hand, highly equal countries are also less likely to default because the sovereign's willingness to pay is higher. Kim (2008) shows empirically a non-monotonic pattern relationship between the sovereign's willingness to pay and the sovereign default. His findings support the assumption that democracies with intermediate income inequality are more likely to default than highly unequal or highly equal democracies.

2.1.2 Inequality and Redistribution

Empirical literature shows that higher income inequality entails more redistribution policies (to name a few, Bertola, 1993; Alesina and Rodrik, 1994; Person and Tabellini, 1994). Alesina and Tabellini (1989) are among the supports that have demonstrated that the more unequal is the level of income in society; the lower is the rate of economic growth. What accounts for the link of these two components are the redistributive policies. Essentially, the core of this assumption is that the level of taxation in a society is determined through a process of political participation of the voters, reflecting their preferences for income redistribution. Following this argument, Meltzer and Richard (1981) depicted a theoretical model based on the median voter theorem asserting the agent preferences' on redistributive policies. This model stresses the agent preferences' trade-off between the benefits from redistribution (transfers) and their implicit costs (higher taxes). The rationale behind this model is that if the median income of the voter is below the average income, thus higher social demand for redistribution will be required by this agent through voting process. Given that, the median agent preferences play a crucial role on government fiscal policies decisions. Hence, given this mechanism, in more unequal countries is higher the demand for redistribution that is financed partly by distortionary taxes, which in turn implies lower rates of investment, and consequently, growth (Bertola, 1993; Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Aghionet et al., 1999).

2.1.3 Income Inequality and Growth

The first approach to assess this issue was introduced by Kuznets (1955) which attempts to explain how the level of income affects income distribution in the long run. Most precisely, the author hypothesizes that structural changes in economies lead by the transition from agriculture to industry and services sectors is responsible for the increase of income inequality. The process of transition from an agricultural-rural economy, assuming lower and more equally distributed incomes, to an industrial-urban economy leads to an increase of income inequality in the earlier stages of economic development. However, as the level of output per capita of the economy grows reflected in the widespread of the new technologies and equalization of returns across sectors, income inequality tends to decrease (Kuznets, 1955). Under these conditions, the author assumes an inverted U-relationship between the degree of income inequality and the level of income.

Further research has been developed to test the relationship of economic growth and income inequality. Using cross-country datasets on income distribution, empirical findings have resembled that inequality can indeed harm economic growth (Alesina and Rodrik, 1994; Bertola, 1993; Bénabou, 1996; Persson and Tabellini, 1994; Perotti, 1996). Moreover, there are some theoretical researches that have assessed the question how different levels of inequality may lead to growth at different stages of development. Barro (2000) test this hypothesis focused on the impact of income inequality on economic performance conveyed in growth investment. His findings rely on a panel random effect model using cross country regressions of 100 countries over the period of 1960-1995[2]. The results from his study show little evidence on the assumption of a linear relationship between inequality and growth. However, using the same sample of countries but splitting it into poor and rich countries, the author points out the ambiguity of the effects of inequality on economic and investment growth. Thus, in poor countries inequality seems to have a harmful effect on the growth of the economy, whereas it appears to have a positive impact on countries with higher incomes. According to Barro (2000), one possible interpretation of this result is the credit market restrictions observed in poor countries. On the other hand, there are some other empirical evidences showing the inverse reasoning[3]. In conclusion, empirical literature partly provides different results related with the ultimate effect of income inequality on growth, showing positive, negative or not significant link. Hence, conflicting evidence in these studies appears to derive from different econometric methods employed, and data specifications.

2.2 Sovereign Credit Risk

The sovereign credit risk plays a significant role on the interplay of the financial markets. As a consequence, it affects directly the ability of investors to diversify the risk of sovereign's debt portfolios influencing the capital movements across countries (Longstaff et al., 2011). The "credit risk" is broadly defined as the risk of loss resulting in the event of "default". There are many factors that might contribute for the risk of loss, however these risks do not account for the perception of "credit risk". The practical reason which leads to the inclusion of the "default" in this concept is due to the possibility of predicting default events thought historical data (Tavakoli, 2001). A sovereign default occurs when sovereign borrows announce their inability or willingness to honor their principal or interest payments, a restructuration or renegotiation of the repayment schedule, or a combination of the two events. In short, these scenarios imply that the main indicators whether a sovereign defaults or not are the debt payment on the due date and the rescheduling arrangement of the external debt (Rajan et al., 2007).

[2] In this panel-data random effect model, Barro (2000) considers that the average growth rates over periods of ten years (1965-1975, 1975-1985 and 1985-1995), are dependent on the initial level of inequality in the years 1960, 1970 and 1980 respectively.

[3] For example, Li and Zou (1998) and Forbes (2000) have showed that inequality can indeed foster economic growth.

2.2.1 Determinants of the Sovereign Credit Risk

In assessing the determinants of default of a sovereign, Reinhart and Rogoff (2009) identified five main drivers that might be in the root of a sovereign credit crisis, namely: (i) the amount of domestic debt; (ii) banking crisis; (iii) the external government debt; (iv) inflation outbursts, and (v) the currency crashes. Additionally, Standard &Poor's (2012) credit rating agency has underlined a methodology to assess the sovereign credit risk analysis based on the following key factors: (1) economic structure and growth prospects; (2) institutional effectiveness and political risks; (3) fiscal performance and flexibility, as well as debt burden; (4) external liquidity and international investment position, and (5) monetary flexibility. The first element refers to the level of income as well as the economic growth accounting for the economic diversity and volatility. The second one considers the effects of the government institutions and policymaking on the sovereign credit risk. Moreover, it also emphasizes the role of the economic reaction to external shocks as well as the reliability and transparency of the data provided by sovereign institutions. The fiscal performance is based on the sovereigns' fiscal and deficit positions along with the debt burden displayed by each country. The following determinant accounts for the international position of a sovereign's currency in the context of international markets and external debt and also of the external liquidity. The last indicator of credit risk sovereign considers the assumption of the effectiveness of monetary policies decisions in light of the sovereigns' ability to implement monetary policies as an instrument to promote fiscal sustainability.

Much of the existing empirical and theoretical research based on the determinants of credit sovereign risk is focused on the external debt of emerging economies (Berg and Sachs, 1988; Eichengreen and Mody, 2000; Longstaff et al., 2011). However, since the outbreak of the global financial crisis in 2008 a new body literature on the determinants of the sovereign debt default based on the CDS spreads has emerged focusing mainly on the euro-area countries. One thing that these studies have in common is the adoption of the CDS spreads as a measure of the market pricing of sovereign default risk.

Aizenman et al. (2011) develop an empirical model attempting to explain the pricing of risk related in the sovereign debt crisis using as main explanatory variable the "fiscal space" (debt/tax; deficits/tax) and macroeconomic determinants as control variables. This relationship is tested by conducting a cross-country study of 60 countries over 5 years (2005-2010) and fixed effects, clustered standard errors, and GMM models. The authors find strong support for the hypothesis that an increase of the market pricing of CDS spreads may be significantly influenced by higher levels of sovereign debt and the fiscal position (past or current deficits/debts) in relation to the tax revenue. Further, through in-sample and out of-sample predictions Aizenman et al. (2011) also find evidences that the CDS spreads for five European peripheral countries were "underpriced" before the onset of the financial crisis whereas "overpriced" during the economic turmoil specially in the peak of the European sovereign debt crisis (in the year of 2010)[4].

In the same line of the previous study, also Fontana and Scheicher (2010)[5] seek an empirical work focused on the determinants of the credit default risk based on sovereign CDS by using data for 26 developed and developing countries from 2000 to 2010. Their results suggest that "global factors" such as the US stock market returns and high-yield markets as well as the volatility risk premium reflected in the VIX[6] index has more impact on explaining the determinants of the CDS than the country-specific determinants, e.g., the equity returns, exchange rate, and foreign reserve. Additionally, following the Pan and Singleton (2008) model on decomposing the CDS spreads into default risk components and risk premium, the authors find evidence that the risk premium (on average) accounts for just one-third of the total credit spread. Other factors contributing for the nature of default implicit in the term structures of sovereign CDS spread are the country-specific and regional economic risks as well as the variations of investors' appetites for credit exposure at a global level.

More recently a new strand of literature provides findings that the instability in the banking sector has been an important driver of sovereign credit risk in advanced economies. The mechanism underlying to this theory relies on the assumption that some banks are too important/big-to-fail, therefore governments injected big amounts of capital in order to guarantee liabilities on the banking system (Kallestrup, 2012).

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[4] The countries included in the sample are the following: Greece, Ireland, Italy, Portugal, and Spain.
[5] Also Pan and Singleton (2008) suggest his empirical findings that variations in CDS spreads in Mexico, Turkey, and Korea were due to global factors such as the investors' preferences for credit exposure rather than considerations of the state of the local economy of these specific economies.
[6] The VIX index refers to the Chicago Board Options Exchange Market Volatility Index and is used as a measure of the implied volatility in the U.S. stock market (S&P 500 index).

All in all, the factors described above provide an explanation of the credit risk through the lens of fiscal and macroeconomic variables.

2.2.2 Mechanics of the Sovereign CDS Market

Since CDS are commonly used to assess credit risk, in this section I describe their mechanics. The credit derivatives were firstly launched at the meeting of the International Swaps and Derivatives Association (ISDA) in 1992. The global credit derivatives has shown a massive annual growth since then whereby they had reached its peak in January 2008 with the total notional amount outstanding of $62 trillion estimated by International Swaps and Derivative Association[7].

A credit default swap (CDS) enables the contracting parties to trade or hedge the risk of a certain entity defaults – it can take the form of a corporate or a sovereign borrower[8]. A CDS contract is traded over the counter. These credit derivatives are defined as a bilateral agreement between two parties: a protection buyer agrees to pay a yearly premium to the seller for losses that might be incurred in the case of default of the reference credit entity (Bomfim, 2005). According to ISLA there are six important credit events (ISDA, 2001):

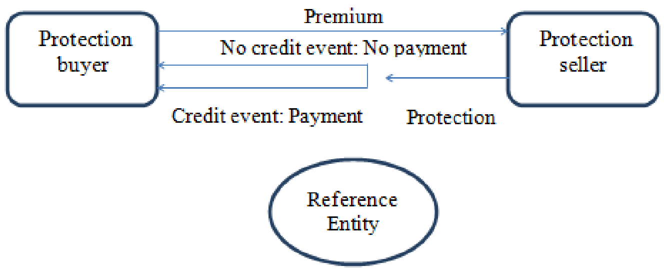
- **Bankruptcy:** not relevant for sovereigns but only for corporate entities
- **Failure to pay**: occurs when the reference entity fails to pay principal or coupon when they are due
- **Obligation default:** regards to the technical default
- **Debt repudiation:** takes the form of compensation and addresses actions by sovereign lenders
- **Restructuring of debt:** in the case of restructuring or reduction of the due debt in order to restore the liquidity
- **Obligation acceleration:** means when the payment becomes due before the expected expiration data

[7] The gross notional value of the CDS spreads resembles the sum of CDS contracts bought from all counterparties accounting each trade once.

[8] Although there are many channels thought which CDS spreads play an important role, this section will focus on the assumption CDS as a measure of credit risk.

The mechanism thought which the CDS market is based on is the following: one party, the protection buyer acquires a yearly premium - "default insurance" - until the occurrence of any specified credit events until the maturity of the contract. On the other hand, the protection seller agrees to make a payment to compensate the buyer in case the underlying CDS contract incur in default or the reference borrow cannot commit with its obligations due to its insolvency (Figure 1.1).

Figure 2.1 CDS payment mechanism



Source: Weistroffer (2009)

A CDS contract reassembles to an insurance policy, in which one party assumes the risk while the other part pays an underlying insurance premium. The (insurance) premium is agreed upon between the two parties in the beginning of the contract remaining usually constant until the contract reaches its maturity and it compensates the seller of bearing the underlined credit risk of a default. It calculation is given by the following formula:

*CDS premium = PD * (1-RR)*

Where the CDS premium represents the amount necessary to cover the expected loss of the reference entity. The parameter PD resembles the probability of default, whereas RR is the recovery rate. Generally the CDS premium is determinate on an annual basis; nonetheless its payment is done in quarterly terms. The Sovereign CDS spreads are quoting conventionally in basis points. For example a spread of 100 basis points, against 10,000,000 USD in sovereign debt for 5 years means that 1% of the notional amount has to be paid each year, so 0.01 x 10 million = $100,000 per year. Moreover, these financial derivatives quotes are represented by the investors' perception of the sovereign credit risk and their willingness to bear the underlined risk (Fontana and Scheicher, 2010).

2.2.3 Government Public Debt and Macroeconomic Implications

Movements in the spreads of CDS can have significant macroeconomic consequences. On the monetary side, a rise in sovereign yields tend to lead to an overall increase in long-term interest rates in the rest of the economy, distressing both investment and consumption decisions. Whereas on the fiscal side, a rise in sovereign CDS spreads tends to be accompanied by a widespread increase of fiscal deficits and government debt. While in situations of economic turmoil central banks can expand monetary policy by using the interest rate as an instrument, in the euro-area countries policymakers face the lack of an independent self-governing monetary policy. This implies that in case of need to rebalance fiscal deficits the national authorities put all weight of the adjustment on fiscal measures (Bassanini and Scarpetta, 2003).

In the light of this, an enormous pressure from international markets was placed on the euro-area countries in order to make them pursue policies to stabilize the economy. In order to prevent a fall in the demand side and a further increase of pricing of the sovereign debt in European countries, fiscal interventions via debt restructuring and fiscal austerity were placed aiming to restore the international investors' confidence. Fiscal policy settings may have an impact on the output in the medium run and also over the business cycle. In particular, if governments decide to finance the government expenditure through a raise of "distortionary" taxes (eg. direct taxes) may distort incentives affecting the level of output (Bassanini and Scarpetta, 2003). On the other side, higher spreads of CDS requires larger debt-servicing costs which indeed raise funding costs. Most specifically, if investors believe a default event might happen, they will demand higher default risk premium, implying higher interest rates. This could also entail an increase in rollover risk, i.e. repaying the public debt by issuing new debts, implying the payment of this debt in the future at extraordinarily high costs (Wright, 2011).

In a complementary analysis, when a government faces a high level of debt and at the same time displays a budget deficit, it is expected a decrease of national savings and a trade deficit, imposing the necessity to finance it through international lending. Given this linkage, the effects on the government debt are twofold. First, the high levels of public debt leads international investors to be aware of the possibility of non-payment and consequently the default of borrowing governments. The result of this assumption is a decrease of the demand of national assets in the international markets, and consequently a restrain of its international lending. On the other hand, a large government debt induces a decrease of the credibility and plays influence in matters of international affairs (Mankiw, 2007).

2.3 The European Economic Context

2.3.1 The Sovereign Debt Crisis

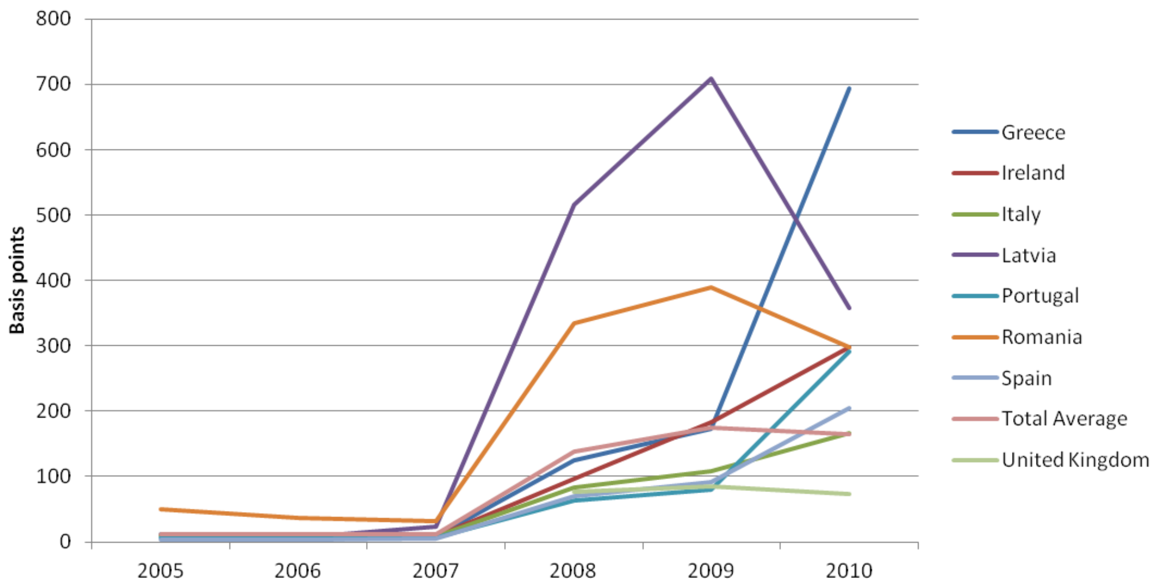
Since the onset of the global economic crisis in 2007 also known as the Great Recession (2007-2009), the sovereign risk premium differentials of European euro-area countries have showed an unprecedented increase (cf. Figure 1 in the Appendix). From this viewpoint, the observed rise of sovereign spreads might well reflect financial markets' concerns about not only the state of national banking systems but also the credibility of the fiscal sustainability. This macroeconomic scenario of significant large government debts and budget deficits implied subsequently the engagement of restructuring plans and commitments to long-run fiscal discipline along the euro-area countries. During this period, the public debt to GDP of most of the advanced economies has increased from 70 percent in 2007 to about 100 percent in 2010 (IMF Fiscal Monitor, 2012). Similarly, the global financial crisis and its aftermath have put to the fore structural imbalances of a set of Europeans countries. At the core of the recent sovereign debt crisis are the Peripheral euro-area countries, namely Ireland, Portugal, Spain, Italy and Greece whose sovereign debt fragilities along with systemic financial problems[9]. For these countries, the macroeconomic consequences were more severe thereby their public debt reached in 2010, on average, about 134 percent of the GDP. By 2010 the CDS spreads of Italy, Ireland, Greece, Portugal and Spain reached their highest values and there were also the downgrades of their sovereign debt ratings (Figure 1.2). In this context, international markets have differentiated country risk across the government's issuers, which in turn implies higher overall sovereign default risk premiums for most of the countries with fiscal fragilities.

Although there is a common fiscal framework for European countries designed to exert pressure among all state members states, regarding the establishing of targets for the national public debts, some EMU member economies have severely violated the criteria drawn up in The Stability and Growth Pact (SGP) in which the government budget deficit and Government national debt should

[9] In particular, Greece, Ireland and Portugal were subject to external aid under financial assistance from the European Union (EU), the International Monetary Fund, the European Central Bank and other UE members in order to attain fiscal sustainability by reducing the public deficits and sovereign debt burdens.

be less than 3% of GDP and 60% of GDP, respectively. The countries that signed the Maastricht Treaty towards the creation of an Economic and Monetary Union (EMU) not only have lost their national authority in terms of monetary policy, but also have limited independency on the policy (fiscal), which is restrained by the fiscal requirements of the SGP that seeks to guarantee a sustainable fiscal equilibrium while promoting economic growth

Figure 2.1 European Sovereign CDS spreads 2005-2010



Source: Bloomberg

2.3.2 Distribution of Income and Government Public Debt

In the literature there is no generalized consensus around the link of causality of the fiscal consolidation followed by indebted governments and the skewing income distribution (eg. Ball et al., *2*013). There is, however, empirical evidence showing that income inequality indeed displays a significant increase in periods of fiscal consolidation. To assess this issue, Agnello and Sousa (2011) pursue an analysis of eighteen global economies during the period 1978-2009. Their findings are in line with the assumption that in periods of economic distress, the income distribution is affected following the implementation of fiscal measures to reduce the public deficit. Additionally, it is assessed that the impact of fiscal consolidation varies according to the size of the consolidation program as a proportion of GDP, ie., austerity programs larger than 0,77 p.p. of GDP induce a higher impact on inequality. Furthermore, the inequality in income appears to amplify in the period following the crisis namely in the aftermath of a banking crisis.

In the OCDE the overall redistribution impact is attained though the transfer systems, that is, the expenditure side of the government budget, whereas the tax systems pays a smaller role on income redistribution side. One of the main significant consequences of fiscal consolidation is the rise of unemployment by affecting wage earners at a greater extent than others economic agents, which may lead to a persistent and continuous increase in inequality in the long-run. In this context, to balance the costs of fiscal measures against the potential rise of unemployment, and consequently the income inequality, it is preferred to implement such measures at a slow pace jointly with policies to promote economic growth, such as incentives to job creation (Ball et al., 2013).

The magnitude of the impacts of contractionary policies on the distribution of income depends to a large extent on the progressivity and weight of the consolidation instrument. These instruments are fiscal policies designed to reduce the public deficit or limit its growth (eg. cuts in benefits or public pensions, increased income taxes and/or reduced tax concessions, increased worker social insurance contributions, increased property taxes and increased standard rate of VAT).
Secondly, policy measures associated to debt consolidation through spending costs generally drives to a deterioration of the economic activity and to a subsequent increase of unemployment. This effect in turn might entail a declining wage share, which in turn exacerbates income inequality (Ahrend et al., 2011).

Past fiscal consolidations have showed that contractionary policies result in an increase of income inequality through two channels. The first one relies on the impact of debt consolidation on the level and progressivity of tax, while the second mechanism on the consequences of a decline of the output leading to an increase of unemployment. Accordingly, the consolidation of government debts usually takes the form of expenditure policies, revenue policies or a mix between the two. On the expenditure side, the adoption of measures to reduce government transfers implies nevertheless an increase of income inequality. This effect arises due to the progressive feature of the transfers thereby a decrease of this component generally lead to an increase of income inequality. (Christensen et al., 2011).

III. Data and Methodology

This chapter describes the sources of the dataset used in this analysis as well as the variables and their specifications as an input for the empirical study. Additionally, it is outlined the methodology along with the econometric techniques employed to test the main hypothesis of this analysis. The last part of the chapter provides an outlook of the descriptive analysis of the CDS spreads sorted by country and also of the overall variables of the study.

3.1 Source of Data

The data used to analyze the level of income inequality across countries and over time in this study is based on micro data derived from the household survey European Union Statistics on Income and Living Conditions (EU-SILC). This dataset aiming at provide cross sectional and longitudinal data relying on multidimensional microdata in the field of income, poverty and social exclusion. The EU-SILC survey was implemented in 2003 in six European countries, whereby in 2005 was launched in all of the 25 Member States, being extended afterwards to Bulgaria, Romania and Malta when they join the European Union[10]. EU-SILC dataset was preceded by the European Community Household Panel (ECHP), which was the main source of primary data on income and living conditions in the European Union used by the Eurostat during the period of 1994-2001. Considering some shortcomings displayed by this survey namely the income definition that was not in harmony with the international practice (according to the Canberra recommendations)[11], the launch of the EU-SILC was of the upmost importance to introduce several new components and methodologies. Therefore, the EU-SILC displays several advantages as a tool for analyzing household income and living conditions when compared with other sources of data. First and contrary to its predecessor it provides more flexibility to the Member States on adopting their own sample designs and data compilation. The "target"

[10] More specifically, the first launch of data (relating to the year 2004) embarrasses information on 13 Member States (Austria, Belgium, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Portugal, Spain and Sweden), plus Norway and Iceland. By 2005, Germany, the Netherlands and the United Kingdom took part in the survey, along with the rest of the new member states (Cyprus, Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia). Finally, from 2007 onwards, the EU-SILC assessing all 27 Member States, further includes Turkey, Switzerland Norway and Iceland as non-members.

[11] Further details about the Canberra recommendations on: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CC-05-006/EN/KS-CC-05-006-EN.PDF

variables are set out and follow the common procedures, guidelines and concepts set in the Framework Regulation. Second, the survey design differs markedly from the ECHP as the EU-SILC takes form of a *rotating* panel instead of a pure panel survey allowing the introduction of new members each year in the sample and also reducing the panel duration generally from 8 years to 4 years. Additionally, this survey reports cross sectional and longitudinal data, which in turn does not have to be connected. Finally, and one of the most important points to recall is the definition of the household income according to the Canberra recommendations. Hence, new components are introduced in the household income definition namely: transfers paid to other households, tax adjustment/tax on wealth, interest paid on mortgage loans, imputed rent, non-cash employee income, value of goods produced for own consumption, and employers social insurance contributions. Moreover, it is accounted the negatives values of self-employment while in the ECPH were set to 0.

One of the main advantages of the EU-SILC database when compared with other datasets is that enables to provide information relying on the total gross income (individual income components such as earnings, self-employment income, transfers are reported as gross values) and the total disposable household income before transfers. Whereas, the ECHP dataset records solely provides income components net of income tax and social insurance contributions, the EU-SILC reports net and gross income components.

The pricing data of CDS spreads and the government bond spreads used in this analysis are obtained from Bloomberg. The series are based on an annual average of daily values corresponding to ten-year maturation titles embarrassing a sample of 26 European countries (cf. Table 1.2 in the Appendix). The time period covered in the sample is January 2005 to December 2010. The period and the country selection are in line with the data available collected from the EU-SILC for the purpose of income inequality analysis[12]. Sovereign CDS instruments initially began to be traded in the over-market-counter just in 2004, and there is a significant lack of data especially until the year of 2007 in which the majority of countries display sovereign CDS quoted in the international markets. Additionally, the ten-year horizon is chosen as the one that reveals most liquidity and also because it is the most common period referred in the literature. It is

[12] Note that the EU-SILC surveys collect yearly data.

important to highlight, nevertheless, that as in the case of the income inequality indicators, not all countries are included in the sample for the full period[13].

Additionally, as robustness check, to assess the impact of income inequality on the sovereign credit risk, a sample panel model of the spread between the yield on ten-year sovereign bonds of eighteen OECD countries[14] and Germany is estimated over the period January 2005 to December 2010. The data are based on the annual average of monthly values from Bloomberg corresponding to ten-year maturity titles embarrassing the sample of 19 European countries used in the present analysis. As a consequence of using German bond yields as a benchmark its observations are not included in the analysis.

The remaining control variables used in the empirical analysis with the exception of the dummies variables were retrieved from the World Development Indicators (WDI) from the World Bank Group and also from the Eurostat database.

3.2 Description of variables[15]

3.2.1 Key Independent Variable

The main independent variable in which empirical models are based on is represented by the income inequality over the period of 2005-2010 and across different countries[16].The selection of countries and time period is in accordance with the micro data available in the household survey European Union Statistics on Income and Living Conditions (EU-SILC) provided by the Eurostat in October 2012, which was used to obtain income inequality in gross terms. In approaching the question of income inequality, a set of methodological questions have to be accounted in order to allow a cross-country and intertemporal comparability of the data with maximum consistency and avoiding biased estimates (Deininger and Squire, 1996).

[13] Luxemburg and Malta do not display sovereign CDS therefore were excluded from the analysis.
[14] From the data sample of this analysis, 19 are currently member countries of the OECD. This subsample encompasses the following countries: Austria, Belgium, Check Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.
[15] Variables are described in Table A.1 in the Appendix.
[16] The countries included in this study are: Austria (AT), Belgium (BE), Germany (DE), Denmark (DK), Cyprus (CY), Czech Republic (CZ), Spain (ES), Estonia (EE), Finland (FI), France (FR), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Netherlands (NE), Poland (PL), Portugal (PT), Romania (RO), Sweden (SE), Slovakia (SK), Slovenia (SI) and United Kingdom (UK).

Traditionally, income inequality can be measured on a net or on a gross basis. The starting point of the definition of the income according the EU-SILC methodology corresponds to the original income[17]. This source of income includes income from state funded pensions. The stage number two of the analysis regards the definition of the gross income thereby it is obtained by the sum of original income and cash benefits. The cash benefits include the unemployment, old-age, survivor', disability, sickness benefits; plus the family/children, education-related and housing allowances; plus the benefits for social exclusion or those not elsewhere classified. At last, the disposable income is given through the deduction of the direct taxes and regular inter-household cash transfers paid to gross income. Thus the disposable income includes all monetary incomes received from any source by each member of the household (including income from work, investment and social benefits) plus income received at the household level and deducting direct taxes (tax on income and social insurance contributions, regular taxes on wealth) and regular inter-household cash transfers paid (Eurostat, 2009).

Deininger and Squire (1996) emphasize the importance of differentiate disposable (or net) income and gross income among countries analysis. Their recommendations lie on the assumption that gross income should be chosen over net income as it reflects the taxation redistribution from richer to the poorer. In light of this, it is argued that what contributes for the difference among gross and net income across countries is the effectiveness and progressivity of their tax system. Hence, these differences might be of higher importance in developed countries considering the significant role of redistributive taxation in these countries. If one considers the Scandinavian countries (Sweden, Norway, Iceland, and Denmark) might expect a more remarkable gap between net and gross income inequality whereby redistribution policies play an important role on their political decisions. Nonetheless, also Germany and United Kingdom show a relatively high discrepancy between levels of gross and net incomes (Jauch and Watzka, 2012). These examples are important to demonstrate at what extent the different income components may affect the magnitude of unequal income distribution interpretation. Also Persson and Tabellini (1994) adopt the concept of "*personal income before tax*" as the most suitable indicator

[17] The original income from market encompasses employee cash or near cash income, non-cash employee income, cash benefits from self-employment, value of goods produced for own consumption, income from rental of a property or land, regular inter-household cash transfers received, interest, dividends, profit from capital investments in unincorporated business, income received by people aged under 16, pensions from individual private plans and old age benefits.

of income inequality. Kim (2008) also prefers gross income over net income. On the other hand, Stiglitz et al. (2009) shows that the most adequate income concept towards the measurement of income inequality is the household disposable income also known as *"adjusted household disposable income"* [18], once it has been adjusted for publicly-provided in-kind transfers. Similarly, the empirical studies of income inequality based on the Luxemburg Income Study (LIS) (Voitchovsky, 2005) and ECHP datasets (Nieuhs, 2008) also report income inequality on a net basis by using the disposable income. Although there is not a generalized consensus around which concept of income inequality is the most adequate, in some empirical findings both components are applied. For example, in Barro´s (2000) and Jauch and Watzka (2012) analysis, the net and gross income is transformed in dummies variables to measure income inequality.

Considering the availability of the EU-SILC database on providing information relying on the total gross income (individual income components such as earnings, self-employment income, transfers are reported as gross values), the gross income will be chosen over net income as a measure of income inequality. The use of gross income allows having a better idea of the effort that is required to the government in terms of social transfers and taxes to reduce inequality. For instance, two countries with the same net income inequality may have different gross income inequalities. The country with larger gross inequality has to do larger social transfers and impose larger distortionary taxes (Aghion et al, 1999) to reduce inequality, which may reduce its growth prospects and affect sovereign risk. This is why I argue that gross income is a better indicator to assess sovereign risk. This indicator is named in this study as the gross equivalised income as it refers to the gross income indicator accounted for the differences in the households' composition and the underlined economies of scales resulted from such structural differences within them. Given that, the adoption of the income inequality indicator in gross terms will emphasize the role of the redistribution on the government's redistributive policies by providing a clearer picture of the income inequality on the analysis.

The criteria used in the EU-SILC survey to deal with the income distribution data in based on the following assumptions (Eurostat, 2005):

- The period over which income is measured is in the accordance of the Canberra Group recommendations taken a year as a reference. The length of the reference period reflects

[18] Following the report assessed by Stiglitz-Sen-Fitoussi Commission (Stiglitz et al., 2009).

the natural accounting period for sources of income related with the self-employment income or income tax data.

- The unit of observation and the income recipient unit in analysing income can be based on the distribution of income across households or rather on individuals. In the EU-SILC dataset the income distribution is measured considering the total household members income. A broader income recipient unit such as the household distribution income is traditionally preferred to gauging the living conditions of populations once it captures the overall situation of the living standards of the individuals in terms of their household income.
- Another important point to be considered in the income distribution analysis is the adjustment of the size and composition of different households. For this purpose, it is used the "*modified OECD*" equivalence scale, thereby the total household income is divided by its equivalent size. This scale assigns a weight of 1.0 to the head adult of a household, 0.5 to all remaining adults aged 14 or more and 0.3 to each child less than 14[19]. The results obtained by using the *"modified OECD"* equivalence scale is therefore a consistent measure of welfare of each member in society defining the equivalent income of the household in terms of individual members.

Since Eurostat only offers information on the net income Gini index, I was forced to calculate the Gini index from micro data (cf. Table A.3 in the Appendix).

Measures of Income Inequality

To account for the income inequality variable two well-known measures of inequality of a distribution are used: the Gini coefficient and the Theil's first measure. In the literature, the Gini coefficient is generally used as the main reliable indicator to measure income inequality. Nevertheless, in order to complement the analysis the Theil index is adopted mainly due to its property of additive decomposability (Nieuhes, 2008).

Furthermore, these two measures derive from the Generalized Entropy (GE) family, which in turn assess different approaches regarded with income distributions (Fields, 2001). Although different measures imply differences views, there are four main criteria that any equality measure should

[19] The 'modified OECD' equivalence scale of [1 + (0.5 × number of additional adults) + (0.3 × number of dependent children)].

possess: (i) the anonymity, which implies that individuals' specific identities should not be accounted for the income inequality (ii) population independence, which requires independence of the measure of inequality towards population changes (iii) income scale independence, which assumes that income inequality does not vary according to income scale, i.e from the units of income and their magnitude; (iv) Pigou-Dalton transfer sensitivity, rely on the assumption that an income transfer from higher-income person to lower income person (with no other changes in the income distribution) conveys an reduction of income inequality.

(i) Gini Coefficient

The Gini (1914) coefficient is commonly interpreted through the concept of the Lorenz Curve, thereby this cumulative frequency curve graphs the distribution of a variable (income, in this case) towards an uniform distribution that embodies equality. The graphical interpretation of the Lorenz Curve depicts the cumulative proportion of income on the vertical axis versus the cumulative proportion of household on the horizontal axis. Given that, the Gini coefficient can be obtained through the ratio of the area between the 45-degree line and the Lorenz Curve (concentration area) to the area of maximum concentration. Whereas the maximum concentration area is represented by one distribution where only one individual owns the total income, the 45-degree line (equidistribution line) represents a concentration area equals to zero, which means perfect equality. Formally, assuming a population of n individuals (or households), where i = 1, …n, with x_i as the income of the person i, the Gini coefficient equals:

$$G = \frac{2\sum_{i=1}^{n} x_i}{n\ \sum_{i=1}^{n} x_i} + \frac{n+1}{n} \tag{1}$$

However, the measure addressed in this analysis to compute income inequality is based on the standard of the Gini coefficient given by:

$$G^* = \frac{n}{n-1} G = \frac{2\sum_{i=1}^{n} x_i}{n-1\sum_{i=1}^{n} x_i} - \frac{n+1}{n-1} \tag{2}$$

Given that, in the case in which the standard Gini coefficient equals to zero the distribution faces the maximum equality, if on the other hand it corresponds to one, means complete income inequality (one single individual or household possesses all the income and the others receive none). Concerning to the sensitivity to changes in the shape of the distribution, the Gini coefficient reacts mostly to the transfers in the middle of the distribution. Despite this indicator is the most widely used as a measure of income inequality, also has some limitations. As an example, this coefficient remains unchanged even if a significant change in the distribution of income occurs (e.g. a demographic change). Similarly, although some economies display similar incomes and Gini coefficients does not mean they have similar income distributions.

(ii) Theil Index

Contrary to the Gini coefficient, Theil's index (T_1) reacts mainly to changes at the bottom end of the distribution. Considering the average income $\bar{x}$ of the overall population *n*, the Theil Index is given by:

$$T_1 = \frac{1}{n}\sum_{i=1}^{n} \frac{x_i}{\bar{x}} \log \frac{x_i}{\bar{x}} \quad (3)$$

The Theil index ranges from zero, with zero assuming a perfect equal distribution and infinity, whereas higher values mean higher levels of inequality.

3.2.2 Dependent Variable

The indicator adopted in the present study to measure the market perception of sovereign default risk is the ten-year spreads on sovereign CDS. Many indicators are generally used as measures of the sovereign credit risk such as the sovereign bond spreads, the sovereign credit ratings, or the interest rate spread of sovereign debt, only to name a few. From a theoretical point of view, the differences between sovereign bonds spreads and CDS spreads should be approximately equal to zero under perfect market conditions (Packer and Suthiphongchai, 2003). Nevertheless, Fontana and Scheicher (2010) have proved that the difference between CDS prices and the spreads on the underlying government bond, also known as "basis", was substantially different from zero in the Eurozone CDS markets during the financial distress in 2010. The main factors that contributed for these differences were the global risk appetite and local specific factors.

Additionally, there are other reasons seeking to explain the reasons behind the differential on the "basis" driven mainly by technical factors, interbank lending, and counterparty risk. For instance, the maps of cash flows of the CDS and bonds contracts do not match exactly leading to differences in their spreads. The CDS as indicators of credit perception do not include funding, whereby the variation of their prices is less sensitive to liquidity considerations when compared to the market bonds (Longstaff et al., 2005). Also, CDS spreads are often regarded as implicitly spreads on bonds in which their prices are less affected by coupon, contracts, or covenants when compared with bonds spreads (Stulz, 2009). Further, changes in credit conditions can also contribute for divergences in pricings that may occur in both markets (Zhu, 2004). Ainzenman et al., (2010) points out three main reasons for the employment of CDS spreads instead of the interest rate spread of sovereign debt. Firstly, sovereign CDS datasets offer a broader coverage of data of developed and emerging countries based on market-based pricing when compared with national sources for bonds rates. Secondly, interest rate spreads embrace not only the default risk but also other components such as inflation expectations. Finally, the use of CDS spreads overcome the issue of the time to maturity derived from the use of interest rate spreads.

In conclusion, CDS spreads are used in this analysis as a proxy of the sovereign default risk. I use the annual average of CDS in order to eliminate the effect of speculation present in short horizons trading. As a robustness check analysis, I include the spreads of bond government yields as a second proxy for the sovereign default/credit risk.

3.2.3 Control Variables

To assess the relationship between sovereign default risk and income inequality, a set of macroeconomic variables are included in the analysis mainly for the control of macroeconomic determinants. These variables are generally employed in related literature of the determinants of CDS including: GDP, GDP *p.c.* (both in logarithms), GDP real growth, debt to GDP ratio, inflation and trade openness[20]. To control for the temporal fixed effects the regressions also encompass temporal dummies, which aim to capture the global shocks. In what follows it is assessed a description and the intuition behind the choice of each variable.

The measure of the economic development of a country (GDP *p.c.*) is considered to play influence on the sovereign's willingness to commit with its external debts (Berg and Sachs, 1989). As Kim (2008) points out, the GDP *p.c.* impacts on the sovereign's willingness to pay its debts as countries with higher GDP *p.c.* are more able to solve their debt service issues thought the implementation of austerity measures. One reason for that is that more developed countries have more capacity to collect taxes and therefore their risk is seen as smaller. Moreover, a

[20] Economic expectations could also be considered in the analysis as a determinant of economic decisions of consumers.

number of empirical studies assessing the determinants of the CDS premium have included the GDP *p.c.* as it may also affects the sovereign CDS spreads (e.g. Aizheh et al., 2011; Uribe and Yue, 2006). Total GDP was included as an indicator of the size of the economy. Smaller countries have less liquid markets and are more exposed to speculative pressures that may increase sovereign risk.

In what concerns the public finance variables, I choose the debt to GDP ratio to assess the level of indebtedness of a sovereign as an important factor at the root of sovereign credit crisis (Reinhart and Rogoff, 2008). The intuition for this choice is that the more indebted country is, the more difficult is to repay its foreign debts. Additionally, there is the pitfall of a country incur in rollover, i.e. once it has no means to repay its external debts it will incur in extra foreign loans to pay these debts (Kim, 2008).

Additionally, other way of seeing the relevance of the debt to GDP ratio is related with the fact that the solvency condition of a country depends on the level of debt, interest rates and nominal growth (real growth plus inflation) (Blundell-Wignall and Slovik, 2011). From this condition, I expect debt and interest rates[21] to have a positive effect in sovereign risk, while real growth and inflation to have a negative effect. The fiscal deficit was not introduced because is correlated with debt, as an increase in fiscal deficit leads to an increase in debt.

Another indicator to control for macroeconomic determinants is inflation. Reinhart and Rogoff, 2008 stress that inflation outbursts are important drivers of sovereign credit crisis thus it is expected a negative effect on sovereign debt risk. But such analysis ignores that high inflation may also reduce the growth potential and may be seen as indicator of macroeconomic risk in an economy (Leão et al., 2009). Therefore, the final effect of inflation needs to be determined empirically. Following the Aizenman et al. (2011) and Kim (2008) studies, inflation turned to be robust and highly significant in their empirical studies in assessing the determinants of the CDS spreads. As such, inflation may have a double effect on the stock of public debt. In one hand, higher inflation implies a reduction of the real price of the existing government debt; on the contrary, the debt dynamics is affected by inducing the government to pay higher nominal interest rates.

[21] In the dynamic model, interest rates are captured by the lagged value of CDS, as they affect the level of interest rates charged by the market.

The real economic growth (GDP growth) controls for the cyclical components of the business cycle that in turn might have impact on the countries' ability to pay their external debts (Kim, 2008). Additionally, a growing in economy allows for an increase in the living standards, decrease of unemployment and political instability leading to a lower probability of a sovereign default (Berg and Sachs, 1989). We saw in the literature revision that inequality may be related with economic growth, with this relation being more effective in the long-run. Therefore, the problem of colinearity between growth and inequality is not relevant as shown by the low level of correlation between variables (cf. Table A.4 in the Appendix).

Similarly, also the degree of trade openness of an economy (trade) is seen as an important determinant of the credit sovereign risk (Aizenman et al., 2011, Berg and Sachs, 1988). This indicator takes into account the sum of the level of imports and exports of a certain country during one year in relation to its GDP. As Kim (2008) points out highly trade dependent countries face more economic difficulties in case of default than less dependent countries. This arises due to the possibility of embargos, blocked access to trade by the creditors, or increasing difficulties in financing imports.

Additionally, a set of distinct dummy variables are included in this analysis to account for heterogeneity across countries. The first dummy variable is considered for the GIIPS countries to control for the large perceived fragility of their fiscal position as well as the large increase in the sovereign credit risk in 2009-10. This variable results from the multiplication of the Gini coefficient by a dummy variable represented by the GIIPS countries as a whole. Moreover, the period considered display stark differences by including different stages of the financial crisis and subsequently the sovereign debt crisis. Following Caceres et al., (2011) approach, the period considered can be divided in four main phases: the Financial Crisis Build-UP (2007), in 2008 was the Systemic outbreak response to the financial crisis followed by the systemic response in 2009. By 2010, it was put into the fore the sovereign credit risk with the focus on the GIIPS countries. In my analysis I see weather in 2009 and 2010 there are some systematic differences in the impact of inequality. Furthermore, the authors also find evidences that during the financial crisis the perception of country-specific risks of EMU countries increased due mainly to the deterioration of the fiscal fundamentals. Given that, a dummy variable is included in order to controlling for the changing dynamic of the sovereign credit risk in the EMU. At last, a set of dummies variables account for the interaction between income inequality and four different groups of European welfare states: Nordic Europe, Continental Europe, Southern Europe and liberal Countries.

3.2.4 Descriptive Statistics

Table 3.1 reports the descriptive statistics of the CDS spreads (10-year tenor) for 26 countries in basis points. The differences in the means and variances in different countries show the developments of CDS spreads over the period 2005-2010. The standard deviation of spread highlights the differences across countries: Germany exhibits a yearly volatility in spread changes of 17 basis points while Greece's 266 basis points, and the highest standard deviation corresponds to the CDS contract of Poland (307 basis points)

Table 3.1 Sovereign CDS spreads individual countries - Descriptive statistics

This table reports descriptive statistics for yearly spreads for ten-year sovereign CDS contracts. CDS spreads are measured in basis points for each individual country of the sample. The time series covers the period from January 2005 to December 2010.

Country	Mean	St Dev	Min	Max	N
Austria	43,95	46,82	2,66	107,54	6
Belgium	38,75	43,97	2,55	109,63	6
Bulgaria	166,63	150,46	27,73	351,01	6
Cyprus	123,47	26,28	105,01	153,56	3
Czech Republic	68,23	58,01	7,12	135,49	5
Denmark	34,22	17,40	18,48	60,61	6
Estonia	294,95	162,41	107,66	396,89	3
Finland	24,59	14,45	4,21	38,15	4
France	24,64	27,49	2,20	70,20	6
Germany	19,14	17,53	3,46	40,13	6
Greece	170,42	265,56	8,66	693,73	6
Hungary	161,72	148,90	18,77	335,68	6
Ireland	161,72	148,90	18,77	335,68	6
Italy	146,71	123,37	8,55	297,56	6
Latvia	322,71	307,00	6,50	708,45	5
Lithuania	219,00	212,35	6,00	496,81	5
Netherlands	51,37	6,63	43,84	56,29	3
Norway	25,76	5,21	22,08	29,45	2
Poland	85,30	78,44	13,41	189,50	6
Portugal	75,82	110,64	6,10	291,87	6
Romania	190,34	167,36	32,25	390,00	6
Slovakia	75,82	110,64	6,10	291,87	6
Slovenia	40,93	41,93	8,36	106,17	6
Spain	63,09	79,42	3,01	205,14	6
Sweden	25,96	28,42	1,79	69,17	6
United Kingdom	78,08	5,43	73,80	84,19	3

Accordingly, sovereign CDS spreads record their peaks at different points of time. For example, the new members states of the UE (Bulgaria, Estonia, Latvia, Lithuania, Poland, Czech Republic, Hungary and Romania), reached mostly the highest value in the height of the global financial crisis (2008-09). The increase of the spreads mirrors specially the economic distress in the Baltic economies (Estonia, Latvia, and Lithuania) which were severally hinged by the financial crisis.

The Latvian CDS spread recorded the highest value of the sample in 2009 (708 points base) (cf. Figure 1.3 in the Appendix) mainly due to pressures on the CDS market, interbank lending rates and also currency forwards (Purfield and Rosenberg, 2010). In these countries the CDS spreads rose drastically whereby the yearly average values ranged from 239 basis points in Italy to 694 basis points in Greece. The increase of the CDS spreads in this period was a result of the sovereign credit crisis faced by these countries. By 2010, the euro area sovereign CDS spreads have not returned to the levels witnessed before the onset of the financial and sovereign debt crisis.

Table 3.2 Variables of the analysis - Descriptive statistics

This table reports the descriptive statistics of the variables used in the empirical analysis. The CDS spreads are measured in basis points, whereas the GDP and GDP p.c. variables are in logarithms. Gini and Theil coefficients were calculated by the author and range from 0 to 1. The remaining variables are in percentage points. The variables refer to the period 2005-2010. Description of the variables presented in Table A.1 in the Appendix. Descriptive statistic of Gini coefficients are displayed in Table A.3 in the Appendix.

Variables	N	Mean	St Dev	Min	Max
CDS (yearly average)	134,00	101,65	145,25	1,79	708,45
10y-Government yields	129,00	1,07	1,80	-3,38	11,06
Gini coefficient (gross/OECD)	102,00	0,47	0,04	0,41	0,59
Gini coefficient (gross)	140,00	0,34	0,04	0,26	0,46
Theil coefficient (gross)	140,00	0,21	0,06	0,11	0,39
GDP growth	156,00	1,55	4,75	-17,55	12,85
Debt to GDP	146,00	50,90	29,53	3,70	148,30
Inflation	156,00	3,00	2,54	-4,48	15,40
Trade	156,00	39,21	16,22	13,30	77,70
GDP (Logarithm)	157,00	26,24	1,56	23,36	32,22
GDP *p.c.* (Logarithm)	156,00	10,20	0,39	9,14	11,02

Table 3.2 provides a summary of the descriptive statistics of the sovereign CDS spreads as dependent variable, the income inequality indicators as the main variable of interest and control

variables used in the regressions. As showed above, the CDS spreads display a large standard deviation which indicates precisely the remarkable overall increase of the CDS spreads in the aftermath of the financial crisis in 2007-08. The explanatory variables are in generally tightly centered around the mean. It is important to emphasize that the large variation of the public debt as a percentage of GDP seems to reflect different levels of public debt across European countries.

3.3 Econometric Methodology

The aim of this study is to test the hypothesis that high levels of income inequality influence the pricing of the sovereign debt. This hypothesis is tested according to econometric models which may vary depending on different data specifications as well as empirical methods. Panel and cross-sectional data demand a consistent econometric estimation to address for unobserved country specific-effects in order to avoid biased analysis. The baseline econometric estimation is based on fixed effects models in several variants and further on the Arellano-Bond dynamic panel estimator to clarify the causal effects derived from the relation between the explanatory variables and the dependent variable. Pooled OLS models are also used for comparison purposes although they disregard time-invariant country characteristics. Following the Ainzenman et al. (2011) and Caceres et al. (2010) econometric framework, the panel data will be divided in one sub-sample resembling the "crisis period" during the global and European financial turmoil (2009-2010) while at the same time it serves to account for the regional heterogeneity across countries. It is also specified a dummy variable for the GIIPS group (in interaction with inequality). The procedure of the estimations has as starting point Pooled OLS estimations in order to assess the impact of inequality on sovereign risk.

Therefore the baseline model is represented as follows:

$$SovRisk_{it} = \beta_0 + \beta_1 Ineq_{it} + X_{it}'a + e_{it} \quad (1)$$

Where $SovRisk_{it}$ is the sovereign risk indicator represented by the sovereign CDS spreads, i stands for the geographic unit (the 26 countries included in the sample), and t for the year, t = 2005,…, 2010. The main variable of interest is the $Ineq_{it}$ and it is given by the Gini coefficient or Theil coefficient, β coefficients are the set of unknown coefficients, X_{it} represents a vector of variables controlling for the sovereign credit risk (logarithm of both GDP *p.c.* and GDP; debt to GDP, inflation, trade, GDP growth, dummy variable euro), and e_{it} denotes the disturbance. Following the hypothesis of a linear positive influence between the level of income inequality and sovereign default risk, β_1 should be positive and significant (Berg and Sachs, 1988; Kim, 2008; McColliste and Karayalçin, 2004). As usual, the variable GDP *p.c.*, and GDP are converted in logarithms because they are in monetary unities and not in percentage points. In a first empirical approach, the pooled OLS results are based on the specification (1), i.e., the lag of the dependent variable will be omitted in order to avoid biased results (I will came to this result latter).

The model presented above relies on the simplest estimations known as pooled regressions in which errors are homoscedastic among individuals and across time. Although OLS models perform limited information for the analysis by ignoring the panel data structure and their specifications, they are easily interpreted and serve as a clear point of reference for the start point (DiNardo and Johnston, 1997). Accordingly, the above panel specification is highly unlikely to be appropriate for this analysis mainly due to the omitted variable bias derived from the presence of unobserved country-specific influences.

From specification of equation (1) one methodological issue arises concerned with the heterogeneity among individuals leading by the presence of individual effects. These effects jointly with the presence of country fixed effects make the OLS inconsistent and biased in the panel estimations. The heterogeneity bias is also true even if the error term e_{it} is uncorrelated with the vector X_{it}.

Additionally, considering the panel data structure of the sample, it is possible to observe heteroskedasticity in the residuals[22]. As such, in order to deal with this issue, all regressions of the analysis apply the robust specification, which corrects for contemporaneously correlated errors and panel heteroskedasticity.

[22] The statistical option is provided by the *xtreg3* command in the Stata software and indicates the presence of heteroskedasticity in the estimations.

3.3.1 Fixed and Random Effects

One way to overcome the problem of the time-invariant country characteristics of the variables is to use fixed-effects estimation. The fixed-effects model controls for omitted variables when these variables change across entities (e.g. countries, people, and companies) while remaining fixed over time (Stock and Watson, 2007). This implies the existence of effects within the individual that may bias or influence the outcome variables of the model. In addition, the fixed effects model assumes that regressors are correlated with the fixed individual effects a_i (equation 3). Given that, each a_i component is considered an unknown parameter and has to be calculated. Moreover, this formulation assumes that the effect of the time-invariant characteristics is absorbed by the constant term. The rationale behind the fixed effects model is that unobserved individual effects may be correlated with the others variables of the regression (Greene, 2008). In the fixed effects models the time invariant variables cannot be included as they are eliminated by the intercept of the model.

The random effects model differs from the fixed effects in the sense that the time-invariant specific effect component a_i is uncorrelated with all the regressors of the regression. In other words, the variation across entities is assumed to be random and it is not correlated with the dependent variable or regressors of the model. In the case that the effects are uncorrelated with the regressors, one can use the random effect model. The random effects estimator in this case is efficient and consistent, whereas the FE estimator is consistent but not efficient. This specification includes a component u_i, which represents the individual random heterogeneity of all observations and remains constant over the time. The random-effects model is also known as the error components model whereby the slopes and intercepts of regressors do not vary across entities.

3.3.2 The Fixed Effect Equations

Applying the Hausman test to the panel data, I obtained the value of the 0. The null hypothesis of this test indicates that this specification should be adopted for this empirical analysis in alternative to the random effects. In other words, the Hausman test points out towards the existence of correlation between the explanatory variables and the error term.[23]

As such, this test supports the use of fixed effects method on the estimations, whereby the fixed effect equations is given by:

$$SovRisk_{it} = \beta_0 + \beta_1 Ineq_{it} + X_{it}'b + u_{it} \quad (2)$$

Contrary to the basic model above, the fixed effects models include a fixed effect component also known as entity fixed effects, a_i, which represents unobserved characteristics to be tested which vary across *i*, but remain unchanged across *t*. Given that, in the fixed effects specification, the error component is the following:

$$u_{it} = a_i + e_{it} \quad (3)$$

Where e_{it} is assumed uncorrelated with the regressors of the model. The fixed effects for each entity (country) intents to control for variables that are fixed over time but differ across entities. In addition, a common transformation for the fixed effects models is the inclusion of time fixed effects which in turn can control for variables that are constant across entities but vary over time. In order to avoid falling into the "dummy-variable trap" it should be considered N-1 dummies otherwise it arise the situation of perfect collinearity.

To sum up the specifications presented in (2) and (3) are standard panel data equations. The presence of time-invariant country characteristics (fixed effects), such as geography, demography may be correlated with the explanatory variables. In order to address the potential issue of endogeneity, I apply the system GMM in the estimations, which considers the inequality and the debt to GDP as endogenous variables.

3.3.3 The Arellano-Bond GMM Estimator

When we introduce the lagged dependent variable in the model with fixed effects, there is a problem of the autocorrelation between the variables $SovRisk_{it}$ and $SovRisk_{i,t-1}$ as the lagged

[23] The statistical tests applied the in panel data concerning the choice of FE or RE models are further developed in the section A1 in the Appendix – Testing Fixed and Random Effects.

dependent variable is a function of u_i, and consequently $SovRisk_{it-1}$ is correlated with the error term (Balgati, 2005).

The dynamic panel data regressions described in equations (2) and (3) may lead to inconsistent estimations due to the presence of individual heterogeneity among individuals and autocorrelation between the lagged dependent variable and the error term. Furthermore, the time dimension in this data set is relatively small (at most 5 years) and, hence, the bias from using a FE estimator might be significant in the results. To cope with these methodological problems Arellano and Bond (1991) developed a dynamic panel data approach which can be regarded as an extension of the Anderson–Hsiao estimator. The estimation is done in first differences. More specifically, the underlined idea of using this model is to remove the reverse causality and endogenous regressors by instrumenting the first-differenced lagged dependent variable also with its past levels (Roodman, 2006). This analysis therefore follows a System GMM approach.

This approach is of particular importance as it deals with by-direction causality between income inequality variable and the debt to GDP. The reverse causality can be explained by considering the effect of an increase of CDS spreads on the fiscal position of a country. This mechanism allows for a higher probability of default in the future which in turn might lead a country to enter in external aid (IMF). Thus in the case of indebted countries there will be a rise of taxation reverting for the debt service which in turn blocks the allocation of revenues for the redistribution purposes, public spending and investment. This in turn will imply more inequality. The mechanism of reverse causality described beforehand might lead to biased estimations. Thus in order to control for the endogeneity issue, the GMM in first-differences is used by transforming the equation (3) into:

$$\Delta SovRisk_{i,t} = \beta_0 + \beta_1 \Delta SovRisk_{i,t-1} + \beta_2 \Delta Ineq_{i,t} + \Delta X_{it}'b + \Delta c_i + \Delta u_{i,t}; \quad (4)$$

$$\Delta u_{i,t} = u_{i,t} - u_{i,t-1} = (c_i - c_i) + (e_{i,t} - e_{i,t-1}) = e_{it} - e_{i,t-1} = \Delta e_{i,t} \quad (5)$$

The core assumption of the GMM Arellano–Bond estimator is that first differences of instrument variables cannot be correlated with the error term. Furthermore, this model enables the inclusion of endogenous variables which are instrumented with GMM-style instruments, i.e, lagged values of the variables in levels which in turn improve the efficiency of the estimations. The specification of the sample data of this analysis suggests that the more appropriate consideration of the GMM estimator is to include two endogenous variables as instruments: the inequality and debt to GDP variables.

The choice of a model as the GMM Arellano–Bond involves the specification of some important procedures necessary to conduct coherent estimations. As such, firstly it is performed the Arellano–Bond test for second-order[24] serial correlation under the null hypothesis of no autocorrelation among the variables. While first order autocorrelation should be present, second order autocorrelation should be absent. Secondly, as the Arellano–Bond estimators are instrumental variables models it is of upmost importance to test the validity of the instruments used in the estimation. One particular point to consider is the choice of the number of instruments larger than the number of endogenous variables, to ensure over-identifying restrictions. The Sargan-Hansen test will be used for over-identifying restrictions, i.e., to validate the instrumental variables used under the null hypothesis that the instrument variables are exogenous to the model (Roodman, 2006). Additionally, this model considers the two-step estimations thereby the standard covariance matrix is robust in matters of panel-specific autocorrelation and heteroskedasticity (Efthyvoulou, 2012).

[24] Second-order because we only have one lag of the dependent variable.

IV. Empirical Results

This chapter presents the results of the empirical analysis. Following the empirical methodology described in the previous chapter, the central hypothesis of this study is tested: "is income inequality an important determinant of the CDS spreads dynamics?".

For the sample of 26 countries included in the sample, regressions are performed in order to evaluate how the annual changes in the CDS spreads are affected by the explanatory variables described in the previous section. For each regression, the annual average of sovereign CDS spreads represents the dependent variable, whereas the explanatory variables are represented by the income inequality and a set of control variables. Additionally, to deal with presence of the heteroskedasticity, all the regressions are estimated using heteroskedasticity-robust-standard errors.

4.1 The Baseline Empirical Model

The starting point of the empirical analysis on determining the impact of income inequality on sovereign credit risk is based on pooled OLS regressions to the panel sample for the period of 2005-2010. Among the several variables affecting the sovereign risk, I chose the debt to GDP, GDP growth, inflation, GDP, GDP *p.c.*, trade, and a dummy variable for the member states of the EMU. The reason for this choice was explained in section 3.2. It can be argued that many explanatory variables are only known with a one year lag, implying that they may not affect the current value of CDS. While that can be true for some variables, it is not true for others, like inflation. But for the variables that are released with a delay, the argument is that despite this, economic agents formulate expectations regarding their values.

As outlined in the previous section, the use of OLS regressions in panel data analysis may lead to biased results as it does not account for country-specific effects. Nevertheless, pooled OLS regressions are generally used in panel data regressions for purposes of comparison with other econometric panel models. In Table 4.1 the specification in column (1) refers to the baseline OLS model and the models (2) and (3) apply the Least Squares Dummy Variable Model (LSDV) to the panel sample. Temporal dummies variables are included in all regressions except in model

(1).[25] According to the results in the specification (1), the Gini coefficient is not statistic significant, which in turn may emphasize the problem of the endogeneity among certain variables. By opposition, the remaining control variables of the estimation are highly statistic significant with the exception of the trade variable. For example, the variable of public debt to GDP shows a positive coefficient and high statistical significance although its impact in widen the sovereign CDS spreads is quite small (the value is 1,28 means that an increase in public debt to GDP by one percent leads to an increase in the CDS spreads by only 1,28 basis points). The euro dummy variable is negatively related to the CDS spreads and indicates that as a country enters the EMU, the default risk will decrease. This result appears to contradict the Dieckmann and Plank (2011) findings showing that EMU-members are most exposed to the increase of sovereign CDS spreads than the non-EMU members. Also, the indicator of the inflation shows a positive relationship with the CDS spread. The results also show that the measure of the size of the economy (GDP) reveals statistically significant on the CDS spreads dynamics. This result supports the assumption that the size of the economy is an important determinant to evaluate the sovereign credit risk (Berg and Sachs, 1989). The level of GDP *p.c.* also has a negative effect on sovereign credit risk. Although the negative sign of the degree of openness of the economy (trade) shows that CDS spreads decrease for more open economies, this variable is not statistic significant in this estimation.

The model (2) and (3) consider the Least Squares Dummy Variable Model to the panel sample thereby time dummies are included in the regressions, to capture the common trends that affect credit risk as global appetite for risk. As can been seen, the results improve when compared with the Pooled OLS estimation. The R-square also show an evident increase by 11%. Similarly to the previous model, the inequality indicator does not show significance at 0.05 level. As it is expected from the literature review, the temporal dummy “t2010” is statistic significant at one percent level revealing the effects of the sovereign debt crisis in this period. Moreover, in line with a comparable study (e.g. Kim, 2008) these findings show a strong and persistent relationship between the inflation and economic growth on the pricing dynamics of the CDS spreads. The

[25] Table 4.1 reports P-values, standard deviations and R-squared for each of the pooled OLS and fixed effects regressions for the whole period sample (2005-2010). The P-values of the regressions address the significance probability of each explanatory variable on the CDS spreads. If a variable has a P-value lower than 0,05 is considered to have a significant impact on the CDS spreads. R-squared indicates how much each model accounts for the total variance in the variation of CDS spreads.

coefficients of these variables in all models presented are mostly of the cases different from zero at one percent confidence level.

The next estimations (columns (3) and (5)) intent to estimate the influence of income inequality within countries on the pricing of sovereign CDS spreads, by using the fixed-effect estimator. This approach has the advantage of amending the previous model by controlling for country characteristics over time (Rodman, 2006). The heterogeneity of cross sectional data of this analysis may induce to biased estimates from time-varying omitted variables. In fact, the data sample presents a set of countries with different economic backgrounds that goes from the most advanced economies of Europe to middle income countries, accounting for different political regimes in the past, and also for different monetary regimes. One way to overcome these different specifications across countries and over time is to consider temporal dummies in line with the country-specific time-invariant effect. Column (3) displays fixed effects estimations which controls for the time specific effects in order to capture the effects of the global and European financial crisis. The results of the estimations of model (3) hold for the specifications of the models (1) and (2) for the most of the variables, with the exception of the indicators of economic development economy (GDP and GDP *p.c.* in logarithms) and the dummy variable t2010 as they turned out not statistically significant.[26] The results indicate that the country fixed effect captures greatly the effect of GDP and GDP *p.c.*, and because of that I drop them in the next regressions. The effect of the year 2010 in the regressions disappears after the introduction of the countries fixed effect, showing that what I thought it was a global effect is indeed a country effect. The introduction of the lagged dependent variable in models (4) and (5) does not seem to change the overall results of the models. In specification (4) the coefficients signs of GDP and GDP *p.c.* turn to be positive when comparing with model (2). This result may derive from the use of the lagged dependent variable in Pooled OLS models which leads to biased estimations (Rodman, 2006). As in the case of Pooled OLS and Fixed Effects models (column (4) and (5)) the lagged CDS variable is statistically significant I include this variable in the following estimations as an endogenous variable.

[26] The model with fixed effects and lagged dependent variable produces biased estimates of this variable. It is presented here only for comparison purposes. I will estimate below the GMM model that addresses the bias problem in the presence of a lagged dependent variable.

Table 4.1 Pooled OLS and Fixed Effects Regressions[27]

Table 4.1 reports estimations obtained using Pooled OLS estimations (columns (1), (2) and (4)) and fixed-effect regressions (columns (3) and (5)) with heteroskedasticity-robust standard errors using annual data for the 2005-2010 (a maximum of 115 observations per model). The dependent variable is the sovereign CDS spread. Inequality is the main explanatory variable and refers to the Gini Index of each country of the sample (ranges from 0 to 1). Columns (4) and (5) include the lagged CDS as an explanatory variable. GDP and GDP p.c. variables are expressed in logarithms. Temporal dummies are added to the models (2), (3), (4) and (5); other variables are described in Table A1 in the Appendix.

	Model									
	Pooled OLS		**Pooled OLS**		**Fixed Effects**		**Pooled OLS**		**Fixed Effects**	
VARIABLES	**1**		**2**		**3**		**4**		**5**	
CDS (lagged)							0.378**	(0.158)	0.437**	(0.180)
Inequality	190.2	(289.7)	141.2	(261.3)	251.7	(403.6)	392.6	(403.6)	685.7	(423.1)
Debt to GDP	1.281*	(0.705)	0.936*	(0.550)	8.352***	(2.673)	-3.201	(2.673)	7.049***	(2.137)
Euro	-38.70**	(18.81)	-31.20*	(17.39)			33.33	(29.96)	-65.72**	(29.04)
GDP Growth	-17.29***	(1.764)	-19.12***	(3.174)	16.51***	(4.245)	-4.973	(4.245)	-8.080**	(3.344)
Inflation	16.13***	(5.155)	15.58***	(4.958)	11.59**	(5.612)	-7.304	(5.612)	26.45***	(8.521)
GDP	-27.42***	(10.19)	-23.74***	(7.905)	22.78	(213.3)	238.5	(213.3)	184.3	(116.0)
GDP *p.c.*	-102.2***	(33.18)	-120.6***	(32.11)	416.9	(367.5)	283.2	(367.5)	-128.4	(279.8)
Trade	-0.888	(0.783)	-0.919	(0.650)	-4.496	(4.818)	-5.402	(4.818)	-5.788	(4.477)
t2006 dummy			43.18*	(21.96)	17.42	(29.96)				
t2007 dummy			21.95	(26.14)	-15.24	(59.03)	-37.91	(59.03)	-33.56	(21.34)
t2008 dummy			60.60**	(24.00)	-19.86	(69.78)	-52.63	(69.78)	15.18	(27.19)
t2009 dummy			16,10	(30.20)	-127.4*	(71.67)	-102.6*	(71.67)	-16.26	(35.69)
t2010 dummy			137.9***	(21.27)	-46.79	(67.47)	-101.1	(67.47)	47.04**	(22.12)
Constant term	1,758***	(463.1)	1,833***	(444.1)	-5,062	(4,56)	-8,162	(6,565)	1,373**	(603.6)
R^2	0.688		0.791		0.710		0.744		0.810	
Observations	115		115		115		98		98	
Countries	25		25		25		25		25	
Fixed Effects	No		No		Yes		Yes		Yes	

Note: Standard errors in parentheses

[27] The euro area dummy is eliminated in model (3) because I insert country effects.

4.2 Controlling for the Endogeneity

As a third step in the empirical estimations, two questions should be addressed: the impact of the lagged value of CDS and the variables endogeneity. Regarding the first point, the lagged value of CDS may affect the current value of CDS, which requires a dynamic panel model, estimated with the Arellano-Bond method. The second issue calls our attention to the fact that some explanatory variables may be endogenous, implying a bias on the estimation of coefficients. The main concern in this specification is with inequality because is the key explanatory variable. Between sovereign risk and inequality might exist a reserved causality, in which high levels of sovereign risk implies public expenditures reductions and tax increase may increase inequality (Agnello and Sousa, 2011). Public debt may also be affected by the sovereign risk, as larger interest rates paid by a country increase the budget deficit and therefore public debt. Thus, I estimated a dynamic panel model assuming as instruments and endogenous variables the inequality and public debt. Moreover, also the CDS, the inflation, the dummy variable euro, the GDP growth and the trade were used as instruments variables. The GMM Arellano-Bond models passed the Sargan and second-order serial correlation tests precluding the employment of this model. In this analysis I did not include the GDP and GDP *p.c.* because they proved to be irrelevant after the inclusion of fixed effects (Table 4.1).

The specification in column (1) uses all available instruments as suggested by the System GMM estimator.[28] As the results reveal, the lagged dependent variable ($CDS_{i,t-1}$) is significantly different from zero at a one percent significance level, emphasizing the persistence over time of sovereign credit risk. This result shows the influence of the previous CDS values on explaining the dynamics of current CDS spreads. The $CDS_{i,t-1}$ in the estimations generates more efficient estimations as it provides information of the CDS pricing dynamics during previous period (Fontana and Scheicher, 2010). In economic terms, it captures the effect that past interest rates (which depend on CDS spreads) may have on current sovereign risk. Additionally, after dealing with endogeneity turned out that the income inequality coefficient is statistically significant at 5% level. Specifically, a 0.1 rise in the Income Inequality is estimated to increase the 10-year CDS spread by 290.09 basis points. It is important to notice that after controlling endogeneity, inequality has become statistically significant as its coefficient increased around 10 times. The result

[28] In this model we lose 2005 and 2006 because the dependent variable is in lags and we use as instruments the lags of variations of exogenous variables.

corroborates the hypothesis developed by Berg and Sachs (1989), Kim (2008), and McColliste and Karayalçin (2004), in which income inequality is a significant indicator determinant of the sovereign credit risk. Hence, this specification holds a relationship between sovereign credit spreads and income inequality thereby the expected positive coefficient is consistent with predictions that arise from the median voter theorem (Meltzer and Richard, 1981). These authors claim that in more unequal societies agents demand more redistribution policies by contrast to an increase of taxation. Considering inequality as a determinant of the sovereign credit risk, in societies with more income inequality, governments respond to the popular pressures by distributing more rather than a future increase in taxation. This in turn implies that countries use their foreign loans to redistribute leading to an increase of the public debts and subsequently decreasing the investment and growth (McColliste and Karayalçin, 2004; Kim, 2008). Another important result in this specification is the fact that the trade variable shows a high level of statistical significance contrary to the estimation showed in Table 4.1.

Furthermore, the effects of inequality on sovereign risk maybe take the U-shape form (Jauch and Watzka, 2012; and Kim, 2008). To test this hypothesis, I add in column (2) the square of the explanatory variable (income inequality) as an explanatory variable. The results of the model are in accordance with the expected by the theory: the coefficient of the income inequality is positive whereas the coefficient of its square is negative. Thereafter, a negative sign means that the more unequal a country is, the more likely the occurrence of a default, but as inequality becomes too high, the probability of default starts to decrease. This evidence was tested by Kim (2008) emphasizing that in highly unequal societies the probability of default is less likely to occur as the creditors would block the loans to these countries as they might assume they will not repay its debts. Nevertheless, contrary to the Kim (2008) projection, the coefficient in this model is not statistic significant implying that these findings do not display a non-monotonic relationship in the income inequality variable. Regarding this specification of the model, other variants and variables will be included in the estimations.

As mentioned in the previous section, the epicenter of the global financial crisis occurred during the period of 2008-2010. Therefore, in order to have a broader view of the impact of the income inequality on the developments of the CDS spreads, the sample is split in a sub sample embodying the years of 2009-2010. Following the methodological procedure of Ainmmazen et al. (2010), the period of 2008-2009 is representative of the financial global crisis and the year of 2010 assembles the sovereign debt crisis. As this analysis is focused on the European countries, I consider the period from 2009 to 2010 as representative of the European sovereign debt crisis (column (3)).

Table 4.2 Panel dynamics estimations - System GMM estimations

Table 4.2 displays the System GMM regression results using annual data for the 2005-2010 for all models except for model (3) which concerns the period of 2009-2010 (a maximum of 73 observations per model). The instruments used in the system GMM regression are lagged levels (two periods) of the dependent variable and of the endogenous covariates Debt to GDP and Inequality. The exogenous variables Euro (dummy), Inflation, GDP Growth and Trade also enter as instruments in first differences. Model (2) includes the square of the Inequality as an exogenous instrument. Colum (4) adds the interaction between the Inequality and GIIPS countries as an endogenous covariate. The table also reports the Hansen test for over-identifying restrictions [p-values]. The dependent variable is the sovereign CDS spread. All variables are described in the Table A1 in the Appendix. The Sargan test of over-identifying restrictions has a null hypothesis of exogenous instruments (not correlated with the error term). The AR(2) test has a null of no autocorrelation in second differences.

	Model							
VARIABLES	**1**		**2**		**3**		**4**	
CDS (lagged)	0.615**	(0.241)	0.620**	(0.300)	0.265	(0.290)	0.489	(0.298)
Inequality	2,909***	(838.2)	8,877*	(4,9)	3,942***	(1,366)	2,666***	(643.7)
Inequality (square)			-9,114	(6,696)				
Debt to GDP	6.562**	(3055)	7.494**	(3390)	5.245	(5.540)	7.454*	(3824)
Euro	-45.81	(58.83)	-67.78	(190.5)	-100.6**	(43.91)	-61.66	(66.19)
GDP growth	-5.209*	(2862)	-5819	(3587)	0.947	(6.529)	-6.365*	(3414)
Inflation	32.68***	(7722)	35.95***	(8402)	14.95*	(8.632)	30.94***	(7435)
Inequality (GIIPS)							-520.6	(2,449)
Trade	-9.687**	(4100)	-8944	(7524)	-12.99	(8.281)	-8172	(5147)
Constant term	-939.7**	(433.8)	-2,004**	(926.1)	-1,011	(777.4)	-918.3*	(482.3)
Observations	73		73		44		73	
Hansen test (a)	0.2905		0.4223		0.2301		0.4055	
Corr. Test (b)[29]	0.7524		0.9067		0.7131		0.7085	
Countries	24		24		24		24	

Note: Standard errors in parentheses

*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)

(a) Reports the Hansen test for over-identifying restrictions [p-values]

(b) Reports the Arellano–Bond test for second-order serial correlation of the differenced residuals [p-values]

The inclusion of this sub period enables to get further insight on the impact of income inequality in periods of economic distress and fiscal budget adjustments leading by indebted countries. Additionally, it describes the effects of the determinants of CDS spreads during the crisis, assessing in particular how much these spreads are driven by specific factors affecting fiscal

[29] The majority of the System GMM estimations included in this analysis displays autocorrelation in first differences. This result is expected when it is applied the Arellano – Bond Dynamic Panel GMM estimator.

sustainability. The crisis period estimation in model (3) is consistent with the estimation of the model (1). Equally in this specification, the income inequality shows a significant impact on the determinants of the CDS spreads. The CDS spreads react more strongly to income inequality in this model which than in model (1). The influence of this temporal difference in the model specification is highly significant; thereby the magnitude of its effect on the CDS spreads is larger than in the model which compiles all period. Thereafter, during the period crisis, an increase of the income inequality leads to an increase of the CDS spreads by 3,942 basis points. This result addresses that in period of economic downturns the income inequality has a stronger influence in the sovereign CDS spreads. As explained in the literature review, the increase of income inequality has significant macroeconomic consequences, which in turn leads to a decrease of the economic growth. Given that, governments with external debts combined with high levels of income inequality face higher costs to deal with redistributive issues (e.g supporting the unemployment) (Christensen et al., 2013). As a consequence there will be an overall lack of confidence by the international investors by assuming that governments will not commit with their obligations leading to an increase of the CDS spreads. Moreover, by considering this sub period, it is patent the lack of statistical significance of the policy fiscal indicator (debt to GDP). This result may indicate a decline of this macroeconomic variable on the sovereign risk perception. Additionally, also the variable of GDP growth loses its significance in this specification. The loss of significance of these two variables may occur simply because there are fewer observations, but it may also be because in the crisis period speculation has become more relevant.

As a complementary analysis, I assume the later phase of the crisis (2010) which mirrors the challenges faced by the GIIPS group in adjusting its fiscal budgets in the context of a sovereign debt crisis. This effect is considered on the income inequality indicator. As such, the Gini coefficient is multiplied by a dummy variable represented by the GIIPS countries as a whole.[30] The objective is to evaluate the interactions between the GIIPS countries and the level of inequality and determine whether the pricing of risk in this group affects the overall results. Furthermore, I expect to determine if inequality has a different effect (expected to be higher) on risk by considering this specific group of countries. The estimation of this specification with the inclusion of a dummy variable for the GIIPS group shows consistency with the results of the

[30] This variable concerns the GIIPS countries and takes the value of 1 in the presence of each one of the GIIPS countries.

previous results assessing the income inequality indicator statistically significant at 1%. Column (4) shows the results for the model specification embodying the GIIPS effect in the regressions. The result supports the assumption tested by Ainmmazen et al., (2010) in which default risk in GIIPS group is priced much higher when compared with the overall sample of countries in 2010.

Additionally, all results show the opposite position of Cacers et al., (2011) which states that EMU members countries were severely more affected by the financial crisis than the non-members. Thus, given that, the dummy variable of euro is not statistical significant in any specification thereby I conclude that the lack of individual monetary authority is not a relevant indicator to explain the dynamics of the CDS spreads on income inequality.

4.3 Robustness Checks

In the next step in the sensitivity analysis I test the robustness of the results deriving a model with an alternative measure of income inequality. The alternative indicator is given by the Theil Index (Niehues, 2008). While the dependent variable and control variables remain the same as in the above regressions (Table 4.2, column (1)), the main explanatory variable is the Theil Index (specification (1). In column (2) it is assessed whether inequality on sovereign risk takes the U-shape form. The finding resulting from this robustness check shows that income inequality is not statistically significant, even though the signals of the remain variables show consistency with the economic theory (cf. Table 4.3). Due to these empirical findings, I conclude that the most relevant indicator of income inequality in terms of sovereign risk is the Gini coefficient as it is robust over the most specifications.

The next step of the robustness check includes individual interactions of group of countries/temporal dummies with the indicator of income inequality. The purpose of such analysis is to examine how robust the previous results are when dealing with interactions of the endogenous variable income inequality with five different groups of countries of the panel data set by using a GMM estimator. According to the Ferreira (1996) typology, European countries can be divided in four groups of welfare states. These groups correspond to the social-democratic (Nordic

Europe), the conservative (Continental Europe), the Mediterranean countries (Southern Europe) and the liberal countries (Anglo-Saxon). [31]

Table 4.3 Robustness checks 1: System GMM estimations using Theil coefficient

Table 4.3 describes the System GMM regression results using annual data for the period of 2005-2010 (a maximum of 73 observations per model). The instruments used in the system GMM regression are lagged levels (two periods) of the dependent variable and of the endogenous covariates debt to GDP and inequality. The exogenous variables euro (dummy), inflation, GDP growth and trade and also enter as instruments in first differences. The dependent variable is the sovereign CDS spread. Model (2) includes the square of the Inequality as an exogenous instrument. All variables are described in the Table A1 in the Appendix. The Sargan test of over-identifying restrictions has a null hypothesis of exogenous instruments. The AR(2) test has a null of no autocorrelation in second differences.

	Model			
VARIABLES	**1**		**2**	
CDS (lagged)	0.717**	(0.287)	0.692*	(0.394)
Inequality (Theil Index)	1,17	(719.4)	1,564	(4,876)
Inequality (square)			-880.4	(-9,285)
Debt to GDP	4.418	(-4519)	5330	(-4291)
Euro	-37.90	(49.42)	-65.93	(96.38)
GDP growth	-5.042	(-3699)	-5270	(-4423)
Inflation	33.35***	(-7141)	34.38***	(-7795)
Trade	-10.32**	(-4652)	-10.08*	(-5933)
Constant term	-72.35	(384.5)	-167.7	(539.9)
Hansen test (a)	0.2818		0.4520	
Corr. Test (b)	0.2708		0.4902	
Observations	73		73	
Number of countries	24		24	

Note: Standard errors in parentheses

*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)

(a) Reports the Hansen test for over-identifying restrictions [p-values]
(b) Reports the Arellano–Bond test for second-order serial correlation of the differenced residuals [p-values]

Table 4.4 reports the results of System GMM estimations where models (1) to (5) include a dummy variable multiplied by income inequality treated as individual endogenous variable. From

[31] The group of Continental countries is represented by Austria, Belgium, France, Germany, Luxembourg and Netherlands. The Mediterranean group encompasses Greece, Portugal, Spain and Italy. The liberal countries are UK and Ireland. The Nordic Europe is constituted by Sweden, Finland, Norway, and Denmark. The East group includes: Bulgaria, Check Republic, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia and Slovenia.

these robustness checks results, the magnitude of estimated income inequality coefficient appears fairly similar to the Table 4.3. Model (2) reports biased results as the dummy variable “Inequality_ Continental” just accounts for two countries (Ireland and UK). Because of that I do not give much importance to the statistical significance of this result. All in all, the effect of income inequality on sovereign credit risk is not significantly different among European country regimes.

In addition, model (6) shows an interaction between the Gini coefficient and a dummy variable for the sovereign crisis in 2009-2010. As a result, the coefficient of income inequality interacting with a temporal dummy t2009-10 is not statistically significant. By including this specification, although the explanatory power of income inequality on credit risk sovereign is reduced, it remains approximately the same as in the main estimations presented in Table 4.3.

Following the analysis of Sections 4.1, 4.2, and 4.3 additional robustness checks were made considering firstly an alternative source of the Gini coefficient indicator and secondly a different proxy for the sovereign default risk. By using the Gini coefficient measured at a gross basis[32] provided by OECD income inequality database, inequality turns out to be statistically insignificant whereas the main findings reported above remain essentially intact. Although this indicator is statistically insignificant, the signs of the coefficients are in accordance with the main results reported above in the regressions of Pooled OLS (cf. columns (1) and (2) in Table A.5 in the Appendix) and GMM (cf. column (1) in Table A.6 in the Appendix).

Several factors might account for the divergence in the results when compared with the main outputs reported in the Section 4.1 and 4.2. Firstly, the data used to impute the OECD Gini gross is provided by national consultants. This in turn implies differences on the source of data when compared with EU-SILC database. Secondly, the data used in this analysis is secondary data is retrieved from the same source (EU-SILC), hence, the inequality indicators follow similar methodology of calculations (cf. Table A.3 in the Appendix). Lastly, once the database refers to the OECD countries, there are 7 countries in the main analysis which are not OECD member states leading to a significant reduction of observations.

Finally, I test whether my results fit to the inclusion of an alternative indicator of sovereign credit risk jointly with the OECD Gini coefficient measured at a gross basis. Thus I employ the spread

[32] Most precisely, the OECD definition for the “gross Gini coefficient” is the Gini coefficient based on equivalised household market income, before taxes and transfers.

between the yield on ten-year sovereign bonds between eighteen European OECD countries and Germany over January 2005 and December 2010 (cf. column (1) in Table A.7 in the Appendix). The estimations follow the models displayed in table 4.2. whereby column (2) adds the square of Gini Inequality Index while column (3) represents a subsample of the period crisis (2009-2010) and model (4) embodies the interaction of the Gini Inequality Indicator and the GIIPS countries as endogenous variable.

As in the previous robustness checks the income inequality indicator fails to reach statistical significance. These results based on the effect of sovereign credit risk on income inequality are consequently inconclusive in both analysis as the inequality coefficient in some regressions appears negative precluding a negative relationship between the probability of a sovereign default and the income inequality. These results reinforce the assumption that CDS sovereign contracts are a more reliable and consequently broader measure to represent sovereign risk default than the spread of 10-year government yields (as explained in the Section 3.2.2).

Overall the results may in turn support the main conclusion of the analysis supported by the assumption that inequality is a determinant of the sovereign risk default. This finding is thus exacerbated in times of economic turbulence as the case of the last financial crisis and the subsequent sovereign debt crisis. Due to these more general and robust findings, I believe that this analysis is of importance to the literature of the topic. To sum up, the overall results estimated in this analysis are in line with the empirical studies of Kim (2008) and Berg and Sachs (1988). Although their analyses are based only on developing countries, both results suggest that the sovereign risk of a country reacts strongly to the level of income inequality of a country. All in all, the GMM Arellano–Bond estimator with the inclusion of the lag of the dependent variable as an instrument in line the explanatory variables debt to GDP and inequality treated as endogenous provide robust results in the estimations.

Table 4.4 Robustness checks 2: System GMM estimations using interactions with the Gini coefficient

Table 4.4 displays the System GMM regression results using annual data for the 2005-2010 (a maximum of 73 observations per model). The dependent variable is the sovereign CDS spread. The instruments used in the system GMM regression are lagged levels (two periods) of the dependent variable and of the endogenous covariates debt to GDP, inequality and dummies variables relating to the social regime of the countries (models (1) to (5)). Model 6 encompasses an interaction between the crisis period and the inequality. The exogenous covariates Euro, GDP Growth, Trade and Inflation also enter as instruments in first differences. The table also reports the Hansen test for over-identifying restrictions [p-values]. All variables are described in the Table A1in the Appendix. The Sargan test of over-identifying restrictions has a null hypothesis of exogenous instruments. The AR(2) test has a null of no autocorrelation in second differences.

VARIABLES	Model											
	1		2		3		4		5		6	
CDS (lagged)	0.615**	(0.241)	0.641***	(0.246)	0.514	(0.318)	0.681***	(0.192)	0.519	(0.320)	0.630**	(0.275)
Inequality	2,909***	(838.2)	3,095***	(1,062)	3,612*	(1,957)	2,470*	(1,354)	2,674***	(747.9)	2,607**	(1,267)
Inequality_ Continental												
Inequality_ Liberal			-22,759***	(8,129)								
Inequality_ East					-1,99	(2,617)						
Inequality_ Nordic							297.0	(3,862)				
Inequality_ South									-710.8	(1,976)		
Inequality_ t2009-10											-163.9	(134.2)
Debt to GDP	6.562**	(3055)	7.084**	(2.862)	7.200**	(3.152)	6.991**	(2.960)	7.428*	(4.342)	9.144**	(4.610)
Euro	-45.81	(58.83)	-41.48	(55.47)	-31.66	(74.74)	-11.13	(55.01)	-52.68	(61.39)	-18.80	(71.86)
GDP growth	-5.209*	(2862)	-4.793*	(2.567)	-4.652	(4.293)	-5.218*	(2.862)	-6.423*	(3.766)	-5.866	(3.836)
Inflation	32.68***	(7722)	36.19***	(9.026)	31.58***	(8.315)	38.26***	(8.654)	31.83***	(7.412)	31.76***	(8.146)
Trade	-9.687**	(4100)	-10.45**	(4.145)	-10.19**	(4.397)	-10.35**	(4.659)	-8.125	(5.600)	-11.09**	(5.281)
Constant term	-939.7**	(433.8)	-566.3	(448.2)	-953.4**	(460.1)	-872.7	(609.5)	-897.1*	(513.5)	-929.5*	(542.1)
Hansen test (a)	0.2905		0.4464		0.9008		0.4128		0.3361		0.4028	
Corr. Test (b)	0.7524		0.8693		0.3729		0.8640		0.7108		0.5999	
Observations	73		73		73		73		73		73	
Number of countries	24		24		24		24		24		24	

Note: Standard errors in parentheses
*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)
(a) Reports the Hansen test for over-identifying restrictions [p-values]
(b) Reports the Arellano–Bond test for second-order serial correlation of the differenced residuals [p-values]

V. Conclusion

The aftermath of the financial crisis in 2008 highlighted the fragility of the fiscal positions of some European economies. In this context, countries that were severely affected by the global financial crisis were forced to pursue fiscal consolidation. Consequently, during this period financial markets exerted pressure on the fiscal stance of indebted sovereign issuers, *i.e.* investors required higher sovereign default risk premiums for most of the European countries. Empirical research has attributed the influence of financial and economic factors as the main determinants of the CDS valuation and the underlined credit sovereign risk (Fontana and Scheicher, 2010). The central hypothesis of this thesis is that income inequality influences the size of the sovereign credit risk and the probability of a sovereign default. Therefore, this thesis provides answer to the main question of this analysis: does income inequality represents an important determinant of the sovereign credit risk? The mechanism through which inequality affects the probability of a default of a sovereign is based in the McColliste and Karayalçin (2004) theoretical framework. Thus the channel of influence of these two variables put into evidence the role of the pression for redistribution by the median voter in unequal societies.

Given that, it is tested whether income inequality displays a positive relationship with the probability of a sovereign incur in default, including countries with serious debt vulnerabilities as the case of the GIIPS group and also its effect on the period of crisis of 2009-2010. Using panel data for EU-26 member states over the period 2005-2010, a panel dynamic study is conducted in order to test the main hypothesis of the analysis. The empirical methodology of this analysis relies on a panel study driven firstly by OLS pooled estimations and also by fixed effects regressions. As the specification which includes country specific effects and lagged dependent variables among the explanatory variables leads to biased estimations, I used the Arellano-Bond GMM estimator in order to deal with the endogeneity of the explanatory variables.

The determinants of the sovereign debt, the sovereign CDS and the credit sovereign risk have received more attention in the literature than the link between sovereign credit/default risk and income inequality. This thesis takes some steps towards filling this gap testing empirically the assumption that greater income inequality increases the probability of a sovereign default using CDS data. Moreover, this study provides an innovative approach for the literature by adopting a sample of European countries with a set of heterogeneous characteristics related with political, economic and historical perspectives.

Three basic results emerge from this empirical analysis. First, the key empirical finding of this thesis relates to the explanatory power of income inequality on the dynamics of the sovereign CDS spreads. Thus this result supports the hypothesis formulated by Berg and Sachs (1988) in which highly unequal societies have a higher probability of default by considering income inequality as a structural factor with significant power to explain a sovereign default. Second, it is assessed that the CDS spreads react more strongly to income inequality in the model which considers the "crisis" period than when I considered the whole sample. This effect indicates that the results are sensitive to the period of the financial crisis. The third result indicates that the effect of inequality is not different for the GIIPS group. Additionally, other results contradict some findings described in the literature review. For example the hypothesis stated by Kim (2008) in which income inequality displays a non-linear relationship with the sovereign default risk is rejected. Also, contrary to the Cacers et al. (2011) hypothesis, the empirical findings do not support the assumption that the sovereign CDS spreads of EMU member states were more affected during the crisis period than the non-members of EMU.

The relationship between inequality and CDS spreads, nevertheless, becomes not statistically significant when we use the Theil index. This indicates that the Gini coefficient is the most suitable indicator of income inequality, probably because it reacts more to transfers in the middle of the distribution, i.e, to transfers that affect the middle class. The result also did not prove to be robust to the use of a different source for the Gross Gini coefficient (OECD) and to the use of an alternative indicator of sovereign risk (spreads of government bond yields).

The main limitation of this study is related with the limited time dimension (5 years). This reduced sample results from the availability of sovereign CDS data (started in 2004) and from the availability of data from EU-SILC dataset (data available from 2005). Given that, a possible extension of this analysis would be to consider a broader data set and study the impact of income inequality on the probability of a sovereign default in times of economic expansion for advanced economies.

An important contribution of this study is highlighted by the political implications resulting from the presence of income inequality in dealing with fiscal pressures and its relationship with the probability of a sovereign default. The key findings of this analysis emphasize the implications of higher income inequality on the CDS spreads .

My conclusions show that countries with higher income inequality have more market perceived credit risk and therefore more difficulty in solving a sovereign credit crisis. To get out of the crisis, some suggest that the most suitable actions to take is to combine the tax and expenditure policy measures in order to attain the fiscal budget equilibrium (Bastagli et. al., 2012). However, this thesis shows that these measures should be taken minimizing their negative effect in income inequality. Moreover, some studies (eg. Kim, 2008) state that an increase of redistributive policies is considered to raise the sovereign default probability. On the other hand, the implementation of fiscal consolidation over the medium term should be aligned with a government framework designed to implement measures for tax avoidance and evasion contributing for a decrease of income inequality (Ball et al., 2012).

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Appendix

Table A.1 Description of the variables

Variables	Definition	Source	Unit
Dependent Variable			
Sovereign CDS spreads	CDS prices with 10-year maturity. CDS pricing based on a yearly average	Bloomberg	Basis Points
Spread 10-year Gov. yields	Spread of the yield on 10-year sovereign bonds between 18 OECD countries and Germany (yearly average)	Bloomberg	Basis Points
Independent Variable			
Gross Income Inequality	Gini before taxes and transfers Income Inequality measured through the Gini/Theil Indexes	OECD Author calculations based on EU-SILC	Percentage
Control Variables			
GDP *p.c.*	Gross Domestic Product *per capita* (in US$)	World Bank WDI	Logarithm
GDP	Gross Domestic Product (in US$)	World Bank WDI	Logarithm
Public debt to GDP	The ratio of the government gross debt divided by GDP	World Bank WDI/Eurostat	Percentage
Trade	The sum of the level of imports and exports divided by GDP (in US$)	World Bank WDI	Percentage
Growth GDP	Annual growth of real GDP	World Bank WDI	Percentage
Inflation	Annual consumer price inflation (%)	World Bank WDI	Percentage
Dummy Variables			
t2006	Equals 1 for the year 2006; 0 otherwise		
t2007	Equals 1 for the year 2007; 0 otherwise		
t2008	Equals 1 for the year 2008; 0 otherwise		
t2009	Equals 1 for the year 2009; 0 otherwise		
t2010	Equals 1 for the year 2010; 0 otherwise		
Euro	Equals 1 for the members states of the European Monetary Union; 0 otherwise		
Gini_GIIPS (*)	Equal one for the GIIPS countries; 0 otherwise		
Gini_South (*)	Equals 1 for the South countries; 0 otherwise		
Gini_Continental (*)	Equals 1 for the Continental countries; 0 otherwise		
Gini_Eastern (*)	Equals 1 for the Eastern countries; 0 otherwise		
Gini_Northic (*)	Equals 1 for the Nordic countries; 0 otherwise		
Gini_Crisis (*)	Equals 1 for t2009 and t2010; 0 otherwise		

Note: the variables represented with (*) refer to the interaction between the dummy variable and the Gini coefficient

Table A.2 Details on data available (CDS spreads)

Countries	Start date	End data	Observations
Austria	2005	2010	6
Belgium	2005	2010	6
Bulgaria	2005	2010	6
Cyprus	2008	2010	3
Czech Republic	2006	2010	4
Denmark	2005	2010	5
Estonia	2008	2010	3
Finland	2007	2010	4
France	2005	2010	5
Germany	2005	2010	5
Greece	2005	2010	5
Hungary	2005	2010	5
Ireland	2007	2010	4
Italy	2005	2010	6
Latvia	2006	2010	5
Lithuania	2006	2010	5
Netherlands	2008	2010	3
Norway	2009	2010	2
Poland	2005	2010	6
Portugal	2005	2010	6
Romania	2005	2010	6
Slovakia	2005	2010	6
Slovenia	2005	2010	6
Spain	2005	2010	6
Sweden	2005	2010	6
United Kingdom	2008	2010	3

Table A.3 Income Inequality by country (own calculation)

Gini (gross)					
Country	**N**	**Mean**	**St. Deviation**	**Min**	**Max**
Austria	6	0,31	0,01	0,30	0,32
Belgium	6	0,33	0,03	0,27	0,35
Bulgaria	4	0,39	0,05	0,36	0,46
Cyprus	5	0,34	0,01	0,34	0,35
Czech Republic	6	0,29	0,01	0,28	0,30
Denmark	6	0,28	0,01	0,26	0,30
Estonia	6	0,34	0,03	0,29	0,37
Finland	6	0,34	0,01	0,33	0,35
France	4	0,33	0,01	0,31	0,34
Germany	6	0,34	0,01	0,33	0,34
Greece	4	0,38	0,03	0,33	0,40
Hungary	6	0,32	0,02	0,31	0,36
Ireland	5	0,39	0,01	0,37	0,40
Italy	4	0,36	0,00	0,36	0,37
Latvia	5	0,41	0,02	0,40	0,44
Lithuania	6	0,39	0,01	0,38	0,40
Netherlands	6	0,29	0,01	0,28	0,30
Norway	6	0,30	0,02	0,28	0,33
Poland	6	0,34	0,01	0,33	0,37
Portugal	4	0,41	0,01	0,40	0,43
Romania	4	0,39	0,03	0,36	0,42
Spain	5	0,35	0,01	0,34	0,35
Sweden	6	0,28	0,00	0,27	0,28
Slovenia	6	0,30	0,00	0,30	0,31
Slovakia	6	0,28	0,02	0,27	0,31
United Kingdom	6	0,38	0,03	0,33	0,41

Table A.4 Correlation analysis

	CDS	Gini Index	Theil Index	GDP	GDP p.c.	GDP growth	Debt to GDP	Inflation	Trade	Euro
CDS	1,00									
Gini Index	0,40	1,00								
Theil Index	0,29	0,91	1,00							
GDP	-0,37	-0,08	-0,01	1,00						
GDP *p.c.*	-0,42	-0,38	-0,24	0,60	1,00					
GDP growth	-0,54	-0,11	-0,08	-0,05	-0,16	1,00				
Debt to GDP	-0,03	0,09	0,10	0,57	0,42	-0,20	1,00			
Inflation	0,33	0,35	0,31	-0,35	-0,45	0,24	-0,35	1,00		
Trade	-0,05	-0,33	-0,35	-0,50	-0,30	0,28	-0,32	0,23	1,00	
Euro	-0,24	0,06	0,05	0,45	0,60	-0,17	0,57	-0,35	-0,28	1,00

Table A.5 Robustness Checks 3: Pooled OLS/FE using OECD Gini gross coefficient

Table A.5 reports estimations obtained using Pooled OLS estimations (columns (1), (2) and (4)) and fixed-effect regressions (columns (3) and (5)) with heteroskedasticity-robust standard errors using annual data for the 2005-2010 (a maximum of 87 observations per model). The dependent variable is the sovereign CDS spread. Columns (4) and (5) include the lagged CDS as an explanatory variable. GDP and GDP p.c. variables are expressed in logarithms. All models are estimated with Gini coefficients of gross income as the main independent variable (Gini coefficients are taken from OECD data base). Temporal dummies are added to the models (2) to (5); other variables are described in table A.1 in the Appendix.

VARIABLES	Model									
	Pooled OLS 1		**Pooled OLS 2**		**Fixed Effects 3**		**Pooled OLS 4**		**Fixed Effects 5**	
CDS (lagged)							0.299	(0.232)	1.095***	(0.300)
Inequality	354.8	(264.2)	130.8	(337.4)	-748.8	(867.7)	6946	(358.9)	-267.1	(705.1)
Debt to GDP	1.441*	(0.827)	1.207*	(0.617)	10.19***	(2.284)	1.418**	(0.658)	11.53***	(2.230)
Euro	-53.18***	(19.96)	-40.75**	(18.68)	-44.53*	(22.27)	-29.44	(20.55)	-15.48	(21.96)
GDP Growth	-14.71***	(2777)	-18.48***	(4991)	-12.73**	(5.253)	-15.40**	(6516)	-6.173	(4.688)
Inflation	18.17**	(7130)	19.50**	(8205)	15.84**	(7.374)	14.12	(12.04)	19.82**	(7.245)
GDP	-21.16*	(11.79)	-17.29**	(7885)	4.621	(208.2)	-15.34	(9552)	-182.8	(228.1)
GDP *p.c.*	-41.69	(30.12)	-99.33***	(33.96)	110.2	(147.7)	-99.61**	(42.29)	-16.27	(242.7)
Trade	0.144	(0.629)	-0.0237	(0.426)	-5.378**	(2.424)	-0.287	(0.452)	-9.463***	(3.260)
2006 dummy			41.15*	(23.09)	35.86	(28.96)				
2007 dummy			56.22**	(25.38)	56.78	(54.37)	16.85	(23.63)	65,22**	(28,47)
2008 dummy			44.93*	(24.06)	16.93	(70.99)	15.77	(36.69)	62,85	(50,77)
2009 dummy			26.36	(34.22)	-78.65	(57.08)	-20.41	(40.66)	-114,7**	(54,06)
2010 dummy			143.4***	(27.62)	-8.913	(56.99)	76.40**	(30.62)	-109,2*	(53,72)
Constant term	807.8*	(454.0)	1,358***	(478.2)	-7,054	(5,843)	1,397**	(594.2)	4,865	(5,375)
R^2	0.506		0.694		0.792		0.687		0.853	
Observations	87		87		87		72		72	
Countries	19		19		19		19		19	
Fixed Effects	No		No		Yes		No		Yes	

Note: Standard errors in parentheses

*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)

Table A.6 Robustness Checks 4: System GMM estimations using OECD Gini gross coefficient

Table A.6 displays the System GMM regression results using annual data for the 2005-2010 for all models except for model (3) which concerns the period of 2009-2010 (a maximum of 53 observations per model). The instruments used in the system GMM regression are lagged levels (two periods) of the dependent variable and of the endogenous covariates Debt to GDP and Inequality. The exogenous variables Euro (dummy), Inflation, GDP Growth and Trade also enter as instruments in first differences. The table also reports the Hansen test for over-identifying restrictions [p-values]. The dependent variable is the Sovereign CDS Spreads. All models (are estimated with Gini coefficients of gross income as the independent variable (Gini coefficients are taken from OECD data base. Model (2) includes the square of the Inequality as an exogenous instrument. Colum (4) adds the interaction between the Inequality and GIIPS countries as an endogenous covariate. The other variables are described in table A.1 in the Appendix. The Sargan test of over-identifying restrictions has a null hypothesis of exogenous instruments. The AR(2) test has a null of no autocorrelation in second differences.

VARIABLES	**Model**							
	1		**2**		**3**		**4**	
CDS (lagged)	0.283	(0.592)	0.672	(1.567)	0.462	(0.664)	0.309	(1.120)
Inequality	973.3	(2,813)	-15,804	(12,616)	1,607	(2,767)	-1,022	(2,173)
Inequality (square)			17,176	(11,793)				
Debt to GDP	7.279*	(4.343)	4.789	(9.069)	5.239	(5.050)	6.015	(7.927)
Euro	-34.08	(95.05)	-65.53	(74.91)	-70.28	(133.1)	-74.72	(115.9)
GDP growth	-8.796*	(4.542)	-8.033**	(4.022)	-7.406**	(3.776)	-7.128**	(2.826)
Inflation	32.30**	(13.72)	33.35**	(16.58)	29.88**	(13.19)	32.26*	(16.80)
Inequality (GIIPS)							-4.090	(3.555)
Trade	-1.357	(2.671)	-3.295	(4.658)	-2.066	(2.500)	4,696*	(2,704)
Constant term	-834.8	(1,207)	3,462	(3,42)	-977.7	(1,16)	-251.2	(1,22)
Observations	53		53		44		53	
Hansen test (a)	0.967		0.749		0.491		0.873	
Corr. Test (b)	0.586		0.893		0.528		0.942	
Number of countries	19		19		19		19	

Note: Standard errors in parentheses

*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)

(a) Reports the Hansen test for over-identifying restrictions [p-values]

(b) Reports the Arellano–Bond test for second-order serial correlation of the differenced residuals [p-values]

Table A.7 Robustness Checks 5: System GMM estimations using OECD Gini gross coefficient and 10-y Government Yields

Table A.7 displays the System GMM regression results using annual data for the 2005-2010 for all models except for model (3) which concerns the period of 2009-2010 (a maximum of 58 observations per model). The instruments used in the system GMM regression are lagged levels (two periods) of the dependent variable and of the endogenous covariates Debt to GDP and Inequality. The exogenous variables Euro (dummy), Inflation, GDP Growth and Trade also enter as instruments in first differences. Model (2) includes the square of the Inequality as an exogenous instrument. Colum (4) adds the interaction between the Inequality and GIIPS countries as an endogenous covariate. The table also reports the Hansen test for over-identifying restrictions [p-values]. The dependent variable is the annual average of the yield on the 10-year government bonds of 18 OECD European countries. All variables are described in table A.1 in the Appendix. The Sargan test of over-identifying restrictions has a null hypothesis of exogenous instruments. The AR(2) test has a null of no autocorrelation in second differences.

	Model							
VARIABLES	**1**		**2**		**3**		**4**	
10-year Gov. Yield bonds (lagged)	-0.100	(0.152)	-0.475	(1.037)	-0.0444	(0.568)	-0.166	(0.235)
Inequality (Gini Index)	3.899	(24.75)	-326.4	(1.055)	3.889	(65.56)	-13.44	(67.98)
Inequality (square)			313.2	(1.055)	0.0848			
Debt to GDP	0.0733*	(0.04)	0.115**	(0.048)	0.0332	(0.087)	0.0671	(0.057)
Euro	0.338	(0.616)	1.833	(5.738)	-0.0871*	(0.624)	0.663	(2.459)
GDP growth	-0.0964*	(0.0530)	-0.0548	(0.188)	0.359***	(0.050)	-0.0682	(0.069)
Inflation	0.313**	(0.145)	0.316	(0.368)		(0.126)	0.392**	(0.194)
Inequality (GIIPS)							0.0338	(0.082)
Trade	0.0703	(0.0629)	0.0272	(0.208)	0.0630	(0.093)	72.12	(58.81)
Constant term	-8.184	(10.34)	75.72	(279.5)	-8.656	(27.10)	-6.694	(24.54)
Observations	58		58		45		58	
Hansen test (a)	0.853		0.893		0.634		0.873	
Corr. Test (b)	0.293		0.414		0.146		0.942	
Number of countries	18		18		18		18	

Note: Standard errors in parentheses

*** p<0.001, ** p<0.05, * p<0.01 (two-tailed tests)

(a) Reports the Hansen test for over-identifying restrictions [p-values]

(b) Reports the Arellano–Bond test for second-order serial correlation of the differenced residuals [p-values]

A.1 Testing Fixed and Random Effects

To determinate which model should be used in the estimations, firstly it is crucial to know whether fixed or random effects exist in the panel data. A random effect is tested by Breusch and Pagan's (1980) Lagrange multiplier (LM) test, while the difference between random and fixed effects models is tested by a Hausman test.

- **The Hausman Test**

The main distinction between the FE and RE estimators lies on the fact weather unobserved individual effects (a_i) are correlated with the regressors (X_{it}). Once stated the main difference between these two models, it is important to decide which approach is most suitable for the analysis. Hausman (1978) provides a test to determinate weather the error term is correlated with the regressors.

The null hypothesis of the Hausman test, indicates that the common effects and the regressors are uncorrelated. As such, if there is statistical evidence in favour of H_0 it means that random effects model should be adopted in contrast to fixed effects models (Green, 2008).

- **The Breausch and Pagan Lagrangianmultipler test**

In the same line, Breusch and Pagan (1980) developed a useful device for determining the preferred specification, whether the random effects regression or a simple OLS regression. This test is based on a Lagrangian multipler test in which the null hypothesis indicated that time specific effects are not presented in the data, which implicitly assumes that panel effect do not exist (Balgati, 2008). Hence the test is given by:

$$LM = \frac{NT}{2(T-1)} \quad \frac{\sum_{i=1}^{N}(\sum_{t=1}^{T}\hat{w}_{it})^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{w}_{it}^2} - 1 \sim x_1^2$$

In the case of null hypothesis, $H_0 : \sigma_v^2 = 0$, one can conclude that there is significant random effects in the panel data. This means that there is evidence of significant\differences across individuals and that the random effects estimators are appropriate to deal with the heterogeneity in the panel data. The result of the LM test, i.e the critical value from the chi-squared, is 1,13 thereby the null hypothesis is rejected suggesting the presence of individual-specific factors in the data.

Figure A1 - CDS spreads for 26 European sovereigns