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The Rescue Support Funds Impact on the Bond Market Stress Index in the Euro Zone

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Abstract
Our aim work objective is to study the impact of the European Financial Stability Fund and its successors (EFSF) on the enhancement of financial stability in the Euro Zone widely affected by the sovereign debt crisis. Through some representative factors, we have developed a Bond Market Stress Index (BMSI) based on the standard portfolio theory. Then, we proposed a model which has shown firstly, an ability to capture the past and future events destabilizing the bond market and secondly, a predictive performance. We find that only one measure among four has alleviated the stress situation, leaving the way open for several questions about the effectiveness and usefulness of the rescue funds and even their ability to meet the long-sought challenge of a financial stability without reach.

Keywords: Financial contagion, Fiscal policy and global imbalances, Bond, Stress, Bailout and regulation, Debt crisis

1. Introduction

Recent increase in the sovereign debt level experienced by some countries in the Euro Zone has attracted the attention of the leaders of these countries on the problems of sovereign debt. In this regard, some researches have shown that high levels of debt can be harmful and often lead to sovereign defaults; indeed, it is in this context that inserts recent study of Furceri and Zdzienicka (2011) on the evaluation of the impact in the short and medium term debt crises on GDP. Using a panel of 154 countries, from 1970 to 2008, these authors showed that the debt crises cause significant and durable production losses, reducing production by about 10 percent after eight years. The results also suggest that debt crises tend to be more harmful than banking and currency crises. Recent studies have examined the financial crises on the stress side to measure the extent and severity of these crises, for example these of Illing and Liu (2006). But concretely, due importance has been given to the seriousness of the financial crises problem from 2006 when the financial crisis has overwhelmed the Euro Zone. The latest studies of Cardarelli et al. (2011), Hakkio and Keeton (2009), European Central Bank (2009a), Yiu et al. (2010) and Lo Duca and

Peltonen (2011) have attempted to develop indices for the financial system in several countries. The financial and economic crisis emerged in the European Union (EU) in August 2007, when the BNP Paribas suspended three of its investment funds that have invested in asset backed securities linked to subprime mortgages debt in the United-States and which had become widely illiquid. Now, the crisis has also spilled over into many emerging markets and subsequently caused the sovereign debt crisis in Europe in early 2010.The first event triggered the crisis of sovereign debt is raised in 2010 , with the Greek debt crisis caused by significant and constant deficit. In autumn 2010, the crisis of Ireland public debt surfaced. In 2011, a series of disturbance reached the stock market, caused in part, by the crisis of the Greek public debt (Website Wikipedia : Debt crisis in the Euro Zone August 27, 2013). Moreover, fearing the alarming situation of some countries in the Euro Zone (Greece, Spain and Italy), several panics took financial market, the most significant are in May 4, 2010, December 7, 2011; May 23, 2012; June 25, 2012; July 23, 2012 and September 26, 2012.On May 9, 2010, the Euro Zone with its 17 members recognizes the severity of the sovereign debt crisis in some European countries including Greece, Spain and Italy create the European Financial Stability Fund (EFSF) which has been strengthen later to help the most vulnerable European countries and prevent contagion to Italy and Spain and the mobilization of 1000 billion euros (440 billion Euros were in the first time).From institutional side, in order to manage the crises facing countries of the Euro Zone, the European Financial Stability Facility (EFSF), the European Financial Stability Mechanism (EFSM) and the European Stability Mechanism (ESM) have emerged. We note that the last fund is a permanent rescue fund with 500 billion euros must replace the EFSF and the EFSM from June 2013.

2. Work objectives

Historically, for centuries, financial crises have been a vast field of several works research which the first are attributed to Thornton (1978, 1802) and Bagehot (1873). Following the adoption of the “floating exchange rate” system by the national central banks in the world in March 1973 and in parallel with the free movement of capital internationally, international crises gain in magnitude. This led to the development of new theoretical approaches, which tend to explain these types of crises. Several models were then implemented with the first generation that rely on economic fundamentals (Krugman, 1979) , second-generation models focus on the credibility of exchange rate regimes (Obstfeld , 1994) and more recently the third generation models of financial imbalances and contagion (Masson , 1998). Sinapi (2010) emphasized the importance and dynamism of economic research devoted to crises, both through theoretical models and empirical studies necessary to identify the key mechanisms of financial instability. These findings seem to suggest the implementation of an essentially empirical methodology to identify crisis leading indicators. In this context, it seems perfectly justified to pursue empirical research on financial crises becoming more frequent and stringent and sometimes catastrophic. We do have in mind their negative effect on endangered economies, their contagion to other countries and even to other regions and essentially the importance of forecasting in economic, social and political.
To do so, we seek to develop at first a mechanism to measure and predict sovereign debt crisis and secondly study the support funds implementation impact on the bond market stress.
Some studies have dealt with the financial crisis from the perspective of empirical measurement of stress across the Euro Zone adopting new construction techniques capable to measure different levels of financial stress in real time and to predict possible episodes of instability, but

these works are limited to the level of evaluation and stress measurement. We intend to continue searching through the evaluation of anti-crisis measures, specifically, the contribution of secure funds (EFSF, EFSM and ESM). Obviously in order to do so, we must construct an index of stress in drawing on the Holló et al (2012) work related in particular to the choice of variables, standardization and especially aggregation in the stress index. For clarity, the measures we are talking about in our research will be only considered in the specific context of the sovereign debt crisis faced by some Euro Zone indebted countries, especially Greece. However, it seems very useful to highlight the lack of empirical studies on the importance of the implementation of such measures! We believe that our research can answer the question of the usefulness of emergency funds implemented by highly bailed out AAA European member states. Our index is now called "Bond Market Stress Index (BMSI)".We will follow a research methodology that will help us to design a stress index derived from the aggregation of a number of factors which we will test later reliability to capture events of previous stress and the current extent of the Euro Zone money market volatility, . The index should provide a more efficient alert threshold beyond which we can recognize that we are in a crisis phase, which could help decision makers quantify properly and timely their current and future needs to guard against the dangers of an outbreak of financial turbulence, evaluate mitigation of crisis (creation of the EFSF / EFSM / ESM), and especially provide warning and prediction signals. Thus, in accordance with the occurrence of several unpredicted turbulence in the Euro Zone (which the last is the sovereign debt crisis) and appearance gaps cited in the introduction related to the performance of stress indices available on market, three main questions to be answered: (i) Can we speak about failure at a practical level of financial stress indicators preventing the Euro Zone to react in time to avoid financial imbalances? (ii) Can we speak threshold to explain the magnitude of financial instability? (iii) What chance has the European Financial Stability Facility and successors in the present circumstances to save the Euro Zone in the future?

3. Constructing of the BMSI

The current sovereign debt crisis in the Euro Zone has attracted the interest of policy makers about the research often urgent solutions to address this crisis and prevent it from spreading to other countries in the Euro Zone, or more dangerously, in other regions far away from the crisis. This requirement has emphasized the importance of equipping some tools for monitoring, prediction and control. The construction of a stress index is, within this framework, to provide decision makers with relevant and reliable tool for assessing stress and why not predict.

3.1 Related literature

According to economic literature, sovereign debt crises pass through three main channels: The first channel is the exclusion of international capital markets (Gelos et al. 2011). The second channel is a cost increase of borrowing (Borensztein and Panizza, 2009). The third channel is international trade (Rose, 2005). In addition to these channels, debt crises may affect output indirectly leading to banking and currency crises (De Paoli et al. 2009), and domestic routes such as the reduction of consumption and the investment or down all the factors of productivity. Empirical studies have confirmed that the debt crisis may lead to significant contractions in output. Sturzenegger (2004) finds that defaults are associated with a reduction in output growth of about 0.6 to 2.2%. Similarly, Borensztein and Panizza (2009) find that sovereign defaults are associated with reduced growth by 1.2% year. De Paoli et al. (2009), by comparing the growth of

production five years before and after the onset of the debt crisis, find that debt crises are associated with large production losses of at least 5% per year. However, Yeyati and Panizza (2011), analyzing quarterly data for output growth found that growth recovers in the quarters immediately after the occurrence of a crisis. Reinhart and Rogoff (2010) distinguish two types of crises defined by events : The first type concerns the external debt crises, it results in a default occurs on an external bond , that is to say a non-repayment of loans denominated in foreign currency held by foreign creditors. The crisis of external debt is a recurring historical phenomenon. Among these debt crises, there may be mentioned that of Latin America in the 1970s, because of made by New York bankers massive loans. It seems that the sovereign debt crises in developed countries were not at the stage of market development. As is also the case in many emerging markets today. Countries affected by the modern sovereign defaults are in effect in Latin America and the poorer European countries, but also in the pre-Communist China, India and Indonesia in the 1960s and Africa. The second type is the crises of the domestic public debt. Information on domestic debt and crises are rare, because it generally does not involve powerful external creditors (Some crises of domestic public debt as the Mexican crisis of 1994-1995). The fact that the debt is not indexed, governments find their interest to reduce its real value by inflation. Reinhart and Rogoff (2010) show that while many countries are in default on their external debt at thresholds seemingly low, it is because the situation of public finances particularly internal bond debt is often dramatic. Leaven and Valencia (2008) identify the sovereign debt crises by date of occurrence (episodes of default) and restructuring. According to Sachs (1989), the debt looks like insolvency unprotected by the laws of bankruptcy business. Creditors rush to serve first on the remaining value of assets, regardless of the interests of the company. For him, there is an optimal debt level for which any marginal additional borrowing led to a significant reduction in investment and the debtor would have an interest in not paying the debt. Indebtedness exposes an economy to the preference of likely future earnings and sacrifice of present commitments. In a larger sense, budget sustainability includes government solvency, stable economic growth, stability, taxes and intergenerational equity (Schick 2005). The public debt increases the exposure of a country to economic and financial crises. Indeed, the vulnerability of an economy crisis going in the same direction as the public debt (Elmendorf and Mankiw 1999). The literature on crises distinguishes several prediction techniques. We are particularly interested in the technique or approach of the "vulnerability indices of the financial system" The stress index should be more informative as suggested by Illing and Liu (2006) and applied by Lo Duca and Peltonen (2011) and should measure the current state of instability in the Euro Zone "systemic stress". An early warning indicator requires a number of conditions that improve reliability. Severity of financial crises and problems related to their anticipation created the need to improve both their monitoring capabilities and their predictive power.
In this context our study on vulnerability index is conducted at two points: the choice of indicators and the method of constructing the index.

a. The choice of individual indicators.

We are dealing with the individual indicators or variables that go into the construction of the stress index. Illing and Liu (2006) define the stress index as the tension felt by economic agents because of the uncertainty and portfolio deterioration of bank assets. It is measured as a continuum of points taking a range of values and whose extremes are considered banking crises. Many factors have been put forward in the literature to try to assess the financial fragility among them variables which affecting the total level of public external debt including: The fiscal deficit

(Blancheton, 2004); the balance of payments, exchange rate equilibrium and the strategy of trade liberalization (Raffinot, 2001); import, export, interest rates, changes in the terms of trade, the growth rate and debt service (Krugman, 1988); capital flight (Boyce and Ndikumana , 2001); imports and the growth rate of GDP (Ojo, 1989). The interest rate spread between deposit certificates or treasury bills and short-term government bonds constitute really a good indicator of bank stress (Colosiez and Djelassi, 1993). A significant increase in this spread can lead investors to place their funds at a lower rate even with central banks or by buying bonds (flight to quality).

Other authors have presented the factors at different angles of view. Flannery and Sorescu (1996) distinguish three types of variables identified as follows: the interest rate spread, the difference between the growth rate of deposits and interest rate and credit risk of the exchange rate. Kaminsky and Reinhart (1999) group these variables into three sectors among them the real sector variables with stock prices index and the government deficit ratio to GDP. Illing and Liu (2006) developed an index of financial stress for the Canadian market based on three types of variables: standard, refined and GARCH, these variables were classified by four markets including: the credit market. The credit market has been exemplary affected by the spread of corporate bond yield calculated as the difference between the long-term bond yield of all corporates and the Canadian government bond yield, the reversed yield curve represented by the difference between the average yields of 5 and 10 year benchmark bond of the Canadian government and the rate of commercial paper (90 days maturity). The independent variables or indicators of stress or individual factors should be reflected in the financial stress and therefore the growth of economies in the Euro Zone. This assumption is based on a set of research which focuses on different components of the Financial Stress Index, including that of (Illing and Liu, 2006) which developed an index of daily stress for the Canadian financial system taking into account the financial assets stress. Several key features of financial stress are present in most financial crises, for example (Hakkio and Keeton, 2009; Fostel and Geneakoplos, 2008), namely: (i) a weak preference for holding risky assets. The lenders and investors demand more of the expected returns on risky assets and lower yields on safe assets (flight to quality, risk aversion), (ii) a decrease in willingness to hold illiquid assets (liquidity preference). The difference between the return rate of liquid assets and illiquid assets widens further. These characteristics tend to lead to a general decline in liquidity and market financing, greater volatility in asset prices, the increased risk of default, and an extension of spread risk for riskier and less liquid assets as well as actual and expected serious financial losses. Mishkin (1994) identifies rising interest rates as factor that can facilitate the emergence of crises.

b. Constructing procedure of vulnerability index

Construction methods of vulnerability indices have been abundant literature according to the type of index. All methods have a convergent combination of a set of variables (indicators of stress) in an appropriate weight to achieve the construction of this index but differ in the weighting technique itself. Each variable considers a stress symptom. So it comes to finding an aggregation system that does not bias the performance of the index. It is for this reason that the choice of weighting method requires special attention; this is a very important step in the construction of the index (Illing and Liu, 2006). The choice affects the quantification of each variable impact on the index level. In this context, we present some weighting techniques that can be adopted. Among the existing technics in the literature, we can mention: the variance-equal weightings, weighting by the market size from which is issued the indicator, the transformation

of variables through their own cumulative distribution functions (CDF) and factor analysis (Illing and Liu, 2006) and the elasticity of the probability divided by each factor (Demirguc-Kunt and Detragiache, 2000). Some methods use even the simple arithmetic mean to aggregate individual factors in a composite stress index.

We particularly linger on the most widely used method (variance-equal weightings) and the more recent approach (the standard portfolio theory) proposed by Holló et al. (2012) on which is based our empirical approach. Both methods are part of the composite indicators taking into consideration more than one factor in the construction of the stress index. The approach of composite indicators was proposed by Kaminsky and Reinhart (2000) in order to estimate the probability of conditional crisis on the simultaneous transmission of signals of any sub-group of indicators deemed relevant by the univariate approach. The method of variance-equal weightings, commonly used in the literature, based on the same weight for all variables used in the construction of the index according to the following formula:

$$\boldsymbol{I_t} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{w}} \frac{\boldsymbol{R_{it}} - \boldsymbol{E}[\boldsymbol{R_i}]}{\boldsymbol{\sigma_i}} \quad (1)$$

Where $\boldsymbol{I_t}$: the index at date (t), (w) the number of variables included in the index, $\boldsymbol{E}[\boldsymbol{R_i}]$ represents the arithmetic mean of variable $[\boldsymbol{R_i}]$and ($\boldsymbol{\sigma_i}$) its standard deviation. The studies carried out using this method had to refer to crises periods already identified for the evaluation of the index , this due to the absence of the identification of the actual level of a stress . From this point of view, this method is not too different with models of "signals" especially that in order to evaluate the performance of vulnerability indices, Illing and Liu (2006) have relied on indicators having predictive qualities. In this respect, we can mention the two financial stress monthly indices calculated by the IMF, one for 17 developed countries (Cardarelli et al. 2011) and the other of Balakrishnan et al. (2009), which presented a study in 18 emerging economies. The main conclusion of this study is that the relationship between banks loans seems to be the main way for the stress transmission. International financial integration brings both growth opportunities and contagion risks. The index is composed of five components, four financial market price indices and one pressure index in the currency market. The five components are reduced by the average and divided by their standard deviations, and then summed to form the index. This combination of variance-equal weightings used by Hakkio and Keeton (2009), has the advantage that large fluctuations in component does not strongly affect the overall index ,but its practical shortcoming consists on the relatively high sensitivity in the new information arrival in the generally low samples (Hakkio and Keeton , 2009). Stuart and Ord (1994) propose to use the empirical distribution function instead of the mean or standard deviation. In order to identify the existing problems in the choice of the appropriate method of weighting, Illing and Liu (2006), in a study of the Canadian financial market presented a study which used 5 methods at the same time and concluded that in terms of overall performance, the weighting method based on the credit weight of each variable, depending on the market to which it refers, is the easiest to construct the indices. This method works well and is easy to interpret and communicate. From there, the authors say "we suggest that it can be used as an index of financial stress for Canada". The methods tested by these authors are: factor analysis, the variance-equal weightings of the credit and transformation by the cumulative distribution function. We complement this literature by the latest technique adopted by Holló et al. (2012). This technique calculates a composite stress index in two stages using data from five distinct markets that represent the entire economy of the Euro Zone (stock market, money market, bond market, the financial intermediary market,

and finally the FOREX market). This index is calculated in two steps. In the first, the weighting factors in the five sub-indices are based on the arithmetic mean. This implies that each factor has the same weight, which in turn, must emphasize the presumed complementary nature of the information contained in the three components of each sub- index. However, when interpreted in terms of portfolio theory , simple averages implicitly assume that the three factors in each sub-index are perfectly correlated which would go against the idea of complementarity between the information content of factors (Holló et al . 2012) . In the second, the five sub-indices are merged into a composite index based on the standard portfolio theory.

3.2 Data and Research Methodology

Our objective through this empirical approach is to build a Bond Market Stress Index for the Euro Zone with relevant and predictive performance. Holló et al. (2012) recommend that, from the moment the stress indicator should measure the systemic stress more or less in real time, the data must be available at a daily or weekly basis. Bell and pain (2000) shows that the choice of the sample, the availability of data, frequency and reliability, influence on the choice of the variable. In our study, we will explain the bond market crisis in the time interval that begins Monday, February 5, 2007 and ends on Friday December 21, 2012. This choice is based primarily on considerations relating to the availability of some data, that we have been unable to obtain a longer period. Data are collected from the websites of each organization. Series are daily rate and the number of observations is 1535. Our data base consists on the following data. For the calculation of our index, we collected four types of data (indicators) compounds all rates, able to capture and measure the stress in the bond market in the Euro Zone. These data will be used in the construction of the Stress Index.

a. German 10-years benchmark government bond yield.
b. "AAA" Euro Zone 7-years maturity government bond yields.
c. "A" rated nonfinancial corporation's 5 to7-years maturity bonds yield.

In addition to the Euro swap interest rate 10-years maturity: The swap interest rate is a contract between two parties who agree to exchange of regularly flow interest (every 3, 6, 12 months) for a specified period and a predetermined amount, the notional, which never be exchanged . It is most often exchange a fixed interest rate against a variable interest rate or exchange of floating rate related to different reference rate. The IRS cannot relate to a single currency transaction.

The bond market is by definition a medium and long term interest rates market. This is an exchange bond market mainly derivatives such as interest rate swaps. According to several studies by specialists in finance and banking, including that of Mr. Jaime Caruana, General Manager of the Bank of International Settlements (BIS), the AAA-rated sovereign debt of the European Unit, covered bonds and non-financial corporate bonds are safe refuges for investors seeking quality in fixed income instruments (BNP Paribas, 2012). The same journal continues its analysis and puts the focus on the volatility of certain categories of enterprises "... Also, because of its relatively low volatility, corporate investment grade debt - excluding financial - is an instrument entirely suitable for allocation dominant bond. Credit risk in this category appears low compared to many political risks of sovereign debt markets are exposed. There are good reasons to believe that companies are now easier to evaluate and analyze many of sovereign debt issuers".

Government bonds of major industrialized countries have the lowest risk. So their interest rates serve as benchmark for other loans of equivalent duration. There are also corporate bonds relative to large companies with different notations: “high quality: AA”, “strong capacity to pay: A”, probably fulfill its obligations: BB”, Current vulnerability to default CCC” or “bankruptcy or default: C”.

3.2.1 Data analysis

We present a diagnosis of the situation of the European bond market to determine the periods that have experienced a change in the evolution of data that will be subsequently combined to give us our variables. Analysis that we will present concerns the graphical and statistical evolution of the four data compared to 2007 with an explanation of the causes of this trend. Since 2007, date of the beginning of our sample that also coincides with the outbreak of the subprime crisis in the United States of America, the bond market as well as market interest rates in the short term in the Euro Zone has experienced alternating four phases of turbulence. The differences between these phases are shown in the following Table 1.

Table 1 Interest rate of the bond market and the swap in the Euro Zone

	GBGBY10	**EZMGBY7**	**ARNCMBY5-7**	**ESIRM10**
05/02/2007	4,04	3,92	4,46	0,04
24/08/2010	2,24	1,94	2,69	0,02
Spread 2010-2007	**-45%**	**-51%**	**-40%**	**-50%**
11/04/2011	3,49	3,31	4,07	0,04
Spread 2011-2007	**-14%**	**-16%**	**-9%**	**0%**
21/12/2112	1,39	1,1	1,62	0,02
Spread 2012-2007	**-65,59%**	**-71,94%**	**-63,68%**	**-50,00%**

Note: (GBGBY10): German 10-years Benchmark Government Bond Yield; (EZMGBY7): “AAA” Euro Zone 7-years maturity government bond yields; (ARNCMBY5-7): “A” Rated Nonfinancial Corporation’s 5 to7-years Maturity Bonds Yield; (ESIRM10): Euro swap interest rate 10-years maturity.

In light of this table, the differences (in bold)recorded in 2010 in the various bond yields and the swap market interest rate of the Euro Zone declined, compared to the reference year 2007 by 45, 51, 40 and 50 base points respectively for “GBGBY”, the “EZMGBY7”, the “ARNCMBY5-7” and “ESIRM10”. In the second period 2007-2011 theses spreads were 14, 16, 9 and 0 base points and were in the last period of our study in 2007-2012 were 65, 72, 64 and 50 base points , indicating an improvement in 2010 and 2012 of the situation of public finances and calming situation in the European bond market. Conversely we recorded deterioration in 2011. The Fig. 1 below shows that the consolidation of this situation is clearer at the end of December 2012, when bond yields in the Euro Zone fell to record lows. However, these yields are still below market bond yields in the United States and more with those of Japan. These findings indicates that since 2007, the bond market as also the money market has been affected by two crises, once the American crisis, and once the crisis of the current sovereign debt, only with the difference, it took about four years out of the first crisis (2007-2010) while it took only two years out of the second, although it appears that the bond yields trends do not yet indicate a stabilization. From the Fig. 2, it appears that non-financial corporations bonds recorded in 2012 a

yield spreads, with sovereign debt, more pronounced according to the rating is in AA, A or BBB. The spread tightening is visible in August after new unconventional measures of the ECB.

Fig. 1 long-term government bond yields

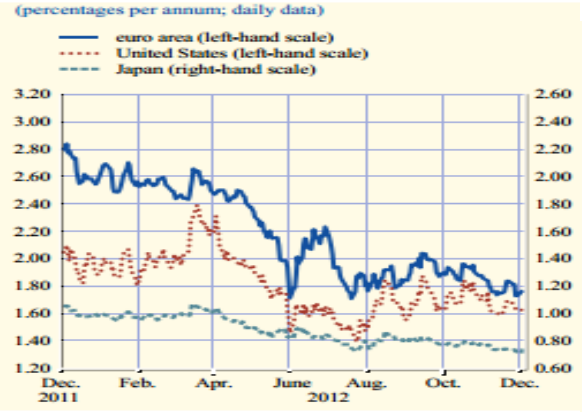
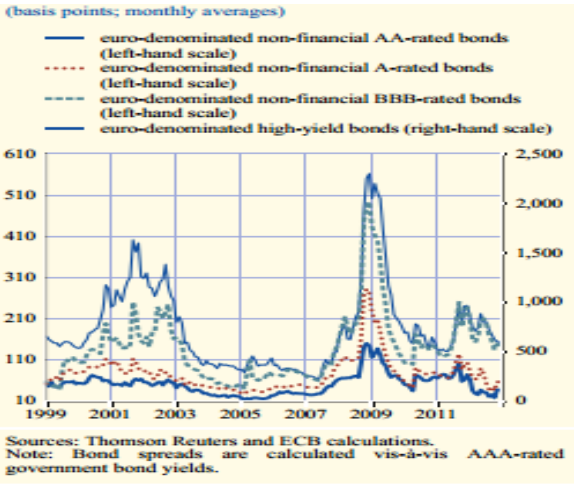


Fig. 2 corporate bond spreads of non-financial corporations



Source: http://www.ecb.europa.eu/pub/pdf/mobu/mb201212en.pdf

3.2.2 The process of transforming data

The procedure of transforming data in variables is performed in order to have more representative variables of financial stress. This procedure involves the following three steps: (i) combine two data together by taking the ratio or the spread between the two. The combination of variables has been widely used by several authors, including: Colosiez and Djelassi (1993), Flannery and Sorescu (1996), Kaminsky and Reinhart (1999), Demirguc-Kunt and Detragiache (1998a), Illing and Liu (2006), Lo Duca and Peltonen (2011), Hakkio and Keeton (2009), Holló et al. (2012). But that does not prevent in certain justified cases to use data itself as a variable. (ii) Calculate the volatility of each variable as either a simple daily variation (Holló et al. 2012; Colosiez and Djelassi, 1993; Flannery and Sorescu, 1996; Kaminsky and Reinhart, 1999; Illing and Liu, 2006; Lo Duca and Peltonen, 2011; Hakkio and Keeton, 2009), an absolute variation (Holló et al. 2012) and absolute or relative absolute returns (Cajeiuro and Tobacco, 2004a, 2004b, 2008b; Holló et al. 2012; Lo Duca and Peltonen, 2011). (iii) Standardize the variables by bringing them to a common scale by an appropriate methodology. The method most commonly used is the variance-equal weightings. This procedure, which implicitly assumes that variables are normally distributed, could be circumvented by standardizing variables by their Cumulative Distribution Function (Prat-Gay and McCormick, 1999). This method is recognized by its robustness greater than the method based on the average and the standard deviation (Stuart and Ord, 1994).

Based on the previous three steps, we collected three variables. The selection of variables was based on the following criteria: (i) the first criterion concern the complementarity of indicators (Holló et al. 2012); factors need not carry the same information. (ii) The second criterion is based on the plurality of variables; This is to take into account a number of relevant variables to explain an episode of crisis according of the number of variables constantly evolving based on

changes occurring in the international financial markets (Evans et al. 2000; Berg and Pattillo, 2000). The following Table 2, reports the final situation of variables used for the bond market with their calculation methods.

Table 2 Variables and formulas of bond market

Variables	**Variables formulas**
German 10-years benchmark government bond yield volatility	The absolute changes in daily yields
Spread volatility of the "A" rated nonfinancial corporation's 5 to7-years maturity bonds yield and "AAA" Euro Zone 7-years maturity government bond yields	The absolute changes in daily yields ("A" rated nonfinancial corporation's - Euro Zone government bond yields). A significant difference indicates problems corporate finance.
Swap Spread Volatility	The absolute changes in daily rates (Euro swap interest rate 10-years - German 10-years benchmark government bond yield). The swap spread is the difference between the interest rate swap contract and the German government bonds yield of the same maturity. This spread measures the risk associated with the investment once the change in interest rate swap affects automatically the gain.

The variables described above capture one or more characteristics of financial stress. Consequently, the variables must have a tendency to move together as the degree of development of financial stress. However, each of these variables may also change for other reasons not directly related to financial stress and even without any flight to quality. Hakkio and Keeton (2009) affect the increase of the spread between two types of obligation to a slowing economy which will increase the rate of default or an actual or projected decline in the supply of Treasury securities, which reduces their yields. Thus, while financial stress can cause variables move together, other factors unrelated to the financial stress can sometimes cause their divergence. This possibility is confirmed by the average of correlation coefficient (0.04). In comparison with the variables average correlation coefficient of Hakkio and Keeton (2009), which is 0.57? Our variables appear to reflect more complementary between them as suggested by Holló et al. (2012).

In earlier developments, we selected the data which we then transformed into variables. Now, the objective is to build a Bond Market Stress Index in the Euro Zone.

3.3 Econometric conception

We begin by calculating the BMSI by taking part in the Holló et al. (2012) method which consists in the normalization method with the cumulative distribution function, such as used by Illing and Liu (2006) and then merging them in the stress index based on the method of the standard portfolio choice theory.

The purpose of the use of the standard portfolio choice theory is determining the weight vector of variables (factors) in BMSI; in fact, this method is based on the basis of the covariance between the sub-indices taking into account the cross-covariance between them. These weights reflected in the structure of cross-correlation (variance-covariance matrix) will be used to

determine the BMSI by analogy to the optimal portfolio returns. This implies that the factors do not all have the same weight in the BMSI.
Specifically, the calculation of the weights will be made by the solver method (an Excel feature), which estimates the weight of each sub-index in the global index, under the condition of a minimum variance and fixed return. To do this we use the following matrix form of the portfolio variance of (w) securities:

$$\boldsymbol{Var} = \boldsymbol{X'VX} \tag{2}$$

X : Column vector of weights, $\boldsymbol{X'} = (\boldsymbol{x_1} \dots \dots \dots \dots \boldsymbol{x_w})$ the transpose of X, and $\sum_{i=1}^{w} x_i = 1$ is the budget constraint and x_i $can\ be < 0$ allowing holding more assets than can our initial wealth.

$$\boldsymbol{V} = \begin{pmatrix} \boldsymbol{cov(1.1)} & . & . & . & . & \boldsymbol{cov(1.n)} \\ . & & . & . & . & . \\ . & & . & . & . & . \\ . & & . & . & . & . \\ . & & . & . & . & . \\ \boldsymbol{cov(n.1)} & . & . & . & . & \boldsymbol{cov(n.n)} \end{pmatrix} \tag{3}$$

V: Is the variance-covariance matrix of factors.

At this level, the main methodological innovation of this BMSI compared to other composite indicators is the application of the standard portfolio theory aggregation of factors in the BMSI, specifically, made on the basis of weights reflecting their cross-correlation structure. As a result, the BMSI puts relatively more weight on the situations in which stress appears in several factors at the same time. This method differs from using the simple arithmetic average which means that each factor has the same weight in the index (a perfect correlation between variables), which goes against the principle of factors complementarity implies low correlation variables. Moreover, the correlation was low and never exceeded 0.16 between the variables and 0.04 as average which proves our complementary variables.

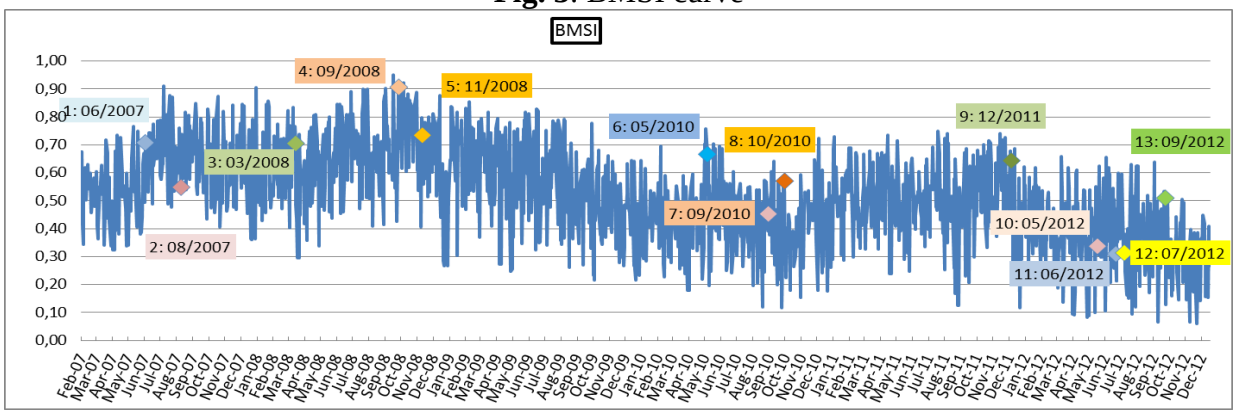
In what follows, the following abbreviation is used: "BMSI" indicates Bond Market Stress Index.

3.3.1 The BMSI Graphical analysis

The evaluation criterion most widely adopted for financial stress indicators is its performance in identifying past periods of financial stress. The reaction of an index should be evident in response to an event causing serious turbulence in the financial system or certain losses. High levels indicate a situation of stress or even a systemic crisis.

In our study, we take the approach of Hakkio and Keeton (2009), which is to assess whether an index peaks are generally associated with well-known historical stress events. We develop following episodes of stress most commonly known and which affected the financial market in general. Figure 3 shows the following curve of the BMSI with highlighting of the most known dates by their negative effects on the financial stability. Chosen dates correspond to events marking the most money market in the Euro Zone during the period of our sample between February 2007 and December 2012.

Fig. 3: BMSI curve



Note: Numbers 1 to 13 represent the references of dates below of events affecting more the money market between Feb. 2007 and Dec.2012.

Table 3 Event's references

Number	Date	Event
1	April 12, 2010	Exploding "subprime" in the United States.
2	May 10, 2010	BNP Paribas suspended three investment funds that have invested in asset backed securities.
3	June 4, 2010	Collapse of Bear Stearns.
4	November 28, 2010	Bankruptcy of Lehman Brothers.
5	January 25, 2011	Abandon the U.S. plan to buy back toxic assets under the Troubled Asset Relief Program (TARP).
6	May 17, 2011	Worsening the financial situation of Greece, Spain and Italy.
7	June 20, 2011	Waiting for a meeting September 25, 2011 the 187 member states of the International Monetary Fund, European stock markets react negatively.
8	July 21, 2011	Faced with the worsening debt crisis and economic indicators turning red, economists, awards, rating agencies and analysts are sounding the alarm.
9	October 18, 2011	Standard & Poor's threatens to lower the rating of 15 out of 17 countries, including Germany and France, before the EU summit, European stock markets fall.
10	November 29, 2011	European shares incur losses as fears of a Greek exit from the Euro Zone.
11	December 9, 2011	European shares fall and markets fear a failure of the EU summit.
12	December 13, 2011	Spain and Greece markets panic again.
13	March 14, 2012	European stock markets posted losses caused by the actions of central banks on the financial sector and the cyclical situation in Spain.

Note: Source AFP news http://www.efsf.europa.eu (economic RSS).

We note already that according to the Figure 3 shown above, the highest peaks of the Stress Index coincide with events the more well known for their adverse effects on international financial markets. Indeed , we report the first extreme levels from June 2007 , the date of the global financial crisis onset, caused by the explosion of the "subprime" in the United States, followed by suspension of BNP three investment funds that invested in asset backed securities linked to subprime mortgage debt which had become totally illiquid on August 2007 , then we

still record the Bear Stearns collapse on March 2008 and the bankruptcy of Lehman Brothers on September 2008 and finally the abandon of the U.S. plan to buy back toxic assets under the Troubled Asset Relief Program (TARP) on November 2008. Then calm is observed, the stress index began to fall and stock market indices resumed their upward trend. This quiet situation continued until the beginning of 2010, when the worsening debt crisis and financial problems of Greece are beginning to worry the rating agencies and the European stock markets. The stress index then resume its volatility in the phenomena of successive stock market panics due to stress accompanying the actions taken by the Euro Zone in order to appease the sovereign debt crisis that has affected many of its countries and still persist when we conduct our research . Among these actions we note the creation of the EFSF. This volatility extends to the last quarter of 2011, when high levels were recorded. From this date begins a final phase of alleviation which we do not know yet the end. This last phase is characterized by the Standard & Poor's rating agency menaces to lower the rating of 15 out of 17 countries, including Germany and France, fears of Greece leaving the Euro Zone, the concerns about the financial situation in Spain and Greece, and the last event for losses caused by the measures taken by central banks and on the financial situation in Spain and cyclical sectors. But it seems, in view of the curve, the situation tends to improve.

3.3.2 Thresholds

One of our main goals is to build a financial stress index to help decision makers to identify the stress levels in the Bond market which can be a serious concern. However, the identification of truly systemic stress levels that could potentially disrupt the financial intermediation process and economic activity is far from obvious.

In the literature several approaches are proposed to deal with this situation. One approach is to compare the stress levels to those observed in the levels known of historical crises have caused serious disruption. In this context, the most widely used approach is to classify financial constraints according to their severity by exceeding the stress index of its historical average by one or more standard deviations. For example, Illing and Liu (2006) for the Bank of Canada index have used a number of 2 standard deviations ; Cardarelli et al. (2011), the IMF one standard deviation; Hakkio and Keeton (2009), the Federal Reserve Bank of Kansas City used also one standard deviation and Vila (2000) 1.5 or 2 standard deviations . A second approach compares the index to its historical average over a moving interval of 50 days and takes only the current stress levels exceeding this moving average by one standard deviation as a signal of systemic risk aversion (Kantor and Caglayan, 2002).

The table 3 above chows the BMSI has reached its first peak in September 2008, reflecting the financial difficulties unprecedented in all advanced economies and lasted longer than in any other crisis since 1980. The second level in November 2008 confirms the high level of market destabilization. The third level is located in May 2010 with the onset of the European sovereign debt crisis. Finally the fourth level recorded December 2011. Among these 4 pics, the Stress Index has exceeded its historical average of more than 1 standard deviation only in 2 events (4 and 5). We recorded also 2 events (6 and 9) with less than 1 standard deviation (see correspondence with the events in Table 3 above and 4 below).

We classified financial constraints according to their severity by exceeding the stress index of its historical average by 0.5 or more standard deviation in using the next formula:

$$\boldsymbol{NB(\sigma)} = \frac{\boldsymbol{BMSI - E(BMSI)}}{\boldsymbol{\sigma(BMSI)}} \quad (4)$$

With (*NB (σ)*): the standard deviations number; BMSI is the Bond Market Stress Index, *E (BMSI)* its mean and $\sigma(BMSI)$ its standard deviation.

Table 4 BMSI discard with its historical average calculated in standard deviations numbers

Event Nr	Event date	Standard deviation Nr
1	Jun-07	0,222
2	Aug-07	0,173
3	Mar-08	-0,510
4	Sep-08	2,299
5	Nov-08	1,278
6	May-10	0,875
7	Sep-10	-0,393
8	Oct-11	0,629
9	Dec-11	0,739
10	May-12	-1,079
11	Jun-12	-1,246
12	Jul-12	-1,221
13	Sep-12	-0,057

We will confirm graph N ° 1 and statistics finding (number of standard deviations) by a study plan with Chow's Breakpoint Test and Cusum De Brow Test. These tests are important in understanding the course of our index which, in passage in time, the instability of coefficients in its model reflects the events to be studied.

3.3.3 Regimes

a. Chow's Breakpoint Test

The literature on structural changes is abundant. For example: Chow (1960), Yao (1988) and Bai and Perron (1998). In our study we will use the Chow Test to compare if the coefficients are identical in two or more sub-periods. The difficulty is to split the sample of observations into two or more sub-samples (intervals). In the case of two sub-samples, a regression vectors model of β1 and β2 parameters with the same dimension (K: number of parameters in the equation) is adjusted. Therefore, it is to test: H0: β1 = β2 against H1: β1 ≠ β2. Chow statistic is given by:

$$\boldsymbol{F = \frac{(SSR - SSR_1 - SSR_2)/K}{(SSR_1 + SSR_2)/(T - 2K)}} \quad \textbf{(5)}$$

Where SSR is the restricted sum of squared residuals under H0, SSR1 is the sum of squared residuals from the regression of the first sub-sample. SSR2 is the sum of squared residuals from the regression of the second sub-sample. And (T) is the total number of observations. The use of models for structural changes results from the importance of breakpoints in chronic of the 3 dates whether the stress index has reached its historical levels: September 2008, May 2010 and December 2011. These 3 events have been selected despite the stress index has only exceeded its historical average by 0.5 standard due to their severity. Note that as of November 2008 is a peak stress, but we ignored the fact because it is very close to that of September 2008. Figure 3 above is consistent with the results of the technical classification of stressful events. Indeed, according to these two methods, we see three levels in the index. The first is in

September 2008, which coincides with the collapse of Lehman Brothers. The second level of stress occurs in May 2010 triggered by the gravity of the financial situation in Greece, Spain and Italy, as well as the beginning of the crisis of sovereign debt in the Euro Zone, the effect on the financial stress was less important than the first period. A final highlight is spotted in December 2011 where increased stress index volatility reached a third level caused by successive panics on the financial markets of the Euro Zone and the deepening debt crisis.

We used the Chow test to confirm the above findings emerged from Figure 3 above the classification of stressful events based on standard deviation. Confirmations are reported in Table 5 below.

Table 5 Chow test results

H0	H1	F-Statistic	Log likelihood ratio	Results
[Feb. 5, 2007– Dec. 21, 2012]	[Feb. 5, 2007–Sep. 30, 2008] and [Oct. 1, 2008–May. 10, 2010] and [May. 11, 2010-Dec. 9, 2011] and [Dec. 10, 2011- Dec. 21, 2012]	56.82804 *** (0)	309.3737 *** (0)	Break on Oct. 1, 2008, May. 11, 2010 and Dec. 10, 2011
[Feb. 5, 2007– Dec. 21, 2012]	[Feb. 5, 2007– Sep. 30, 2008] and [Oct. 1, 2008– Dec. 21, 2012]	**46.72504*** (0)**	**90.94613*** (0)**	Break on Oct. 1, 2008
[Feb. 5, 2007– Dec. 21, 2012]	[Feb. 5, 2007–May. 10, 2010] and [May. 11, 2010– Dec. 21, 2012]	0.304969 (0.737191)	0.611511 (0.736567)	Break on May. 11, 2010
[Feb. 5, 2007– Dec. 21, 2012]	[Feb. 5, 2007– Dec. 9, 2011] and [Dec. 10, 2011– Dec. 21, 2012]	**16.00363*** (0)**	**31.76015*** (0)**	Break on Dec. 10, 2011

Note 1: Asterisks (***, **, *) indicate the significance at (1%, 5% and 10%) of the coefficients.
Note 2: With T0 = Feb. 5, 2007; T1 = Oct. 1, 2008; T2 = May. 11, 2010; T3 = Dec. 10, 2011 and Tm+1 = 2012. With (m) is the number of breaks and (m + 1) is the number of sub-samples.
Note 3: A p-value <0.01 indicates that we reject H0, so the presence of break.
Note 4: Statistics given by Eviews 5.

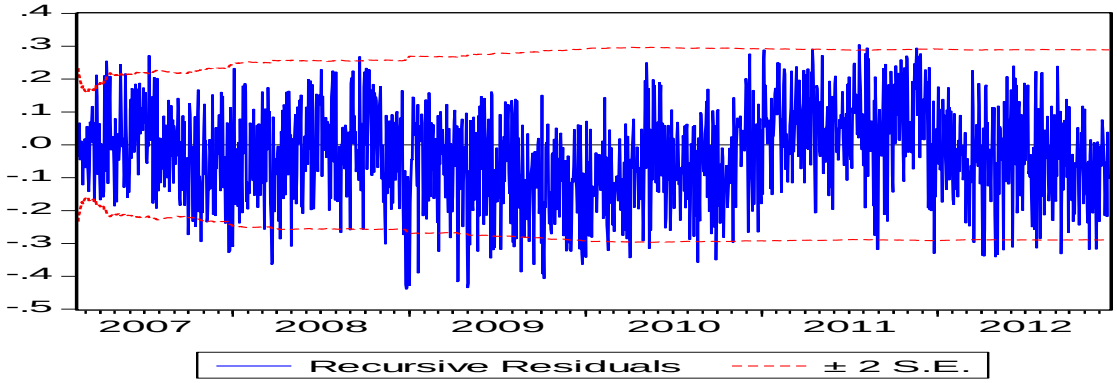
Table 5 shows that p-value is equal to zero in two dates in bold (Oct. 1, 2008 and Dec. 10, 2011), confirming only two break points. We therefore reject H0 and we are in presence of breaks on these two dates and accept H0 in the third date (May 11, 2010). Thus, we do not admit the assumption of stability in Oct. 1, 2008 and Dec. 10, 2011 and admit it on May 11, 2010.

b. Cusum De Brow Tests (recursive residuals)

Cusum test "Cumulative sum" is based on the cumulative sum of recursive residuals. Recursive residuals represent the difference between the cumulative prediction (t-1) by (t) and actual in (t). These tests are graphical tests to admit or not the assumption of stability. The advantage of this type of testing is that it allows conducting a study of a regression stability without defining a priori the date of break on the coefficients. The stability criterion is the following: if the cumulative sum goes outside the area between the two critical lines is that the coefficients are unstable. As against, if not, is that the model coefficients are stable.

By subjecting our stress index regression to this test, we confirmed the change of structure at the same two dates of the Chow test. Figure 4 below shows the positioning of this curve with respect to the range defined by the dotted lines.

Fig. 4 Cusum De Brow test result



The Fig. 4 shows that the curve out of the corridor in the two dates (Oct. 1, 2008 and Dec. 10, 2011) confirming the results of the Chow breakpoint test (Statistics given by Eviews 5). Thus, all these results (graphical analysis, standard deviation, Chow and Cusum tests) confirm the performance of our MMSI in identifying past periods of financial stress, this is proven by the response of our index to events causing severe turbulence in the Euro Zone and by high levels indicating a situation of stress or even a systemic crisis in times of break Oct. 1, 2008 and Dec. 10, 2011. These dates correspond to well-known events of historical stress through their effects on financial stability during the period of our sample between Feb. 2007 and Dec. 2012. So we confirm the ability of our BMSI to identify past periods of financial stress. In addition, we also confirm the ability of the BMSI to help policy makers to identify stress thresholds in the financial system that could be a real imbalance and affirm the possibility of speaking threshold to explain the extent of financial instability.

4. Anti-crisis measures impact on the BMSI

Faced with worsening public deficits of some countries in the Euro Zone the17 members of the Euro Zone had to implement strict policy compression expenses of its member States affected by the crisis in order to reduce their sovereign debt, in addition to the creation of European Financial stability Fund (EFSF), strongly bailed out by AAA member States. This bailout is to stop definitely the contagion.

In this context, we propose a model with better predictive performance and management of the crisis of European sovereign debt.

4.1 A summary of literature

Although the limited literature in relation to the EFSF impact on the financial stress, due to the subject topicality, we will still present some work on the measurement of rescues actions significance undertaken by the Euro Zone since the first fund in 2010.

Since November 2009, the debt weight has continued to increase especially for Greece. This led the Euro Zone to intervene to avoid payment default despite the risks. The behavior of an actor insured against the risk grows to take more risk and increases the likelihood of the risk in question (Bastidon et al. 2012). The defaults are the result of a failure of coordination among stakeholders of the need for a rapid response that depends on the degree of insolvency of the State, a restructuring of a bailout and political crisis prevention.

The restructuring of Greek sovereign debt imposes particular to ask questions and further analysis on the effectiveness and even the usefulness of preventive measures for the management of crises through the creation of financial rescue fund (EFSF then ESM), knowing that management decisions does not always seem to be taken in the right direction. Indeed, (Bastidon et al. (2012) showed that the two rate increases by the ECB in April and July 2011 have had a destabilizing effect on bank intermediation, because they do not conform to the following theoretical requirements which unconventional measures should primarily preserve the commitment to maintain sustainable rates at very low levels.

In a study covering the period 2008-2011, Serbini and Huchet (2013) showed that the quality of bank intermediation and the nature of tax efforts implemented, condition spreads versus Germany (sovereign spreads in the Euro Zone), and that aversion is the result of a degraded environment, including the state of public finances. These authors found that the highest spread is that of Greece. In addition, by introducing the EFSF as a dummy variable, the authors show that this variable is significantly positive on the spread. This variable takes into account the first aid plan in place for Greece in May 2010 and the first payments of the EFSF to Ireland and Portugal, respectively in February 2011 and June 2011.

Attinasi et al. (2009), in a work on measures to support the banking sector, used dummies variables taking the value 1 the only day of the announcement of a bank bailout and take into account the size of guarantees and recapitalizations . The dummy variable used by Barrios et al. (2009) to capture rescues during the period following the announcements envelopes of bailouts by national banks is not significant. Zgueb Rejichi (2011) used five dummy variables to study the behavior of the Hurst exponent as a result of financial reforms of equity market in the MENA region.

Hakkio and Keeton (2009), whose work has focused on well-known historical stress events, require that financial stress index must be either efficient in identifying past periods of financial stress "in-sample" and in future period "out-of-sample". These authors evaluated the KCFSI ability to predict the CFNAI comparing forecast errors of "out-of-sample" model using only lagged values; Preliminary analysis suggests that the use of information on the KCFSI improves "out-of-sample" CFNAI forecasts in some horizons but not others. The indicator of financial stress must finally be effective in the identification of future periods of financial stress and predict stressful events (Lo Duca and Peltonen, 2011; Banque de France, 2011). A performance indicator should emit significant signals "in-sample" and "out-of-sample". A test results of four early warning models made before the crisis on the Asian crisis showed that the best of them was efficient at 50 % "in-sample" (half of the crises were planned) and 33% "out-of-sample". Berg and Pattillo (2000) and Kaminsky & Reinhart (1999) used the ratio (noise / signal) to test the "in-sample" performance.

In general, the prediction horizon differs depending on the cases; it can reach up to twenty-four months in case of monthly data frequency and one to three years if they are annuals (Kaminsky and Reinhart, 1999; Demirguc-Kunt and Detragiache, 2000). Lo Duca and Peltonen (2011) insist on the time horizon in predicting the occurrence of systemic events. These authors set the time horizon to 6 quarters; they justify this choice by the need to provide policy makers with a suitable time interval in order to adopt measures to prevent the occurrence of systemic events. The prediction horizon is a condition that must be neither short to implement a prevention policy after the outbreak of the alert, or long for that predictions do not lose their reliabilities (Demirguc-Kunt and Detragiache, 2000; Bussiere and Fratzscher, 2006).

In order to analyze the volatility of the stress index, we will use the methodology based on the application of ARCH / GARCH models. To measure the effect of macroeconomic shocks on the

level and volatility of spreads, Arru et al. (2012) and Slingenberg and de Haan (2011) used a GARCH methodology.

4.2 Data and Research Methodology

Our research methodology consists of four steps, primarily the study of statistical properties of the BMSI serial. We retain this data as first data serial for our empirical investigation. Secondly we identify the ARMA (p, q) to be used for our serial. The third stage will concern the GARCH modeling of the process selected in the previous step. This model will serve to study the impact of anti-crisis measures on the BMSI. Finally we close by the introduction in the selected conditional variance model additional effects of explained variables as four dummies to measure the impact of these four measures among eighteen taken by the European emergency fund during the period between on May 9, 2010 (date of the EFSF creation) and the Dec. 21, 2012 end date of our sample. We recall that these measures have been taken to rescue countries experiencing difficulties in honoring their commitments and pay their sovereign debts. These four dates are a second data of our study. The goal is to find a possible match between these four dates and the decrease of the BMSI.

4.3 Empirical Results

4.3.1 Descriptive statistics

As indicated previously, our index has already been calculated, our present task is just to check the normality and stationary. The analysis concerns the normality and stationary of the serial distribution on the period beginning Monday, February 5, 2007 and ends Friday, December 21, 2012. The assumption of normality is verified by the Skewness and kurtosis near 0 and 3 respectively. Stationary, however, has been verified by the absence of a unit root at different thresholds of significance and using the ADF test (1979, 1981) and the Phillips-Perron test. The results of these tests are shown in the following Tables 6 and 7:

Table 6 Descriptive statistics of the BMSI

	MMSI
Skewness	-0.079446
Kurtosis	2.587963
Jarque-Bera	12.47324

Note: Statistics given by Eviews 5

Table 7 Results of the serial stationary test of MMSI

	Lags N°	Model N°	Statistic ADF/PP	Critical value 1%	Critical value 5%	Critical value 10%	Result
ADF	10	3	-6.170102	-3.964077	-3.412761	-3.128358	Stat
PP	10	3	-34.01394	-3.964037	-3.412742	-3.128346	Stat

Note 1: Column “lags N°” indicates the order of the autoregressive process used for the serial.
Column “model” indicates: Model 3 (model with constant and trend). Column “Statistic PP/ADF” indicates statistic Dickey Fuller / Phillips-Perron. Columns “Critical value 1%”, “5%” and “10%” indicate the critical value respectively 1%, 5% and 10% and column “Result” shows the results of the stationary test.
Note2: Statistics given by Eviews 5

4.3.2 Volatility modeling

Modelling the mean volatility of the BMSI serial made clear the ARMA (1.1), ARMA (1.2) and ARMA (2.1) which after checking the heteroscedasticity condition were subject to the conditions of the model choice GARCH / EGARCH (p, q). After estimating the serials process and performed tests of statistical significance of each coefficient of the selected process and the estimation by the maximum likelihood method, we selected the ARMA (1.2)-GARCH (0.1) model. The Table 8 below shows the process used. Among the reasons for eliminating some models among others we can mention the probability of the test statistic ARCH-LM> 5%, the negativity of some of their coefficients or as the non-significance of some coefficients a, α, b and β. The detailed parameters of the selected model are given in Table 8 below:

Table 8 Estimation results by the method of maximum likelihood

Parameters	Process: ARMA (1.2)-GARCH(0,1)
Mean equation	
C	0.447348**
	(0.0376)
a1 (AR(1))	0.998695***
	(0.0000)
a3 (MA(1))	-0.887262***
	(0.0000)
a4 (MA(2))	-0.049769***
	(0.0365)
Variance equation	
$\boldsymbol{\alpha_0}$	0.000129
	(0.5350)
$\boldsymbol{\beta_1}$ **GARCH**$\boldsymbol{(-1)}$	0.992713***
	(0.0000)
Q (11)	5.2783
	(0.727>5%)
Q^2 (11)	63.877
	(0.001<5%)
LM	38.41652
	(0.000000<5%)

Note 1: Q (11) and Q^2 (11) are the statistics of Ljung-Box Q (Q-stat) the first 11 autocorrelations standard residuals and squared residuals, LM is the Statistic of ARCH-LM test, the values in parentheses represent probabilities t-Student and asterisks (***, **, *) indicate the significance at (1%, 5% and 10%) of the coefficients.
Note 2: Chosen models are in bold.
Note 3: Statistics given by Eviews 5.

In reviewing the above Table 8, we note that the selected ARMA (1.2) - GARCH (0,1) model has significant mean equation parameters at 1% and β coefficient significant at 1%, indicating the existence of ARCH effect and showing the dependence of BMSI volatility on time. Furthermore we find that the probability of Ljung-Box statistic of the first 11 standard residues autocorrelations is greater than 5 % indicating that future values do not depend on past values and no significant correlation of the successive variations, whereas the probabilities of Ljung-Box statistic of the first 11 square residues autocorrelations is less than 5 % indicating that

the future values depend on past values and the significant correlation of the successive variations.

Thus, according to the test results presented above, we can assume that this model is statistically adequate for modeling with dummies. The selected model will be used later to study the impact of the implementation of anti-crisis measures on the BMSI.

4.3.3 Evaluation of the predictive power of the selected model (robustness checks)

After estimating the GARCH model, we will now determine whether this model provides a better prediction based on the two prediction methods: The static and dynamic method. We used a forecasting time horizon of 90 observations for the two methods "in-sample" and "out-of-sample" forecast. The forecast period considered covers an "out-of-sample" forecast time interval from Dec. 24, 2012 to April 26, 2013 and "in-sample" from Aug. 20, 2012 to Dec. 21, 2012. The following Table 9 shows the values of the standard criteria RMSE, MAE, MAPE and TIC, obtained by sequences of 90 observations for the static and dynamic forecasting.

Table 9 Chow test result

Test	Sample	Static	Dynamic
In-sample	[Feb. 5, 2007–Aug. 17, 2012] and	RMSE : 0.120879	RMSE : 0.142824
forecast	[Aug. 20, 2012–Dec. 21, 2012]	MAE : 0.099597	MAE : 0.117618
	90 observations	MAPE : 49.20438	MAPE : 63.02596
		TIC : 0.180705	TIC : 0.197230
Out-of-sample	[Feb. 5, 2007– Dec. 21, 2012] and	RMSE : 0.130576	RMSE : 0.153106
forecast	[Dec. 24, 2012–April 26, 2013]	MAE : 0.105589	MAE : 0.124290
	90 observations	MAPE : 26.97710	MAPE : 37.17180
		TIC : 0.121246	TIC : 0.139833

Note 1: RMSE: Root Mean Squared Error, MAE: Mean Absolute Error, MAPE: Mean Absolute Percent Error, TIC: Theil Inequality Coefficient.
Note 2: Statistics given by Eviews 5.

From the results shown in Table 9 above, we find that using the two methods (static and dynamic), the ARMA (1.2)-GARCH (0.1) model of the BMSI has standard criteria RMSE, MAE and MAPE calculated according to the method of "in-sample" and "out-of-sample" very low, indicating good predictive power forecasting. Similarly, the TIC test is very close to zero. These findings verify the practical level performance of the BMSI in the identification of future periods of financial stress and prediction of stressful events. We therefore use this model for modeling BMSI with dummy variables.

4.3.4 Modelling of Stress Indices with dummies

Euro Zone, since the outbreak of the sovereign debt crisis in May 2010, has established a number of decisions attempting to lower the high level of fiscal deficits and public debt. Decisions include the deletion of 50% of Greek debt held by creditor banks in the country in addition to some loans from Europe and the IMF, repetitive lowering interest rates of the major

Euro system refinancing operations, interest rates on the marginal lending rate, the interest rate on the deposit facility, conducting two operations to provide liquidity in the longer term for a period of three years, reduction in the rate of reserve requirements, the creation of the EFSF etc. Measures taken under the EFSF during the period April 12, 2010 to December 21, 2012 (date of the end of our sample) are showed in Table 10 below.

Table 10 Anti-crises measures

Number	Date	Event
1	April 12, 2010	Allocation of 110 billion € for Greece (80 billion € EAMS, 30 billion € FMI.
2	May 10, 2010	750 billion € for stability in the Euro Zone
3	June 7, 2010	Creation of the European Financial Stability Fund EFSF (incorporated in Luxembourg under Luxembourgish law on June 7th 2010, See http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/misc/114977.pdf)
4	November 28, 2010	Allocation of 85 Billion € for Ireland
5	January 25, 2011	Coming out of the EFSF program for Ireland.
6	May 17, 2011	Decision of 78 billion € for Portugal
7	June 20, 2011	Increase of the capacity of the EFSF + European Stability Mechanism (ESM),
8	July 21, 2011	second envelop for Greece +increase of the intervention field of EFSF/ESM
9	October 18, 2011	Increase of the envelop of the EFSF with 1000 billion €
10	November 29, 2011	Approbation of the envelop increase of the EFSF
11	December 9, 2011	The ESM will enter into force in July 2012 and the EFSF will continue until June 2013.
12	December 13, 2011	EFSF will make his first adjudication
13	March 14, 2012	Approbation of the second program for Greece
14	March 30, 2012	The Euro-group decides to keep the EFSF and the ESM in parallel
15	April 26, 2012	EFSF organize its first action
16	May 15, 2012	EFSF organize its first action via adjudication
17	July 20, 2012	The Euro-group guaranteed assistance to the banking sector in Spain.
18	20/07/2012	ESM inaugurated

Source : http://www.efsf.europa.eu

We will take the effective EFSF creation date (May 9, 2010) as the start of our study of anti-crisis measures impact cited above on bond stress in the Euro Zone since this event is the turning point in the Euro Zone politics to deal with liquidity problems of its countries member. Our study focuses on the impact of four of the anti-crisis measures on the situation of uncertainty and panic and hence the financial stress. The choice of these four measures among the 18 is based on the fact that only these four measures were associated with decisions of fund allocations to requesting countries. Other measures are not associated with bailouts of state budgets seeking assistance decisions. We ignored the first measurement of April 12, 2010, although it concerns financial assistance, because the event is outside our study period. The question to which we seek an answer is: the 4 events, do they really have an impact on the bond market stress?

We use a dummy variable for each of the four selected measures, which take the value 0 before that date and 1 after. We introduce these dummy variables in the conditional variance equation of the BMSI serial. Insofar increased Stress Index reflects an increase in uncertainty and therefore the stress in the bond market in general of the Euro Zone, it is estimated that these dichotomous variables, which are supposed to contribute to alleviate the situation are negatively correlated with the stress index. In other words, if the coefficient of the dummy variable is significant and negative it means that the measure contributes significantly to the decrease in the BMSI and thus to improve the stress and vice versa. According to (Elmendorf and Mankiw, 1999), public debt increases the exposure of a country to economic and financial crises and the vulnerability of an economy crisis goes in the same direction as the public debt. Estimation process results retained after integration of aid and assistance measures in the form of dummy variables are presented in the following Table 11:

Table 11 Anti-crisis measures impact on the BMSI

ARMA (1.2)-GARCH (0.1)	Estimation		Event kind
	Coefficient	Probability	
$\boldsymbol{\alpha_0}$	0.000129***	0.0000	
$\boldsymbol{\beta_1}$ **GARCH**(-1)	0.992713***	0.0000	
Dummy 1	6.15E-17*******	0.0000	750 billion € for stability in the Euro Zone
Dummy 2	2.29E-17******	0.0377	Allocation of 85 Billion € for Ireland
Dummy 3	**-2.84E-17***	**0.0650**	**Decision of 78 billion € for Portugal**
Dummy 4	2.13E-17	0.1240	second envelop for Greece +increase of the intervention field of FESF/ESM

Note 1: Dummies: 1 ... 4, are dummies included in the equation of the conditional variance, sorted oldest to newest.
Note 2: Asterisks (***, **, *) indicate the significance of (1%, 5% and 10%) of the coefficients.
Note 3: The values in bold are related to significant and negative measures.
Note 4: Statistics given by Eviews 5.

Table 11 shows the impact of four events on the stress index. It emerges that two events have a significant and positive coefficient suggesting a negative effect on stress which increases with the arrival of these events and one event has significant coefficient at 10% reflecting a positive and beneficial effect on stress (in bold) and one event with insignificant coefficient were found. This finding is consistent with that of Serbini and Huchet (2013), which by introducing the EFSF as a dummy variable, show that this variable is significantly positive on the spread (spreads versus Germany). Another research work confirms ours that is one of Attinasi et al. (2009), in which work on measures to support the banking sector, found that the dummy used by Barrios et al. (2009) to capture rescues during the period following the rescues envelopes announcements with domestic banks is not significant. The measures studied were not all the same direction or the same magnitude on the index conditional equation volatility. We adhere to this level with the results of Zgueb Rejichi (2011); the volatility associated with each event varies depending on the quality and speed of transmission of information diffused. We can say that the policy of

assistance and support to Euro Zone countries experiencing significant fiscal deficits and require the EFSF rescue , as financial or regulatory measures did not have all positive and significant effect (negative dummies) on the bond market stress. We find here compliance with the research results of Bastidon et al. (2012) that encourage a deeper reflection on the effectiveness and usefulness of the European stability fund created to save the Euro Zone. These same authors mention the risky policy of the ECB, which sometimes does not comply with the theoretical requirements. We conclude that the chances of the European Financial Stability Facility (EFSF) under current conditions to save the Euro Zone in the future remain unproven and possibly other work will decide on the issue of usefulness of the EFSF or its successors, to achieve concrete and satisfactory results.

5. Conclusion

Faced with the worsening public deficits of some countries in the Euro Zone and the threat of spreading to other countries or regions and disability organizations in the Euro Zone to deal with this phenomenon , policymakers saw the need for the establishment of a rigorous policy of compression spending, more than the creation of an European Financial Stability Fund (EFSF) which originally should prevent the spread of the Greek crisis to other countries of the Euro Zone , and whose budget can reach 1.000 million €. In this context, based on a recent literature, we developed a model that allowed us to evaluate these measures. Using a research methodology, consisting of four steps, the most important are the identification of ARMA (p, q), the GARCH modeling and the introduction into the conditional variance of the selected model four dummies to measure the impact of the four measures among eighteen taken by the European emergency funds (EFSF and successors). The successful process for modeling with dummy variables is ARMA (1.2)-GARCH (0.1) has undergone an evaluation of its predictive power based on the two methods of static and dynamic forecasting. We used a time horizon of forecasting 90 observations for the two forecasting methods “in-sample” and “out-of-sample” and we showed that this model offers good predictive performance. The results obtained allowed us to verify the performance of the indicator of financial stress in the identification of future periods of monetary stress and predict stressful events and also helped us to exclude the possibility of failure in practice of our BMSI to predict stressful events. We then used this model for modeling stress indices with 4 dummy variables. The results show that only one event has a beneficial impact (negative and significant coefficients of dummies) on the stress which decreases with the arrival of this event. However, two coefficients are significant and positive indicating that the event has a negative effect on stress and one not significant. The policy bailout fund through anti-crisis measures, not all had positive and significant effects on the Bond Market Stress Index. Moreover, taking several important decisions outside the EFSF and especially after the four events used as dummy variables could result doubts that cover the effectiveness of these funds support. In fact, on October and November, 2011 in order to reduce the liquidity problem faced by the Euro Zone, the Governing Council of the ECB took decisions on monetary policy. Among these decisions, we can mention the following: the minimum level of capital “hard” of banks (capital and retained earnings compared to loans) should be raised to 9% (were 5%), a strong reduction of the Greece debt by the deletion of 50% (one hundred billion euros out of a country total public debt of 350 billion Euros), loans from Europe and the IMF to Greece with 100 billion euros at the end of 2014 (was 109 billion Euros on July 21, 2011), the decrease of the main refinancing operations interest of the Euro system to 1.25 % on November 9, 2011 then reduced on December 14, 2011 to 1% and on July 11, 2012 to 0.75%, the lower of the interest rates on

the marginal lending facility to 2.00% on November 9, 2011 and on December 14, 2011 to 1.75 % then on July 11, 2012 at 1.5 %, the interest rate on the deposit facility decreased to 0.50% on November 9, 2011and on December 14, 2011 to 0.25 % and then on July 11, 2012 to 0 %. On 2012, conducting two operations provide liquidity in the longer term for a period of three years, expanding the list of assets eligible as collateral accepted in Euro system refinancing operation, reducing the reserve requirements rate from 2% to 1% and the suspension of fine-tuning operations. In the same sense, the Euro Zone has taken some more actions such as the implementation of another mechanism which is a special fund backed by the IMF and invited contributions from emerging countries such as China and Russia in addition of aid from Japan. All these findings to levels of statistical results on the usefulness of sovereign funds or multiple decisions taken in the context of European monetary policy insist that the chances of the European Financial Stability Facility (EFSF), under current conditions, to save the Euro Zone remain minimal. The question remains for the moment asked and may be more works will decide on the usefulness of the EFSF or its successor to achieve concrete and satisfactory results. We reach the thesis that invites further reflection on the effectiveness and usefulness of the European stability fund created to save the Euro Zone.

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